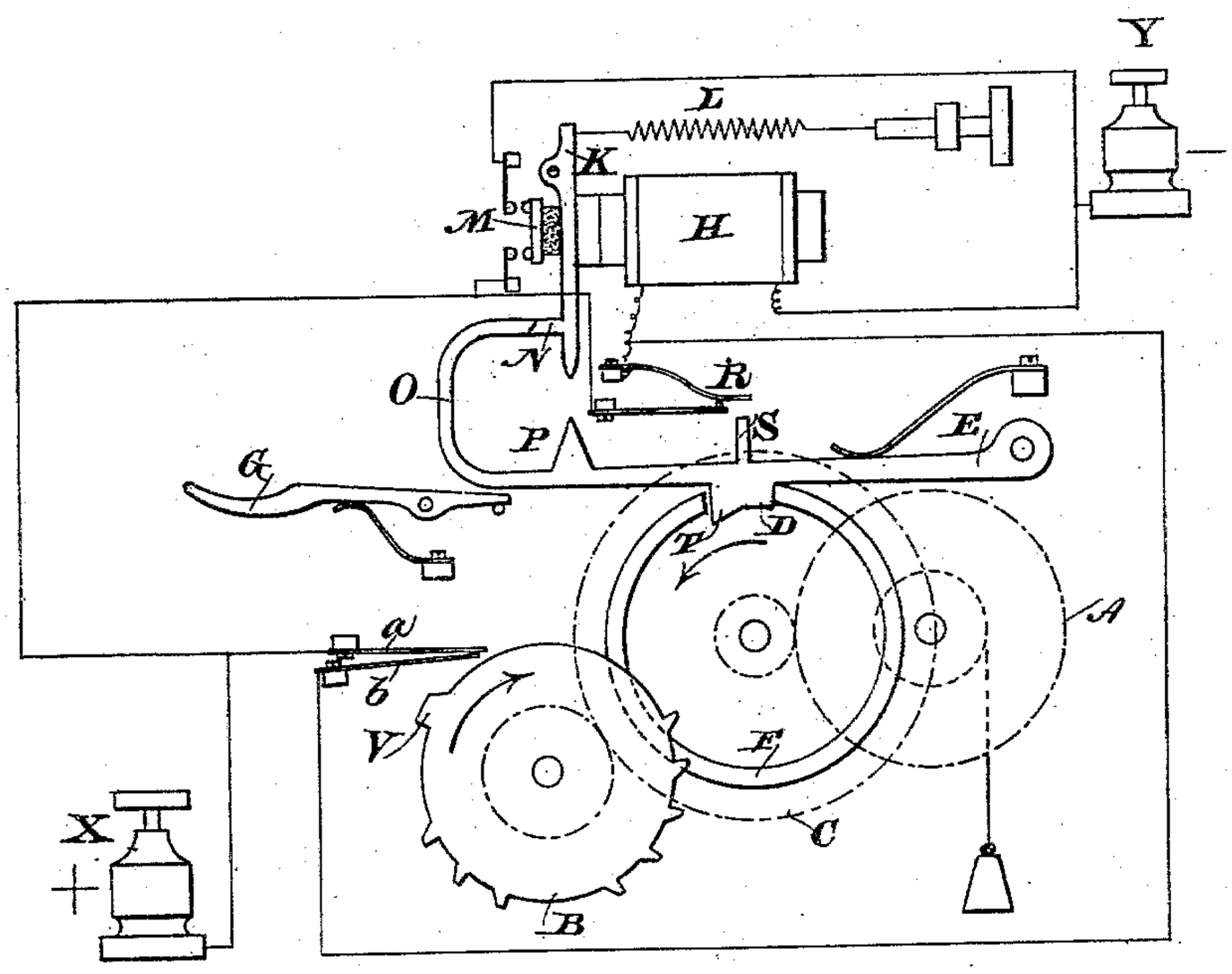
(No Model.)

G. F. MILLIKEN.

FIRE ALARM SIGNAL BOX.

No. 565,086. Patented Aug. 4, 1896.



WITNESSES:

A. D. Brine

R. F. Hayes.

INVENTOR:

George F. Milliken

by Bartley & Wright

ATTYS.

UNITED STATES PATENT OFFICE.

GEORGE F. MILLIKEN, OF BOSTON, MASSACHUSETTS.

FIRE-ALARM SIGNAL-BOX.

SPECIFICATION forming part of Letters Patent No. 565,086, dated August 4, 1896.

Application filed April 20, 1891. Serial No. 389,578. (No model.)

To all whom it may concern:

Be it known that I, GEORGE F. MILLIKEN, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Fire-Alarm Signal-Boxes, of which the following is a specification, reference being made to the accompanying drawing, which shows my invention in a diagrammatic manner.

My invention relates to what are known as "non-interfering signal-boxes," this class of boxes consisting of those which are provided with special devices for preventing the sending of a signal from any box during the time that any other box on the line is in operation.

The usual mechanism of a fire-alarm signal-box consists of, first, a time-train adapted when started to set in motion a signal-wheel or equivalent circuit-breaking device included in the main-line circuit, by means of which the said circuit is interrupted a definite number of times, so as to give a predetermined signal by means of the arrangement of breaks in a normally-closed circuit. As a large number of signaling mechanisms of this character are usually connected in series on a closed circuit, it is important that no two be allowed to transmit signals at the same time, so as to cause a confusion of such signals, which is termed "interference."

Previous to my invention various devices for preventing interference had been invented and are still in use. The principal feature of most of these devices is an electromagnet in each box in series with the signal-wheel, which magnet normally holds its armature attracted, but upon interruption of the circuit becomes deënergized and permits its armature to fall away and disable the box, usually by forming a short circuit around the signal-wheel. The pulling of the starting-hook of the train causes the said armature to be locked in whichever position it may be at the time of pulling the hook, so that if the hook should be pulled in any box it would at once lock the armature of the magnet in a position by which the signaling-wheel would be shunted and thus prevent the transmission of the signal, provided that the circuit was open by the sending of a signal from another box. If, however, the hook should be pulled at an instant when the circuit is closed during the transmission of a signal from another box, the armature would, on the contrary, be locked in its normal attracted position and an interfering signal sent in, for the reason that the short circuit around the signal-wheel could only be closed by the armature falling back from its said normal position. It will thus be seen that the instrument just described is not a perfect non-interfering box, because that it is possible to send an interfering signal, provided the hook be pulled at the instant that the circuit is closed.

To overcome the difficulty above referred to, it has been proposed to allow a certain length of time to elapse between the starting of the box (the armature being released at the same time) and the locking of the armature in either its attracted or retracted position. This lapse of time is longer than the longest closure in any signal, so that if another box is already at work sending a signal it will certainly produce a break in the circuit during the said lapse of time, and the armature of the non-interfering magnet in the starting box will hence be retracted to disable the box and will be locked in such retracted position at the expiration of said lapse of time. This prevents the chance of a starting box coming into operation during a closed-circuit period of a signal already in course of transmission. In applying this principle, however, to a box in which the signal-wheel is of the open-circuit variety—by which I mean a wheel having its teeth so spaced as to maintain the circuit open during the time that a signal is being transmitted, except for an instant preceding each break—and to a signal-wheel, which also requires repeated rotations to complete the signal, it has been considered necessary to secure the aforesaid lapse of time between the starting of the box (with the simultaneous release of the armature of the non-interference magnet) and the relocking of the said armature by a retardation in the speed of the train at starting, such retardation or departure from the normal rate of speed of the box being of an amount which will cause a starting box to run for a length of time longer than the longest closure in any signal before beginning to

send its own signal. Such method of operation is, however, objectionable for many reasons, and I have aimed to avoid the necessity of such retardation in speed by the following arrangement:

I provide a box having a signal-wheel of the open-circuit variety which is so geared to its operating-train as to rotate two or more times for each run of the train and thereby repeat two or more times whatever signal may be given by the particular arrangement of circuit-breaking teeth on the periphery of the wheel. I provide in such a box that at the moment of release or starting of the operating-train the said train will begin to run at its normal rate of speed, that is, without relying upon any departure from the normal rate of running of the box, and I provide, moreover, that for a definite length of time after the starting of the box the armature of the non-interference magnet shall be left free, so that it may be retracted and the box thereby disabled if a signal is already being transmitted from another box, and, lastly, I provide that during this lapse of time the signal-wheel of the starting box shall not be in a condition to open the circuit. Otherwise the box would break the circuit at a time when its own armature is free, and thus disable itself.

More specifically I provide a releasing device for the train, consisting of a lever carrying a detent which engages with a notch in one of the slow-moving wheels of the train, and which is withdrawn therefrom upon the manual depression of the lever by the person "pulling" the box. The lever is also arranged so that the same movement which releases the train also releases the armature. The train after starting automatically relocks the armature at the expiration of a period of time longer than the longest closure in any signal, and, at the moment of locking, a special circuit-closing device, which during the said lapse of time has been operated to prevent the signaling contact-springs from operating in their normal way to send the signal by opening and closing the circuit, is automatically actuated, so as to place the signaling contact-springs in control of the circuit, whereupon, unless the box has been disabled, the signal may be transmitted in the ordinary manner. If, however, a foreign box happens to open the circuit during the aforesaid lapse of time, or, as it may be termed, "free-armature period," the starting box will be disabled by reason of the retraction of the armature of its non-interference magnet, and the armature will be automatically maintained in its retracted or disabling position until again restored by the train. The disabling means consist, in the box herein illustrated, of a shunt-circuit adapted to be closed by the retraction of the armature, so as to short-circuit the entire box, and this shunt-circuit is only opened when the box is restored to its operative condition by mechanical replacement of the armature in its normal position after the run is completed. The device for maintaining the circuit closed during the free-armature period consists, in the box shown herein for illustration, of a shunt-circuit around the signaling contact-springs which contains a circuit-closer arranged to be automatically operated by the train after the aforesaid lapse of time, while the signaling contact-springs are normally free of the toothed signal-wheel, so that the said wheel may run for a definite time before beginning to operate the contact-springs. For convenience herein the shunt-circuit by means of which the armature and the non-interference magnet act to disable the box may be termed the "determining shunt-circuit," while the circuit which shunts the contact-springs only and acts to maintain connection from one to the other during the initial free-armature period may be termed herein the "operative shunt."

The operation of the apparatus thus described, in general terms, is as follows: When it is desired to send a signal, the hook is pulled, starting the time-train, which time-train, at the end of a determined period, breaks said operative shunt-circuit, whereby the apparatus is in operating condition and the signal-wheel, which has meanwhile been brought into line, interrupts the circuit at intervals and sends the desired signal, provided, however, that the line is clear, that is, that no signal is being sent from another box, which fact is determined by the non-interference magnet and the shunt which it controls. If the line is not clear, but on the contrary a signal is being sent from some other box, and the main line is alternately open and closed, giving a succession of open and closed circuit periods, the effect will be as follows: If the hook is pulled during the open-circuit period, the armature of the magnet instantly falls back and shunts the whole apparatus, and if the hook is pulled during the closed-circuit period the signal-wheel is already shunted by what I have termed the "second" shunting-circuit, and this circuit will not be broken until the train has run such a length of time that the closed-circuit period is at an end and an open-circuit period has ensued, when the whole apparatus will be shunted in the manner above stated. In other words, many other types of non-interference boxes are non-interfering during the open-circuit periods only, but mine is non-interfering during the closed-circuit periods as well, because even if the hook is pulled on a closed-circuit period a definite length of time must elapse before the box is in signaling condition, and that length of time is always sufficient to cover the closed-circuit period and extend to an open-circuit period, when the box will be rendered non-interfering in the usual manner by means of the magnet and the determining-shunt.

Referring to the accompanying drawing, A represents a train of clockwork which when

started by the pulling of hook G drives at a definite speed a toothed signal-wheel B, the teeth being so arranged as to open and close the main circuit a definite number of times by coming in contact successively with the springs *a* and *b*. In other apparatus than mine these springs *a* and *b* normally rest against one of the projecting teeth of the wheel *b* and maintain the circuit closed, but in my device the circuit is normally closed at another point—viz., the operative shunt-circuit—and these springs are left out of contact with the wheel and each other, for a purpose to be hereinafter described. I shall hereinafter refer to these springs as the "signal-contacts" and to the wheel B as the "signal-wheel."

C is the stop-wheel of the train, and is normally held by a projection D on releasing-lever E, which drops into an opening in flange F on the wheel.

G is a lever terminating in a hook adapted to be pulled by hand and by its electrical connection therewith lift releasing-lever E, so as to release the clockwork by raising the projection D from engagement with flange F.

H is the "non-interference" electromagnet, K its armature-lever, and L a spring tending to hold the armature open or away from the magnet. On the back of lever K is a circuit-closer M, (by means of which the magnet controls the determining-shunt,) and a cam N, which is normally engaged by a projection O from lever E, constituting a restoring device, and the lever K thereby forced up against the magnet and there held while the parts are in their normal condition. Without this restoring device the armature of the magnet would remain permanently retracted, as it is cut out of circuit by its own armature closing the determining-circuit, which shunts both the signal-wheel and the magnet.

P is a stop or second locking device on lever E, which when the latter is thrown up goes on one side or the other of lever K and holds it away from or up to the magnet H.

R is a set of spring-contacts forming a circuit-closer adapted to be operated by a projection S from the lever E when the latter is raised, and forming the means by which the time-train controls the operative shunt-circuit. The circuit-closer thus formed may be called with relation to the time-train a "retarded circuit-closer," inasmuch as it is not operated immediately on the starting of the train, but only after a definite period has elapsed.

The apparatus which I have thus far described is shown in its normal position with no signal being sent, and I shall describe, first, the manner in which it operates when it is desired to send a signal with the line clear, that is, with no other apparatus in action, and, second, the way in which it operates as a non-interfering box when the line is not clear, so that although the clock-train may be started no signal can be sent in to interfere with that from another box.

Referring to the drawing, the normal circuit is via what I have called the "operative shunt," being from the positive binding-post X to the contacts R, to the magnet H, and to the negative binding-post Y, thus shunting the signal-wheel. From this line there are two branches, one leading from the said line through contacts M to the negative binding-post, and forming what I have called the "determining-shunt," which when closed short-circuits both the signaling-contacts and the magnet, the other leading from the said line through the signaling-contacts *a b* to magnet H, to negative binding-post Y, which may be called the "signal-wheel" circuit, which when closed and opened by the teeth of wheel B sends a predetermined signal on the line, provided the two other circuits are opened, the one at M and the other at R.

The circuits being in the condition shown, the hook G is pulled, the lever E lifted, the projection D withdrawn from flange F, and the train started. The movement of lever E also releases lever K by freeing cam N from extension O, but the circuit being still closed the lever K does not fall back. As the train runs, the extension D rides on flange F till the cam T is also raised upon the flange and lifts the lever E a second step. This second step has the effect of opening contacts R by means of projection S and of locking lever K by means of projection P; but this second step does not take place and the contacts R are not opened until the signaling-springs come in contact with the tooth V of the signal-wheel, so that the main line is unbroken until the tooth V passes the signaling-springs and the first interruption takes place. This first break, together with succeeding breaks and closures, sends the determined signal onto the line, and the signal is repeated until the opening in flange F comes around again to the proper point and the lever E drops back, and the parts are restored to their normal condition. During the operation thus far described the armature-lever K has been prevented from falling back and closing the shunt-circuit at M during the periods of open circuit by the stop P, which has been thrown up at the left of lever K.

I will now proceed to explain how it is impossible for an interfering signal to be sent. Supposing the parts to be in the position shown, and that another signal-box on the line is in action, giving a series of makes and breaks, it will be apparent that in the previous device, above referred to as having been used with partial non-interfering effect, if the hook is pulled during an open-circuit period the lever K having fallen away will be simultaneously locked back by projection P, short-circuiting the signaling-contacts and thus preventing interference. If, however, the hook in said previous device is pulled during a closed-circuit period, the lever K will remain held up, and an interfering signal will be sent. My invention, however, prevents such an oc-

currence because, although the hook may be pulled during the closed-circuit period and the lever K remain held up, the apparatus is practically inoperative, because the signaling-contacts *a* and *b* are shunted at R by the second short circuit and will remain shunted until the train has run long enough for the lever E to be lifted the second step by the cam T and the contacts at R thereby separated. When, however, that has taken place, the closed-circuit period is sure to be at an end, and an open-circuit period has ensued, allowing the armature K to fall back and close the first shunt-circuit at M and be subsequently locked by the projection P coming up to the right of the lever, whereupon the apparatus will be short-circuited and remain so until one rotation of wheel C has taken place and the dropping of lever E has caused projection O to strike cam N and restore lever K to its normal condition.

It will be noted that the projection P comes up at the left of lever K and holds it in closed position whenever the line is clear and the signal is to be sent; but if the projection comes up to the right of K it holds it in an open position whenever the line is not clear and an interference is to be avoided. The latter action presses the contact parts at M closely together, although the spring L alone would hold them in such position with a certain degree of pressure. It will also be noted that the length of time between the instant when lever E is lifted its first step by the hook G and the instant when it is lifted its second step by the cam T is longer than any possible closed-circuit period of any other instrument on the line, and that since the tooth V is longer than the other teeth of wheel B the parts are easily arranged in their relations, so that the signal will be given by an interruption of the line at the signaling-contacts and not at contacts R when operated by projection S.

Although I have shown the signaling-contacts as being normally open and free from tooth V, it is evident that the apparatus will still be practical in a degree if the circuit is closed on a tooth longer than the others by springs *a b*, instead of at R, and contacts R left normally open, because if when the hook is pulled and train started another box is transmitting a signal the non-interference magnet will be sure to release its armature, causing the box to be shunted before the raising of the lever E the second step, unless the box is started when the first box has the circuit closed on a similarly long tooth, or, in other words, the non-interference would be effective for all short-tooth closed-circuit periods only. It is to be noted in this connection that when a number of boxes, all identical with the one above described, are on the same circuit the longest signaling-closure in the system is that produced by the first tooth of any signal-wheel at each rotation succeeding the first, if that tooth is longer than the others on the same wheel. Hence, if the free-armature period at starting is to be longer than the said longest signaling-closure, the starting box must have some device, independent of the first tooth of the signal-wheel, which will maintain the circuit closed after starting for a longer time than it would be maintained closed by such a long first tooth, in order that the box shall not begin its signal until its own armature is locked against retraction. Such a device is found in my circuit-closer R, whose operation is determined by the running of the train quite independently of the circuit-breaking action of the signal-wheel. Of course other equivalent devices may be used to prevent or suspend the circuit-breaking action of the signal-wheel in the starting box until the expiration of the predetermined time and the relocking of the armature. It is also to be noted that any other equivalent arrangement may be adopted for disabling the box, but I prefer to accomplish this by shunting the magnet and contacts as described.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination in an electric signaling apparatus of a signal-wheel or circuit-breaker, a non-interference magnet in circuit therewith, a shunt-circuit controlled by the said magnet, a second circuit shunting the signaling-contacts, and a circuit-breaker therein, adapted to be operated by the actuating-train after a predetermined period.

2. The combination in an electric signaling apparatus of a signal-wheel, contacts therefor, an actuating-train for said wheel, a non-interference magnet, a circuit shunting both the signal-contacts and the said magnet, and controlled by the magnet and a second circuit shunting the signal-wheel only, and controlled by the actuating-train.

3. The combination in an electric signaling apparatus of a signal-wheel and contacts therefor, an actuating-train for said wheel, a non-interference magnet in the circuit, a shunting-circuit around the signal-wheel and magnet controlled by said magnet, a releasing device for the said train, a restoring device for the armature-lever of said magnet connected to said releasing device, and a locking device also connected to the releasing device adapted to hold the armature-lever in one position or the other after it is released according as the circuit through the magnet is open or closed.

4. The combination in an electric signaling apparatus of a signal-wheel and contacts therefor, an actuating-train for said wheel, a releasing-lever for said train, a non-interference magnet in the circuit, a shunt-circuit controlled by said magnet, a second shunt controlled by the said train, and a locking device for the armature of said magnet controlled by the said lever.

5. 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 said train, a non-interference magnet in the circuit, a circuit shunting both the signal-wheel and the magnet and controlled by the magnet, a circuit shunting the signal-wheel only, and controlled by the said train, and a locking device for the armature-lever of the said magnet connected to the said releasing-lever.

6. The combination in a signaling apparatus of a signal-wheel with its contacts and actuating-train, a non-interference magnet in the circuit controlling a shunt-circuit around the signal-wheel and magnet, a spring tending to hold the armature of said magnet away therefrom, a releasing device for the said train normally holding the armature against the force of said spring, a shunt-circuit around the signal-wheel controlled by said releasing device and a stop on said releasing device for holding the said armature either to or from the magnet.

7. The combination in an electric signaling apparatus of a signal-wheel, its contacts and actuating-train, a non-interference magnet in circuit therewith, a circuit shunting both the signal-wheel and the magnet, a circuit-breaker therein normally retained by the magnet in its open position, an operating connection between said circuit-breaker and the said train whereby the former is restored to its normal open position by the train at the end of its course, a second circuit shunting the signal-wheel only, and a circuit-breaker therein normally closed, but provided with a connection to the time-train whereby it is operated at a predetermined period after the train has been started.

8. The combination in an electric signaling apparatus of a signal-wheel with its contacts normally open, a time-train for actuating said wheel, a releasing-lever for said train, a non-interference magnet in the circuit, two shunting-circuits, the first shunting both the signal-wheel and magnet, the second the signal-wheel only, a circuit-breaker in each of said shunt-circuits respectively, that in the first circuit being normally held open by the magnet and a connection between the time-train and each of said circuit-breakers, whereby that in the second shunt-circuit is opened at a predetermined period after the starting of the train and that in the first shunt-circuit when the train has run its course.

9. The combination in an electric signaling apparatus of a wheel spaced to correspond to one round of a signal and adapted to rotate from the time of its release at a substantially uniform rate of speed, an actuating-train geared to the said wheel in such ratio that it will rotate two or more times for each run of the train, a non-interference magnet, a releasing device for the train and for the armature of said magnet, and a locking device for said armature controlled by the train, the two devices being adapted to act in succession with an interval dependent on the normal speed of the train and longer than the longest closure of any signal, so as to leave the armature free after the starting of the train and during the said interval.

10. The combination in an electric signaling apparatus of a signal-wheel spaced to correspond to one round of the signal and adapted to rotate from the time of its release at a substantially uniform rate of speed, an actuating-train geared to the signal-wheel in such ratio that it will rotate two or more times for each run of the train, a non-interference magnet, a complete releasing device for the train which when operated will free the train and permit it to operate at its normal rate of speed, a releasing device for the armature of the said magnet controlled by the releasing device for the train and a locking device for the said armature controlled by the running of the train and set so as to be operated thereby at the end of a period after the release of the train longer than the longest closure in any signal.

11. The combination in an electric signaling apparatus of a signal-wheel of the open-circuit variety, an operating-train therefor geared in such ratio that the signal-wheel rotates two or more times for each run of the train, a non-interference magnet, a releasing device for the train and for the armature of said magnet, means for again locking the armature after a lapse of time longer than the longest closure in any signal, signaling contact-points normally out of control of the signal-wheel and a circuit-closing device for maintaining the circuit from one of said signaling-contacts to the other during the said lapse of time.

12. The combination in an electric signaling apparatus of a signal-wheel of the open-circuit variety spaced to correspond to one round of the signal, an operating-train therefor geared in such ratio that the signal-wheel will rotate two or more times for each run of the train, a non-interference magnet, a releasing device for the armature of said magnet, signaling-contacts normally out of control of the signal-wheel, a locking device for the armature and a circuit-closer, both controlled by the train and set to be operated thereby after a lapse of time greater than the longest closure in any signal, the said circuit-closer acting to maintain the connection between the signaling-contacts during the said lapse of time.

13. In a non-interference box having at starting a free-armature period longer than the longest closure in any signal, the combination of a signal-wheel, signaling-contacts normally free of the said wheel and circuit-closing devices controlled by the train and operating during the said free-armature period to maintain the circuit closed between the said contacts during the said period.

14. In a non-interference signal-box the combination of signal-wheel B, signaling-contacts normally out of the control of said wheel, slow wheel D, a releasing device for the train,

a circuit-closer for maintaining the electrical connection between said contacts, the said circuit-closer being controlled by the train during a period after its release longer than the longest closure in any signal, and being released by the train at the end of said period, and an operative connection between said slow wheel and the signal-wheel, so set as to bring the teeth of said wheel into engagement with the signaling-contacts at the end of said period.

In testimony whereof I have hereunto set my hand this 16th day of April, 1891.

GEORGE F. MILLIKEN.

Witnesses:
CHAS. E. BEALE,
E. M. BENTLEY.