

A. C. FRASER.

ELECTRIC BLOCK SIGNALING INSTRUMENT FOR RAILWAYS.

No. 548,435.

Patented Oct. 22, 1895.

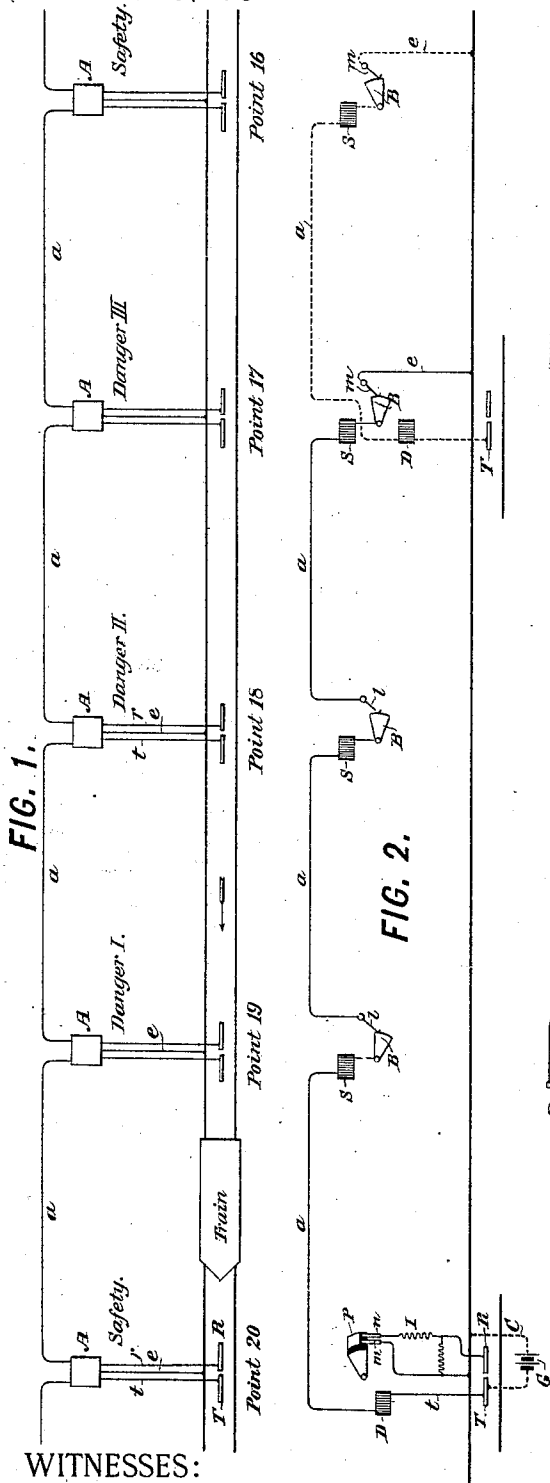


FIG. 10.

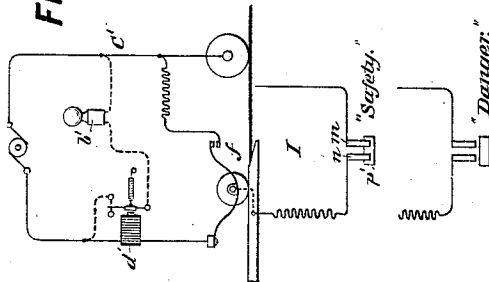


FIG. 4.

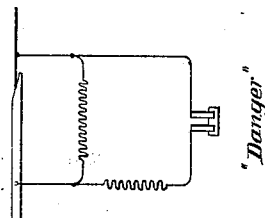
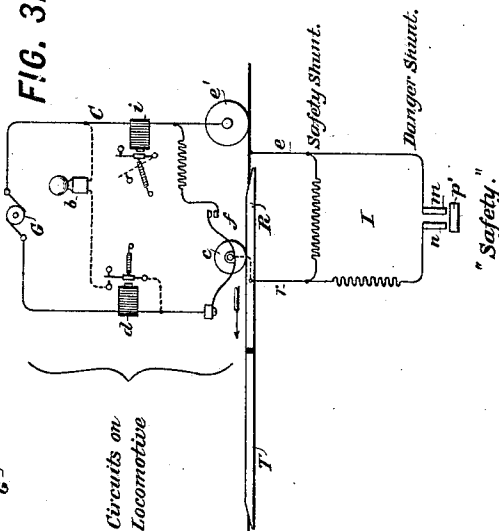


FIG. 3.



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FIG. 5.

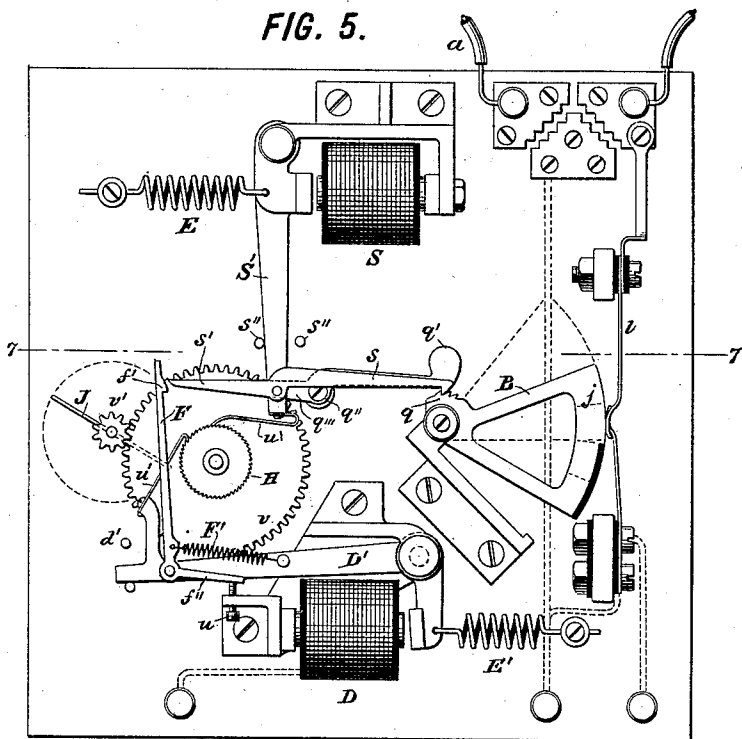


FIG. 6.

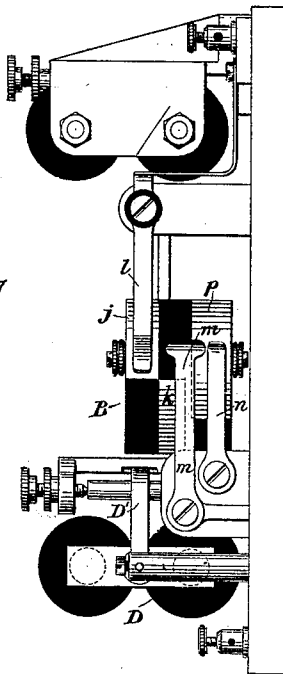


FIG. 7.

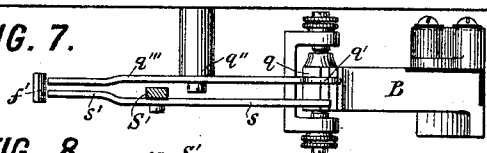


FIG. 8.

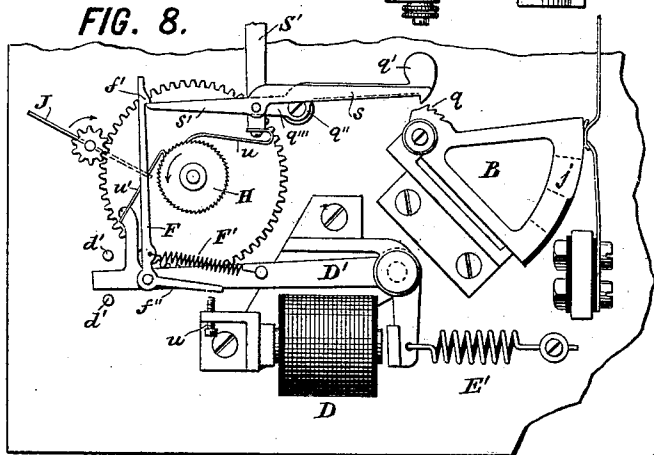
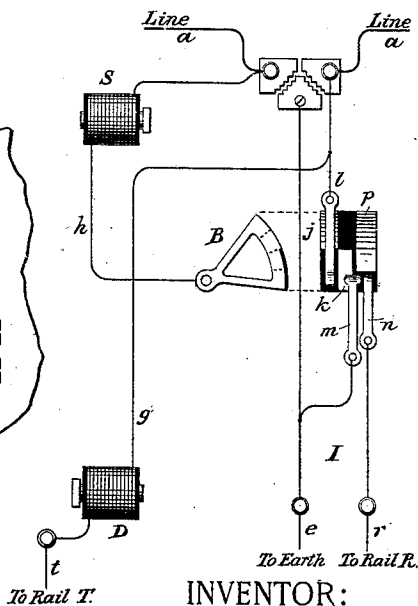


FIG. 9.



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FIG. 11.

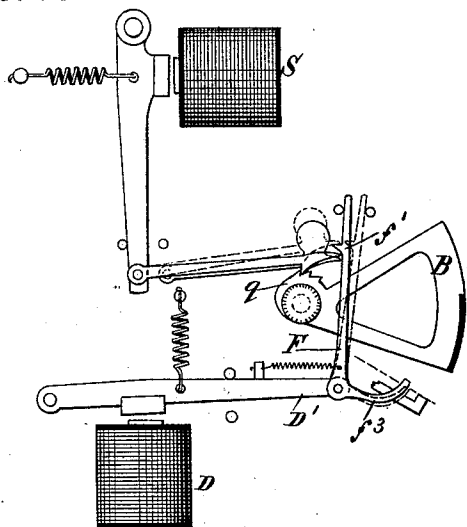


FIG. 12.

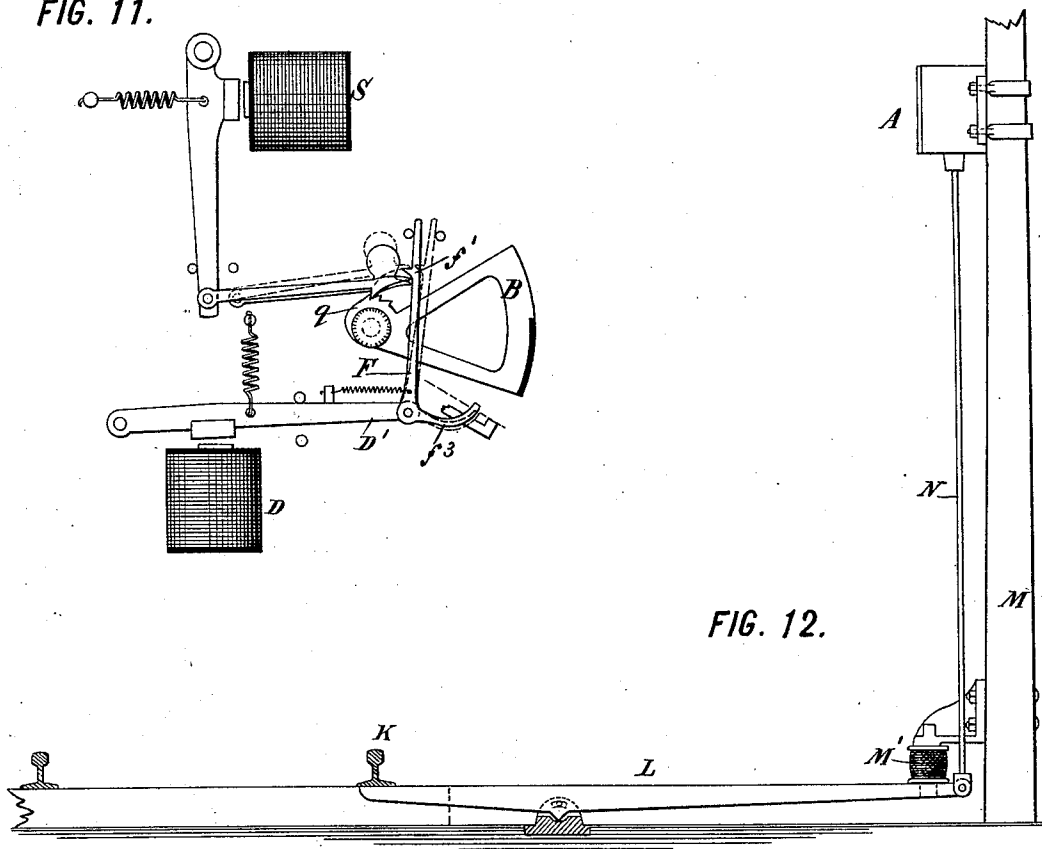
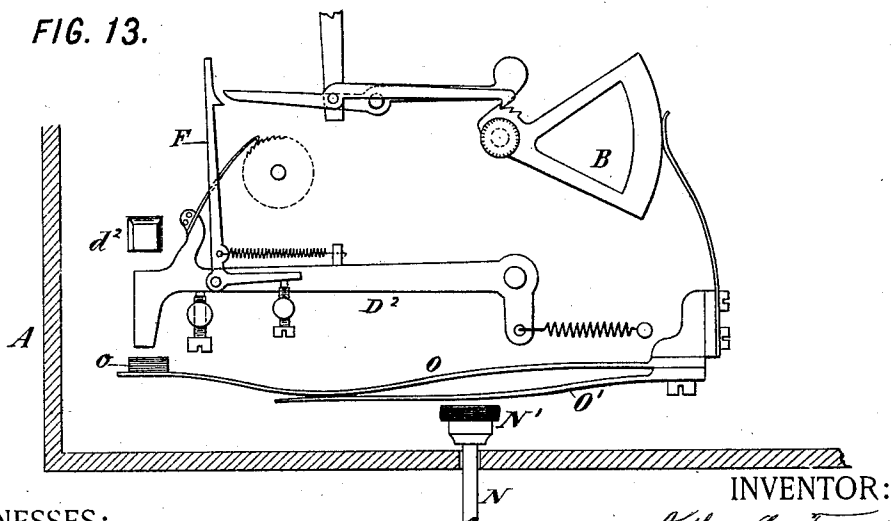


FIG. 13.



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FIG. 14.

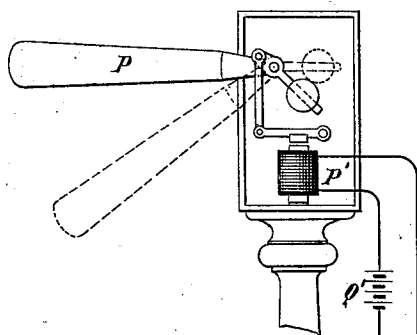


FIG. 15.

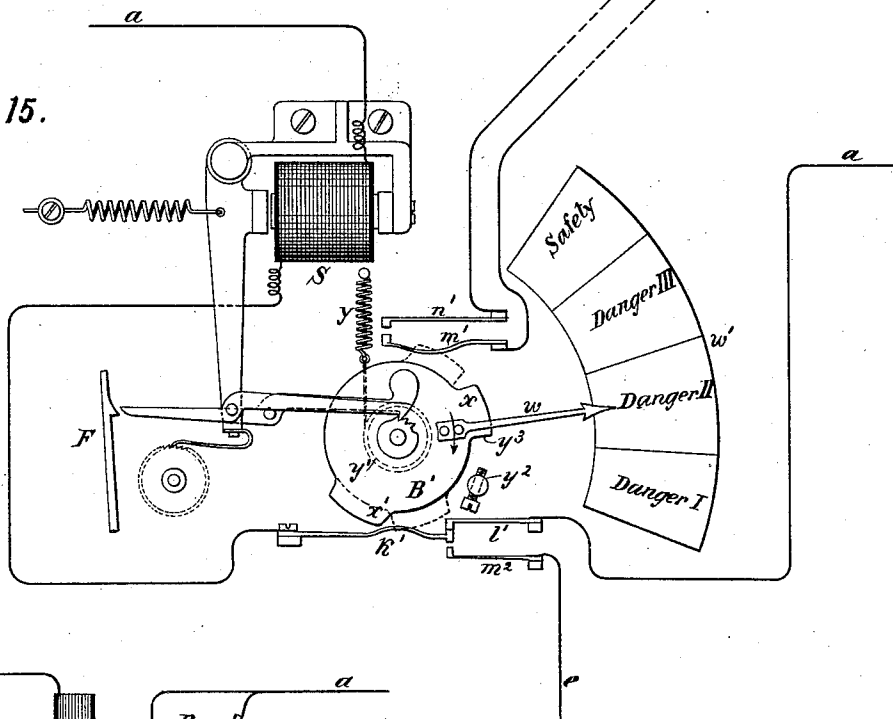
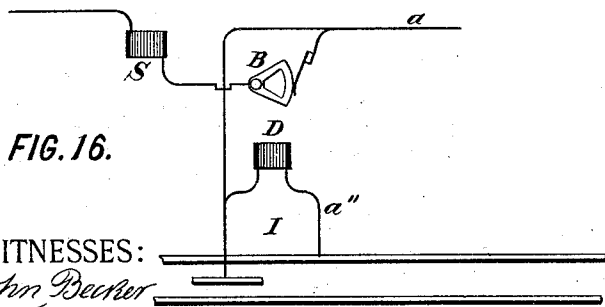


FIG. 16.



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UNITED STATES PATENT OFFICE.

ARTHUR C. FRASER, OF BROOKLYN, NEW YORK.

ELECTRIC BLOCK-SIGNALING INSTRUMENT FOR RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 548,435, dated October 22, 1895.

Application filed February 26, 1891. Renewed March 26, 1895. Serial No. 543,282. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR C. FRASER, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Electric Block-Signaling Instruments for Railways, of which the following is a specification.

This invention relates to electric block-signals for railways, being designed especially for use with those systems wherein the signal is given in the cab of the locomotive, although applicable, also, to the electric control of visual signals along the track.

The invention aims to render it practicable to leave a trail or succession of signals set to "danger" behind each passing train in readiness to give the required danger-signal to the following train. This is accomplished by the operation of signal-setting instruments at the signaling-points or block-divisions, and which are connected by a single line-wire. Each instrument comprises a movable commutator or circuit-controlling part and two electromagnets for moving it to different positions—one, which I will designate the "danger-magnet" for moving it to the position to give a danger-signal, and the other which I will designate the "safety-magnet" for restoring it by two or more impulses to the position for giving a safety-signal. Whenever a train passes the signaling-point or block-division at which a given instrument is located, it excites the danger-magnet and causes the movement of the commutator to an extreme position in one direction indicative of "danger." When the train reaches the next point in advance, the impulse which it sends back over the line excites the safety-magnet, which moves the commutator back one space toward the "safety" position, still leaving it, however, at "danger." A second, third, or fourth impulse through the safety-magnet is necessary to fully restore the commutator to the "safety" position, the number of such impulses depending upon the number of danger-signals which it is desired in any particular case to leave behind each advancing train.

The characteristic features of my invention are the employment of two distinct magnets, the one for setting the commutator to "dan-

ger" and the other for restoring it by a plurality of impulses to "safety." The application of interengaging connections between the armature-levers of these magnets and the commutator, whereby whatever be the position of the commutator either at "safety" or at any "danger" position (less than the "extreme danger" position) the operation of the danger-magnet will disengage the commutator from its restoring mechanism and move it to the "extreme danger" position, so that after the passage of each train, no matter how close it may follow upon its predecessor, each instrument shall be left at "extreme danger" and shall require the predetermined number of pulsations to restore it to "safety," the provision of means whereby both magnets act to move the commutator upon the retractile stroke of their armatures or otherwise upon the cessation of the electric impulse only, and means for retarding the retractile movement of their armature-levers or otherwise preventing the operation of the magnets upon the commutator before a given interval of time has elapsed, thereby preventing liability of imparting a double movement to the commutator by reason of an accidental double electric impulse, as may occasionally happen.

My present invention constitutes one step or feature in a complete system of electric railway signaling, the other parts of which are and will be embodied in other applications.

I will proceed to describe the preferred embodiment of my present invention and certain modifications thereof with reference to the accompanying drawings, wherein—

Figure 1 is a plan of a railway-track, being one of the tracks of a double-track railway and showing in elevation the signal-boxes A A at the signaling-points or divisions thereof and diagrammatically the electric conducting-wires connecting these boxes with one another and with the respective track and contact rails. Fig. 2 is a diagram showing the actual circuit connections for transmitting a signal upon the passage of the train shown in Fig. 1 over the next signaling-point in advance. Fig. 3 is a diagram of the circuits on the locomotive, showing it at the instant of receiving a signal and in connection with the signal-receiving circuit on the track, the lat-

ter being set to "safety." Fig. 4 is a similar diagram of the signal-receiving circuit, showing it set to "danger." Fig. 5 is a front elevation of my improved signal-setting instrument, showing it in position marked "Danger II" in Fig. 1. Fig. 6 is a side elevation of the instrument. Fig. 7 is a fragmentary horizontal section on the line 7 7 in Fig. 5, showing certain of the parts below this line in plan. Fig. 8 is a fragmentary view of the lower portion of Fig. 5, showing the parts in a different position. Fig. 9 is a diagram showing the circuit connections with the several parts of the instrument. Figs. 10 and 10^a are diagrams answering to Fig. 3 and showing modification. Fig. 11 is a front elevation showing a modification of the instrument shown in Fig. 5. Fig. 12 is a transverse section of a railway-track, showing a modification; and Fig. 13 is a fragmentary sectional view of the signal-box A shown in Fig. 12, showing the inclosed instrument in front elevation answering to Fig. 5. Fig. 14 is a sectional elevation of a visual signal operated by my instrument. Fig. 15 is a front elevation of a modified construction of signal-instrument. Fig. 16 is a diagram showing a modified circuit arrangement.

I will describe the application of my invention to the operation of signals to be given in the cab of the locomotive. In so doing I will assume that the signal of "danger" is to be given in the cab by augmenting the current on a normally-closed locomotive-circuit C, (shown in Fig. 3,) fed by a dynamo or other electric generator G, and including a danger-signaling magnet *d*, which with the normal current has not sufficient power to attract its armature, but upon such an augmentation of the current as is provided to give a danger-signal it attracts its armature and diverts a current through a shunt (shown in dotted lines in Fig. 3) to ring a rheotomic bell *b*, or in any other way to give an alarm or other signal to the engineer. The particular means of giving the signal to the engineer is immaterial to my present invention, which has reference solely to the operation of signal-instruments along the tracks for setting signals at the respective signaling-points to "danger" or "safety," respectively.

According to my invention each track of a double-track railway is divided into blocks or sections of any suitable length—say, for example, of one-half mile or one mile—and at each block is placed a signaling-box A, Fig. 1, which may be mounted on a telegraph-pole alongside the track. The respective boxes are connected together by line-wires *aa*. Each box is also connected by a wire *e* with one of the track-rails or with an earth-plate or otherwise with any suitable earth or ground connection. At each signaling-point two contact-rails are laid on or alongside of the track, one a receiving-rail R, connected by a wire *r* with the box A, and the other a transmitting-rail T, connected with the box by a wire *t*.

These rails are preferably laid between the track-rails, and are beveled off at their opposite ends, as indicated in Fig. 3, so that upon the passage of a locomotive a contact-wheel *c*, carried thereby in connection with the circuit C, will roll up one end of one rail, being lifted thereby to break the circuit at the circuit-breaker *f*, (which may be omitted,) rolls along the two rails, and descends the incline at the opposite end, so that during this interval it puts one terminal of the circuit C in connection successively with the contact-rails R and T. Any other suitable construction of contact device, such as a brush or rubbing contact sweeping over the rails, may be substituted. The other terminal of the circuit C connects by a ground connection *e'* of any suitable sort with the track-rails or otherwise, to the ground or earth. None of the features thus far described are original with me, nor are they all essential to my invention.

Each signal-box A contains a danger-magnet D and a safety-magnet S, with certain circuit-controlling devices, which I will designate as a "commutator." The circuit connections within the instrument are best shown in Fig. 9. The wire *t* connects with the coil of magnet D, the other terminal of which connects by a wire *g* with the line-wire *a*, leading to the rear. The other line-wire *a*, coming in from the point in advance, leads to one terminal of the magnet S, the other terminal of which connects by a wire *h* with the movable member or drop B of the commutator. On the face of this commutator there are three brushes, a line-brush *l* in connection with the line-wire *a*, leading to the rear, an earth-brush *m* in connection with the earth-wire *e*, and a receiving-circuit brush *n* in connection with the wire *r*, leading to the receiving-rail R.

The arrangement of the commutator and its brushes may be greatly varied. In that shown the wire *h* is connected through the metallic portion of the commutator with a metal face or contact-plate *j* for connection with the line-brush *l*, and with another face or plate *k* for connection with the brush *m*. The commutator also carries, insulated from it, a metal plate or bridge *p*, sufficiently wide to connect together the brushes *m* and *n*. The connections are such that in the normal positions of the respective instruments—that is to say, when all the instruments are set to "safety"—the connections are through a series of short circuits, one of which is shown in dotted lines in Fig. 2, each extending from the transmitting-rail T through the danger-magnet D, over a line-wire *a* to the next station in the rear, through the safety-magnet S at that station, and by the commutator and earth-brush *m* and wire *e* to the track-rail or earth and back through the latter; but whenever a train is passing along the road, these separate short circuits or loops are connected together over three blocks, more or less, so that the safety-magnets S of three sta-

tions in the rear of the train are connected serially in the same circuit, as shown in full lines in Fig. 2. It follows from this that when a train reaches the position indicated by the heavy dotted lines at the left of Fig. 2, so that its locomotive-circuit is connected by one terminal to the track-rail and by the other with the transmitting-rail T, it sends an impulse through the wire *t* and the danger-magnet at the station it is passing, thence back over the line, exciting the safety-magnets S at the three points next in the rear, and passing at the third by the wire *e* to the earth or track-rail, returning through the latter to the wheels or other ground connection of the locomotive.

The general arrangement of the circuits being now understood, I will proceed to describe the mechanical construction and mode of operating the signal-setting instrument, with reference particularly to Figs. 5 to 8.

The instrument consists, generally, of the magnets D and S and a commutating part or circuit-controller B, capable of moving to different positions and operated or governed in its movement by these magnets or their equivalents. The position occupied by the part B determines the signal which will be given to a passing locomotive. Its movement is back and forth between two extreme positions, one of which is the position of "safety," while the other and all intermediate positions are positions of "danger" or "caution." The number of these different positions will depend upon the number of danger-signals to be left behind each train, and will consist of the one safety-signal, plus the total number of danger-signals. In the example shown in the drawings, where three danger-signals are marked, respectively, "Danger I," "Danger II," and "Danger III," are left behind each train, the commutator is movable to four different positions.

The electric connections of the commutator are such that in the "safety" position it connects the line *a*, coming in from the station in advance, to earth; in the position "Danger III" it also connects it to earth, and in the positions "Danger I" and "Danger II" it connects the line in advance with the line in the rear. These are the connections for the transmitting-circuit. For the local or receiving circuit lettered I, in Figs. 3 and 4, the commutator connects the brushes *m n* in the "danger" positions and breaks the electric connection between them in the "safety" position.

The commutator B is preferably pivotally mounted, so as to have an angular motion, although it might have a sliding or rectilinear motion. In the construction shown it is in the form of a segmental "drop" which tends to fall of its own weight to the "extreme danger" position, as shown in Fig. 8. In order that it may be lifted or restored to the "safety" position shown in Fig. 9, it is provided with a series of ratchet-teeth *q*, engaged by a pawl *s*,

pivoted to the armature-lever S' of the safety-magnet S. The ratchet-teeth are also engaged by a stop-pawl *q'*, arranged just behind the pawl *s* and pivoted to a post *q''*. Whenever the magnet S attracts its armature, the pawl *s* moves forward and drops into engagement with a tooth in advance on the ratchet *q*, and when the magnet releases its armature, the retractile movement of the lever S' under the tension of its retracting-spring E, causes the pawl *s* to pull up the drop one space. This operation is repeated each time the magnet is excited, until the drop is raised to its highest position, (shown in dotted lines in Fig. 5,) after which no further excitation of the magnet S will under any ordinary circumstances occur. The drop is held from falling during the attractive stroke of the armature-lever by the stop-pawl *q'*. The armature-lever plays between stops *s''*, which limit it to the exact movement essential to operate on the drop.

Whenever the magnet D is excited, the retractile movement of its armature causes the commutator-drop B to fall to the lowest position, as shown in Fig. 8. To effect this the armature-lever D' carries a hooked finger F, which, upon the attractive movement of the armature-lever, is lifted to a position with its hook *f'* above the ends of tails *s' q'''*, formed on the respective pawls *s* and *q'*. Upon the release of its armature its retraction by the spring E' draws down the finger F, and its hook *f'* engaging the tails of the two pawls lifts them to the position shown in Fig. 8, so that their noses are lifted out of the teeth of the ratchet *q*, thereby freeing the drop B to permit it to fall to the bottom. The finger F is acted upon by a light spring F' to draw it to the right, so that its hooked end shall properly engage the tails of the pawls. To cause the hooked finger to disengage itself from the pawls and permit the latter to drop again into engagement with the ratchet-teeth, a stop *u* is provided, which, at the end of the retractile movement of the lever D', is encountered by an arm *f''* of the finger F and tilts the latter against the tension of its spring sufficiently to throw its hook *f'* back out of engagement with the tails of the pawls, whereupon they drop back by their own weight (or by any suitable light springs that may be applied to them) into engagement with the ratchet-teeth. The armature-lever D' works between stops *d'*, which properly limit its movement. Thus it is obvious that whatever be the position of the drop or commutator B above its lowest position at the instant when the danger-magnet is excited, it will, upon the cessation of the excitation of this magnet, be dropped always to the lowest position or that of "extreme danger," and upon each excitation of the magnet S it will be lifted one space until finally restored to the "safety" position. If a following train runs too close behind its leader and receives a danger-signal, it will immediately after receiving such signal drop the commutator B to its lowest position, where it will re-

quire three impulses to raise it again to "safety."

I am aware that the instrument thus described does not in itself provide for the following contingency, namely: When a second or following train has run within the range of signals left by its leader it does not prevent an impulse telegraphed back by the leader from influencing the instruments behind the following train. For example, if the following train shall pass point 17 in Fig. 1 before the leader passes point 20, the leader in passing point 20 will send an impulse back through the instruments not only at points 19 and 18, but points 17, 16, and 15 behind the following train, setting each instrument one space toward "safety." This movement will ground the advance-line at point 18 after having reduced the trail of signals behind the following train by one. If the following train should pass point 18 before its predecessor passes point 21 the same result will again follow. This derangement of the signals in case two trains run too close together is prevented by further improvements, which will be made the subject of future applications for patents.

It will be observed that the movement of the commutating part B is effected not upon the excitation of either magnet but upon its demagnetization, so that as long as the current through the magnet continues the commutator remains immovable, and no change whatever is made in the line connections governed by the commutator. Hence the armature-levers are made to act upon the commutator upon their retractile strokes under the impulse of their springs.

In the employment of the contact-wheel *c*, as shown in Fig. 3, it may sometimes occur that this wheel in passing over the rail T will fail for an instant to make perfect contact with it or will jump or rebound, so that the electric impulse sent through the wheel and rail over the transmitting-circuit, instead of being a single continuous impulse, as it should be, will be divided into two or more impulses in rapid succession, which might sometimes result in causing the safety-magnets to lift their respective commutators two or more spaces instead of one, thereby restoring the instruments prematurely to the position of "safety" and giving delusive signals in the rear. To prevent any such result in the case of a divided impulse, I provide the instrument with what I call a "retarder," the effect of which is to render the retractile movement of the armature of the safety-magnet or of both the danger and safety magnets so gradual as to preclude the possibility of a divided impulse causing a double movement of the commutator. This retarder is so applied as to act only in one direction—namely, during the retractile stroke of the lever. It offers no retardation whatever to the attractile stroke of the lever, which it is desired should be performed with the utmost promptness, to which end the

parts that it carries are made as light as possible, so as to have the minimum of inertia to be overcome. Numerous forms of retarders adapted to perform this result are already known in the mechanic arts, among which may be mentioned fans, escapements, dash-pots, &c., and such retarders are also well known which will give a retarded movement in one direction and offer no obstruction to an equal movement in the opposite direction. The simplest and most practical form of retarder, however, and the one which I prefer, is a fan or flyer driven from the armature-lever through the intervention of a ratchet-wheel and pawl. I have shown the armature-lever *S'* as provided with a very light spring-pawl *u'*, the end of which, during the attractile stroke, clicks over the fine teeth of a ratchet-wheel *H*, so that by its engagement therewith the return movement of the lever necessarily carries the ratchet-wheel with it, and this in turn, through gearing *v v'* or any other mechanical connection, revolves a fan or flier *J*. Upon the demagnetization of the magnet *S*, the retractile spring of its armature has not only to lift the drop *B*, but also to set the fan in motion. The fan is so geared as to take some appreciable time to bring it up to maximum speed, so that the retractile stroke of the armature-lever occupies, perhaps, a quarter or half a second, or any interval of time suitably in excess of any possible interval between two impulses while the locomotive contact is passing over the contact-rail. Such a second impulse will simply cause the magnet *S* to reattract its armature before the armature has had time to be retracted, and so could not have the effect of moving the drop two spaces.

By preference I apply the retarder also to the armature-lever of the danger-magnet in order to prevent its active movement transmitted through the hooked finger *F* being made too sudden. It is preferable that this movement should be so gradual as to disengage the pawls deliberately and to hold them elevated in the position shown in Fig. 8 for a sufficient time to enable the drop to fall to the bottom before the lever *D'* completes its own stroke and disengages the hooked finger from the pawls to permit them to drop back. For this purpose the lever *D'* is also provided with a spring-pawl *u'*, which may engage the same ratchet-wheel *H* or another one on the same spindle, or a separate retarder might be provided for the lever *D'*.

The employment of the retarder for the danger-magnet is less important than for the safety-magnet, because the first impulse drops the commutator to the "extreme danger" position and the second impulse could drop it no farther. It might, however, release the pawls prematurely and enable them to re-engage the ratchet before the drop had fallen quite to the bottom, and for this reason its use is preferable.

In the event that an accidental double im-

pulse is not to be apprehended the retarder for the danger-magnet may be omitted and the construction shown in Fig. 11 may be employed instead. Here the armature-lever D' is somewhat differently arranged and the hooked finger F has its hook f' turned upwardly, forming a lifting-tooth. On the attractive movement of the armature, the finger F is drawn down to bring the tooth f' below the ends of the pawls, and upon the retractile stroke the finger F is thrust upwardly, so that its tooth lifts the pawls to the position shown in dotted lines out of engagement with the ratchet-teeth, so that the drop B is free to fall. If no other provision were made, the pawls would be held elevated and would be impotent to act on the drop to restore it. To avoid this and insure the restoration of the pawls into active condition, the finger F has a tail or arm f^2 , the end of which projects into the path of the drop just sufficiently to be struck thereby as the latter falls to its lowest position, so that the finger F is thrown by this impact to the position shown in dotted lines, thereby moving its tooth f' out from beneath the pawls, which consequently drop immediately into engagement with the ratchet-teeth ready for the next movement of the magnet S.

It is not essential to my invention that the motive devices for acting through the levers D' and S' or other communicating parts upon the pawls for effecting the various movements of the drop shall be electromagnets, as other means might be provided for communicating the requisite movement to these parts.

My invention comprehends any motive device to which energy may be applied from or upon the passage of a train passing over the signaling-points, and by which this energy shall be exerted to effect the essential movements of the drop B or other commutating or circuit-controlling or signal-operating part of the instrument. Such motive devices may be mechanical, pneumatic, or hydraulic, all of which are well known in the art; but for various reasons I prefer electromagnets as being more practical and less objectionable than any other means of communication.

As an example of the modification just suggested, I show in Figs. 12 and 13 a means for operating the lever D' by mechanical means in lieu of the magnet D. The depression of the track-rails under the weight of a passing train is here utilized as the source of mechanical motion to be transmitted to the instrument. A rail K, Fig. 12, rests upon one arm of a lever L, fulcrumed to a firm support alongside the track, and the other or long arm of which extends adjacent to a telegraph-pole or other suitable post M, receiving the downward pressure of a spring or buffer M', and its end is connected with a rod N, extending up and entering the bottom of the box A, containing the signaling-instrument. Inside the box it is provided with a padded or cushioned head N', which comes beneath one or more

flexible springs O O', so that when the rail K is depressed by a passing train the lever L is vibrated, the rod N pushed up, and its head N' exerts an upward pressure against and correspondingly flexes the springs O O'. The outer end of these springs is provided preferably with a short cushion o , which as the springs are pressed up encounters the end of a lever D², (equivalent of the lever D' in Fig. 5,) which it presses upward until stopped by a stop d^2 . This lever D² is provided with a retracting-spring and with a hooked finger F, exactly the same as the lever D' in Fig. 5, and is preferably engaged with a retarder in the same manner. When thus thrust up, it is held there by the head N' as long as the rail K is depressed, and if the rail rises and falls as the different trucks of the train pass over it the consequent up-and-down movement of the head N' is either taken up by the flexure of the springs O O' or, if the head drops low enough, permits the springs to flex downward sufficiently to release the lever D² and upon the next upward movement to re-engage it. As the lever D² is connected with the retarder, it does not fall immediately, but a series of upward impulses transmitted to it from the pad o have the effect of holding it substantially motionless in its uppermost position. When the train finally passes over the signaling-point, the rod N descends to its normal position, thereby freeing the lever D² from the tension of the spring O and permitting it to descend and by the action of the finger F to withdraw the pawls $s'q'$ and cause the drop B to fall to its lowest position. The mechanically-actuated parts K, L, N, and O serve in this construction as substantial equivalents of the danger-magnet D and its actuating-circuit.

I have stated that it is not essential to my present invention that the danger-signals should be given to the cab by augmenting the current on a normally-closed circuit, as shown in Fig. 3. A modification is shown in Fig. 10, wherein the danger-signal is given by breaking the circuit. The receiving-circuit I consists of a single loop terminating in springs or brushes $m n$, bridged by a piece p' for safety or with any other equivalent circuit-breaker. By the action of the circuit-breaker f on the locomotive the partial circuit I is cut serially into connection with the locomotive-circuit C', and if the circuit-breaker $m n p'$ be closed the locomotive-circuit is not broken; but in case of danger the receiving-circuit is broken, as shown in the sketch 10^a beneath Fig. 10, thereby causing the magnet d' to release its armature and thereby closing the circuit shown in dotted lines to the rheotomic bell b' or other alarm device. I prefer, however, the arrangement shown in Fig. 3, for reasons fully stated in the application filed by Elisha B. Cutten and myself February 6, 1891, Serial No. 380,444. I make no claim herein to anything claimed in that application.

My invention is not necessarily limited in

its application to instruments for giving signals to the cab of a locomotive, as it may also be used for operating or controlling visual signals arranged along the track or for indicating in a train-dispatcher's office, a signal-house, &c., the condition of the road ahead.

Fig. 15 shows an instrument wherein the commutating or circuit-controlling part, here lettered B', operates a visual indicator, showing at a glance the condition of the track ahead. This indicator consists of a pointer *w* movable to different positions over a scale *w'* on which are marked words "Safety," "Danger III," &c., indicative of the different conditions. Fig. 14, taken in connection with Fig. 15, shows how my invention may be applied for operating a visual signal. The signal shown in Fig. 14 consists of a semaphore-arm P, counterweighted in the usual manner, so that it tends to move to the position of "danger." (Shown in full lines.) An electromagnet P' has its armature connected to this semaphore, so that when the magnet is excited the attraction of its armature shall draw down the semaphore to the "safety" position shown in dotted lines. The magnet P' has its coils included in an electric circuit Q, fed by a battery Q', and which is closed when the signal is set to "safety," so that the magnet is kept excited and holds the armature down.

The instrument shown in Fig. 15 controls the closing of this circuit by means of a cam projection *x*, which in the "safety" position of the commutator B' holds two springs *m' n'* pressed together to close the circuit Q; but in all other positions of the commutator these springs are at liberty to fly apart, thereby breaking the circuit and permitting the semaphore-arm P to move up to "danger." Fig. 15 also shows two other respects in which my instrument may be modified. I have hereinbefore referred to the commutating part B as a drop, movable by its own weight in one direction and ratcheted back by the action of the magnet S. In this figure the commutating part B' is a disk or wheel capable of an oscillatory motion and tending to move in the direction of the arrow marked on it by reason of the tension of a spring *y* exerted through a cord or chain winding on a drum or pulley *y'*, forming part of the disk B'. The action of the pawls and ratchet-teeth is the same as in the constructions before described, and the pawls are withdrawn in the same manner to free the ratchet and permit the commutating part B' to revolve under the tension of the spring to bring it to the "extreme danger" position. In this position it is arrested by a stop *y''*, which is encountered by a shoulder *y'''* on the disk.

The other modification shown in Fig. 15 consists in the substitution of contact making and breaking springs for the commutating plates and brushes on the face of the drop B shown in Figs. 5 to 9. The springs *m n* of the receiving-circuit I have their equivalents in the springs *m' n'* already described. The

means for commutating the line from advance into connection with the line in the rear or with the earth consists (in lieu of the brushes *l m* and commutating surfaces or contacts *j* and *k* in Figs. 5 to 9) of two contact springs or stops *l'*, connected to the line in the rear, and *m''*, connected to earth, between which plays the end of a contact-spring *k'*, operated by a cam projection *x'* on the disk B', as clearly shown in Fig. 15. In the positions of "safety" and "Danger III" the spring is pressed down to make contact with the stop *m''*, and in the positions "Danger II" and "Danger I" it is released, so that it springs up into contact with the stop *l'*.

In the description of Fig. 2 I refer to the danger-magnet D as being included serially in the line-circuit. This is not essential to my invention, as the danger-magnet may be arranged in any manner, either serially in the line or independently thereof. Fig. 16 shows it connected in derivation with the line, being included in a branch circuit *a''*, extending from the contact-rail T to the track-rail or earth. I contemplate also introducing the magnet D in some part of the receiving-circuit I, its particular location being immaterial to my invention, provided that it be so arranged that its operation by each passing locomotive is insured.

It will be apparent that my invention may be modified in many ways without departing from its essential features. Some such modifications I have illustrated by the examples shown in the drawings. Other modifications will be readily inferred by those skilled in the art from what has been already herein stated as the essential features and operation of my invention. For example, the ratchet-and-pawl movement for restoring the commutator step by step toward the position of "safety" may be substituted by any other equivalent step-by-step mechanism—such, for example, as an escapement.

I have stated in this application and in the claims that upon the action of the danger-magnet D or other danger-motive device the commutating part drops or moves to the "extreme danger" position. By this I do not mean necessarily that it moves to the extreme limit of its movement in this direction, because in some instances it may be desirable after it has moved to the position marked "Danger I" in the drawings to move it still farther in the same direction. What I mean therefore by "extreme danger" position is the extreme position to which the drop or commutator B moves under normal circumstances and which normally is always one position—namely, that designated "Danger I" in the drawings.

It is essential to my invention that under any normal circumstances whenever a locomotive or train passes a signaling-point and acts upon the instrument there it shall move the drop or commutating part immediately to this position from whatever other position it

may occupy at the moment—that is, either from “safety” or from any position intermediate of “safety” and “extreme danger.” It is this movement away from the “safety” position and toward and stopping at one certain determinate position (which I have characterized the “extreme danger” position) that distinguishes my invention from those signaling-instruments in which the moving part is moved one step at a time in one direction by one magnet and equally one step at a time in the opposite direction by another magnet—as, for example, those instruments of the character of telethermometers wherein the movements of a distant part are reproduced by intermittent movements of the driven part of the receiving-instrument.

In practice the signals given by my improved block-signaling instrument may be cautionary rather than “danger” signals, or cautionary signals may be given by my instrument and “danger” signals by some other signaling means. In such cases the word “danger” throughout my specification and claims is to be understood in the same sense as though the word “caution” were employed instead.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. In a railway block signal, the combination of signal-setting instruments at the signaling points along the track, such instruments consisting of a circuit-controlling part or commutator movable to a safety position and a plurality of danger positions, a “danger” motive device actuated from a signaling point to move said part from the safety or any intermediate position to the extreme danger position, and a “safety” motive device actuated from signaling points in advance and acting to move said part each time one space toward the safety position whereby each train sets the instrument to danger, and a predetermined number of pulsations from points in advance are required to restore it to safety.

2. In a railway block signal, the combination of signal-setting instruments at the signaling points along the track, such instruments consisting of a circuit-controlling part or commutator movable to a safety position and a plurality of danger positions, a “danger” motive device actuated from a signaling point to move said part from the safety or any intermediate position to the extreme danger position, a “safety” electro-motive device acting to move said part each time it is excited one space toward the safety position, and a line or transmitting circuit in connection with said safety electro-motive device whereby each train sets the instrument to danger, and a predetermined number of electric pulsations over said circuit from points in advance are required to restore it to safety.

3. A signal-setting instrument for railway block signaling consisting of a circuit-controlling part or commutator movable to a safety

position and a plurality of danger positions, a safety motive device and actuating mechanism interposed between it and said part adapted upon each impulse from said motive device to move said part one space toward the safety position, and a danger motive device adapted to move said part from any other position to the extreme danger position.

4. A signal-setting instrument for railway block signaling consisting of a signal-controlling part movable to a safety position and a plurality of danger positions and tending to move toward the extreme danger position, a safety motive device and mechanism interposed between it and said part acting to move the latter one space toward the safety position at each impulse of said motive device, and a danger motive device acting to free said signal-controlling part and thereby cause it to move to the extreme danger position.

5. A signal-setting instrument for railway block signaling consisting of a signal-controlling part movable to a safety position and a plurality of danger positions and tending to move toward the extreme danger position, a safety motive device and mechanism interposed between it and said part acting to move the latter one space toward the safety position at each impulse of said motive device, and a danger motive device acting to disconnect said mechanism and to free said signal-controlling part and thereby cause it to move to the extreme danger position.

6. A signal-setting instrument for railway block signaling consisting of a signal-controlling part movable to a safety position and a plurality of danger positions, a ratchet and pawl mechanism adapted to restore said part step by step to the safety position, a safety motive device actuating said ratchet and pawl, and a danger motive device acting to disconnect said ratchet and pawl and move said signal-controlling part to the extreme danger position.

7. A signal-setting instrument for railway block signaling consisting of a signal-controlling part movable to a safety position and a plurality of danger positions, ratchet teeth connected thereto, a pawl engaging said teeth and adapted to restore said part step by step to the safety position, a safety motive device actuating said pawl, a disengaging mechanism for disconnecting said pawl from said ratchet teeth to free said part and permit it to move to the extreme danger position, and a danger motive device for actuating said disengaging mechanism.

8. A signal-setting instrument for railway block signaling consisting of a signal-controlling part movable to a safety position and a plurality of danger positions, a danger motive device acting to move the same to a danger position, a safety motive device, a step by step mechanism connected thereto and adapted on each retractile movement thereof to move said signal-controlling part one space toward the safety position, and a retarder en-

gaging said mechanism and acting to retard or prolong said retractile movement.

9. A signal-setting instrument for railway block signaling consisting of a signal-controlling part movable to a safety position and a plurality of danger positions, a danger motive device acting to move the same to a danger position, a safety magnet or electro-motive device, a step by step mechanism connected thereto and adapted on each retractile movement thereof to move said signal-controlling part one space toward the safety position, and a retarder engaging said mechanism and acting to retard or prolong said retractile movement, whereby an accidental double or divided electric impulse is rendered impotent to effect a double pulsation of said step by step mechanism and the consequent too rapid restoration of said part to safety.

10. A signal-setting instrument for railway block signaling comprising a signal-controlling part movable to a safety position and a plurality of danger positions, a step by step mechanism for restoring it to the safety position, a safety motive device actuating said mechanism, a danger motive device, and a disengaging mechanism actuated thereby and acting to disconnect said step by step mechanism, combined with means for causing it to maintain said mechanism disconnected for a sufficient time to enable said signal-controlling part to move to the extreme danger position.

11. A signal-setting instrument for railway block signaling comprising a signal-controlling part movable to a safety position and a plurality of danger positions, a step by step mechanism for restoring it to the safety position, a safety motive device actuating said mechanism, a danger motive device, and a disengaging mechanism actuated thereby and acting to disconnect said step by step mechanism, combined with a retarder engaging said disengaging mechanism and adapted to prolong its action and thereby hold said step by step mechanism disconnected a sufficient time to enable the signal-controlling part to move to the extreme danger position before said step by step mechanism is restored to engagement therewith.

12. In a signal-setting instrument for railway block signaling, the combination with a circuit-controlling part or commutator movable to a safety position and a plurality of danger positions, a line circuit extending in advance and to the rear, circuit connections controlled by said commutating part for connecting the line in advance to the line in the rear or to earth in the different positions of said part, a danger motive device acting to move said part from the safety or any intermediate position to the extreme danger position, and a safety magnet or electro-motive device acting to move said part at each impulse one space toward the safety position.

13. A signal-setting instrument for railway block signaling consisting of the combi-

nation of a circuit-controlling part or commutator movable to a safety position and a plurality of danger positions, a line circuit extending in advance and to the rear, electric connections controlled by said commutating part and arranged to connect the line in advance with the line in the rear at all danger positions except the final one next to the safety position and for connecting the line in advance with earth in the final danger and the safety positions, a danger motive device to move said commutating part from the safety or any intermediate position to the extreme danger position, and a safety magnet or electro-motive device operated from the line in advance and adapted at each impulse to move said commutating part one space toward the safety position.

14. In a system of railway block signaling as a means for leaving a trail or predetermined number of danger signals behind each train, the combination of signal-transmitting points along the track, a line wire, and signal-setting instruments in connection with said line said signaling points and earth, each instrument consisting of a circuit-controlling part or commutator movable to a safety position and a plurality of danger positions, a danger motive device actuated from the adjacent signaling point to move said part from any other position to the extreme danger position, a safety magnet or electro-motive device operated through the line circuit and acting at each impulse to move said commutating part one space toward the safety position, and circuit connections between the line in advance and the line in the rear and earth, arranged to connect the safety magnets of the instruments at successive points which are set to danger together through the medium of the line circuit, and to earth the line at the rear instrument which is set to danger, whereby an electric impulse from a point ahead will actuate the safety magnets of the several instruments setting the rear one to safety and advancing each intermediate instrument one space toward safety, while the instrument at the point which is passed is set to extreme danger irrespective of its previous condition.

15. The combination in a signal-setting instrument of a circuit-controlling part or commutator B, ratchet teeth q connected therewith, stop-pawl q' , acting pawl s , an armature lever S' for moving it, a safety magnet S for vibrating said lever, a danger motive device, lever D' vibrated thereby, and a hooked-finger F' carried by the latter and adapted upon the vibration thereof to engage said pawls and lift them out of connection with said ratchet teeth, thereby freeing the commutating part and causing it to move from any other position to the position of extreme danger.

16. The combination of a circuit-controlling part B, its ratchet q , pawls q' and s , armature lever S' , safety magnet S , lever D' , hooked-finger F' moved thereby and adapted upon the vibration thereof to engage said pawls

and disconnect them from said ratchet, a retractile device for said finger, and a disengaging stop for moving said finger out of engagement with said pawls at the end of the retractile movement of said lever D'.

17. The combination of safety magnet S, its armature lever S', retracting spring E, pawls, ratchet q, commutating part B connected with said ratchet, and a retarder consisting of a pawl u on said armature lever, a ratchet wheel H engaged by said pawl, and a fan or equivalent retarding device J driven from said ratchet wheel.

18. The combination of a signal setting instrument alongside the track, having a circuit-controlling part or commutator, a track-treadle for dropping it to the "danger" position, and an electro-magnetic step by step device operated from signaling points in advance for restoring it by a predetermined series of movements to the "safety" position.

19. The combination of a signal setting instrument alongside the track, having a circuit-controlling part or commutator, means for dropping it to the "danger" position, an electro-magnetic step by step device operated from signaling points in advance for restoring it by a predetermined series of movements to the "safety" position, and a visual signal connected to said instrument to be controlled in its operation thereby, tending to assume a danger position, and constructed to be withdrawn to a safety position upon the restoration of said commutator to the "safety" position.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ARTHUR C. FRASER.

Witnesses:

GEORGE H. FRASER,
CHARLES K. FRASER.