No. 754,362. PATENTED MAR. 8, 1904.

H. BEZER.

RAILWAY SIGNALING SYSTEM.

APPLICATION FILED OCT. 16, 1901.

NO MODEL. 8 SHEETS—SHEET 1.

Fig. 2,

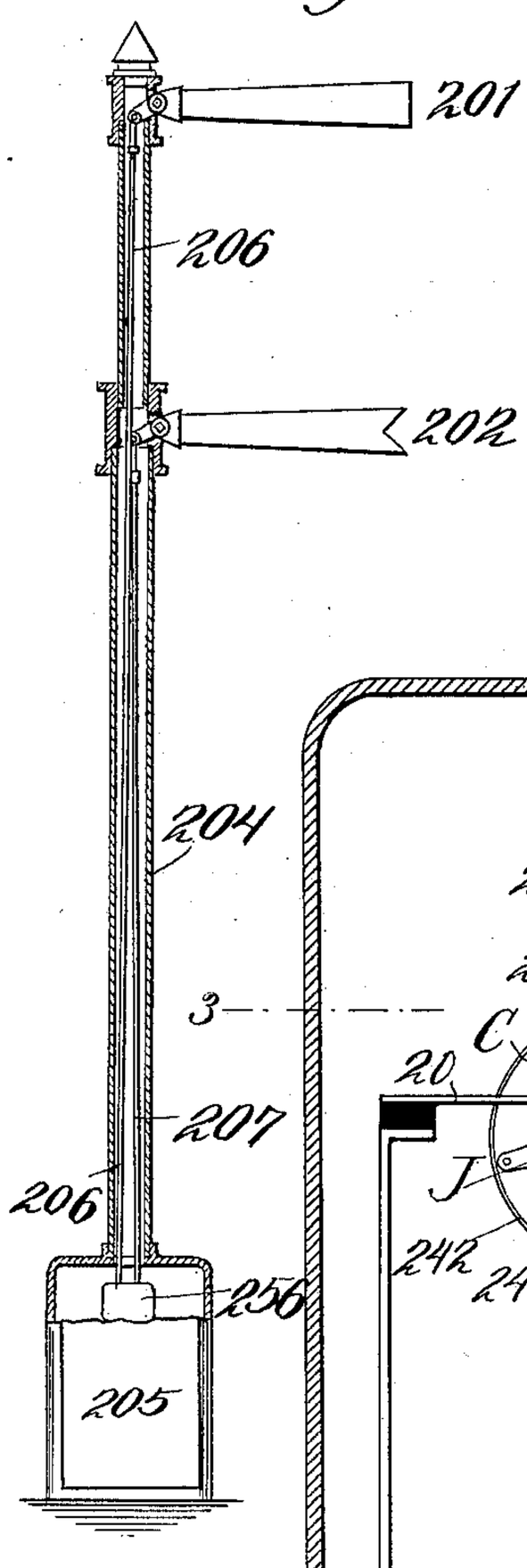

Fig. 1,

Fig. 1a,

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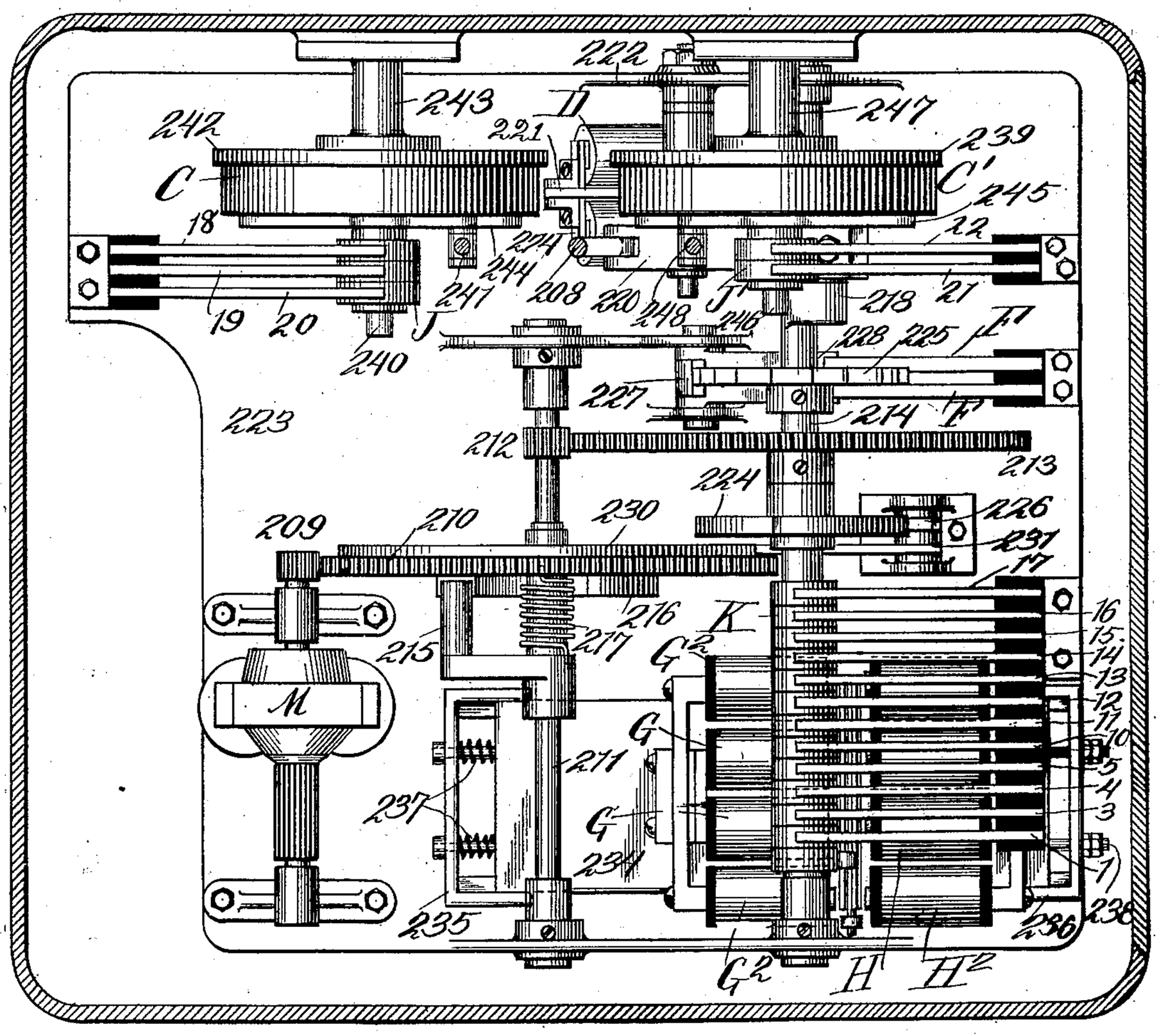
NO MODEL. 8 SHEETS—SHEET 2.

Fig. 3.



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NO MODEL. 8 SHEETS—SHEET 3.

Fig. 3.

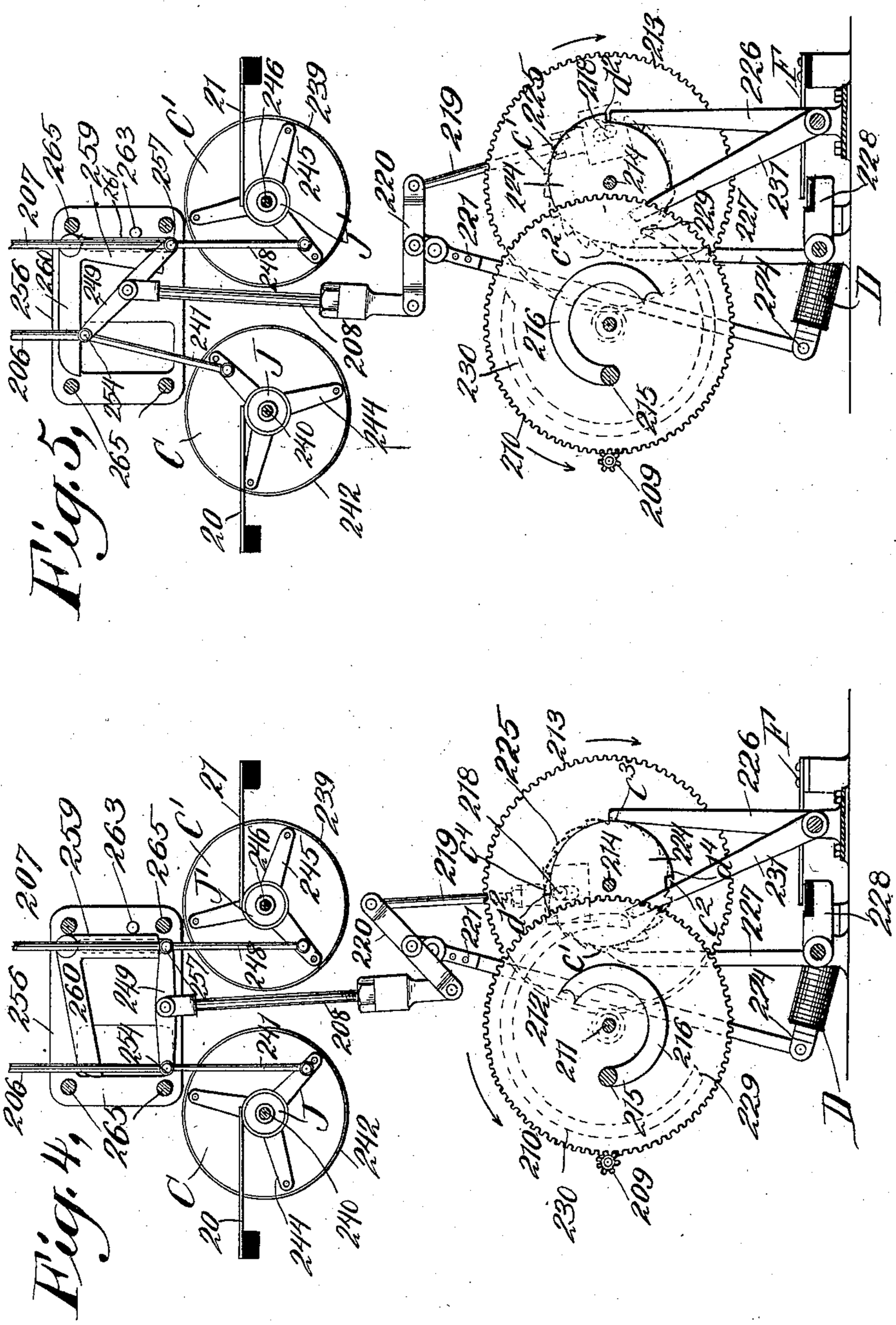

Fig. 4.

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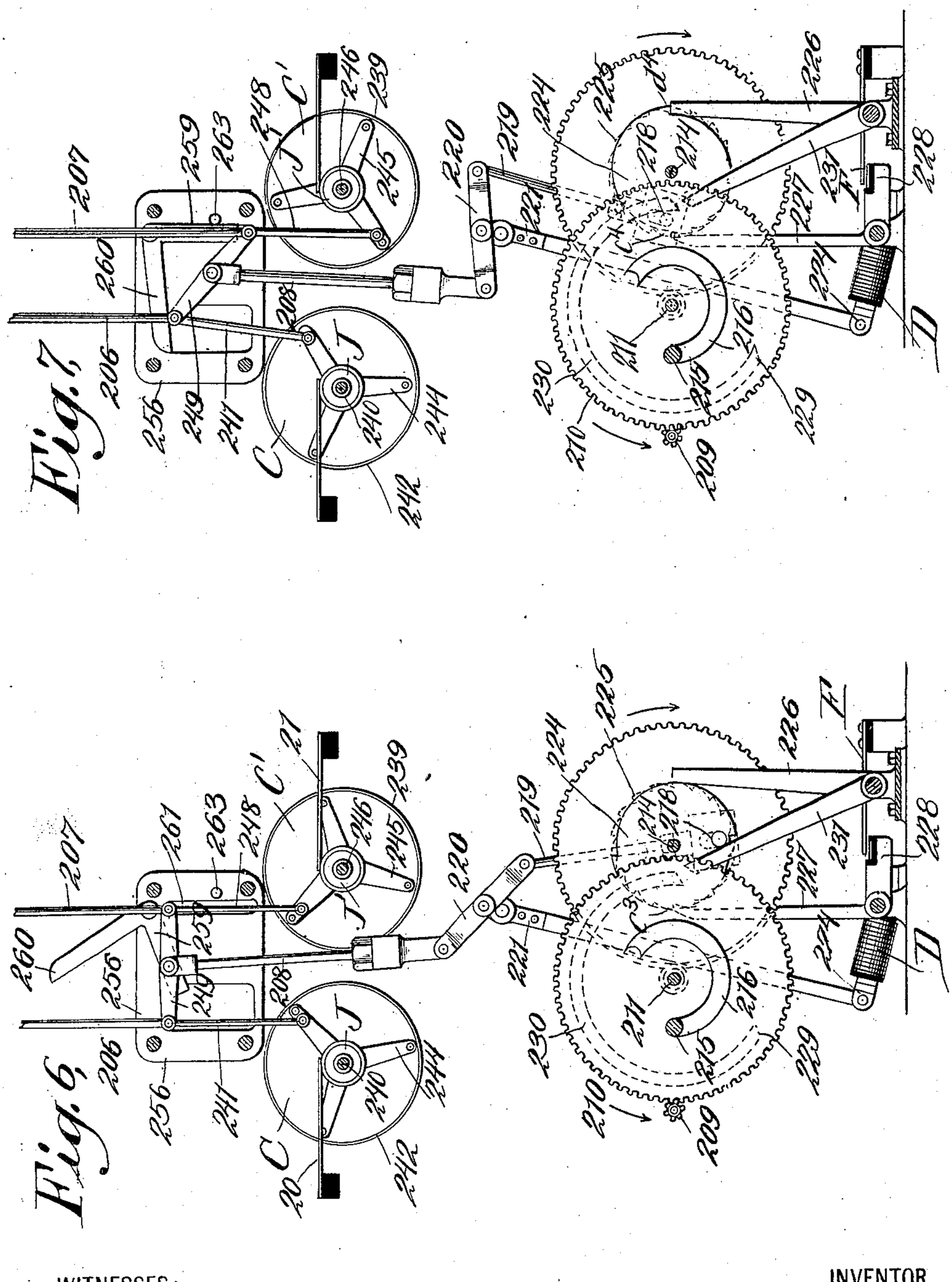
NO MODEL. 8 SHEETS—SHEET 4.



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NO MODEL. 8 SHEETS—SHEET 5.

Fig. 10,

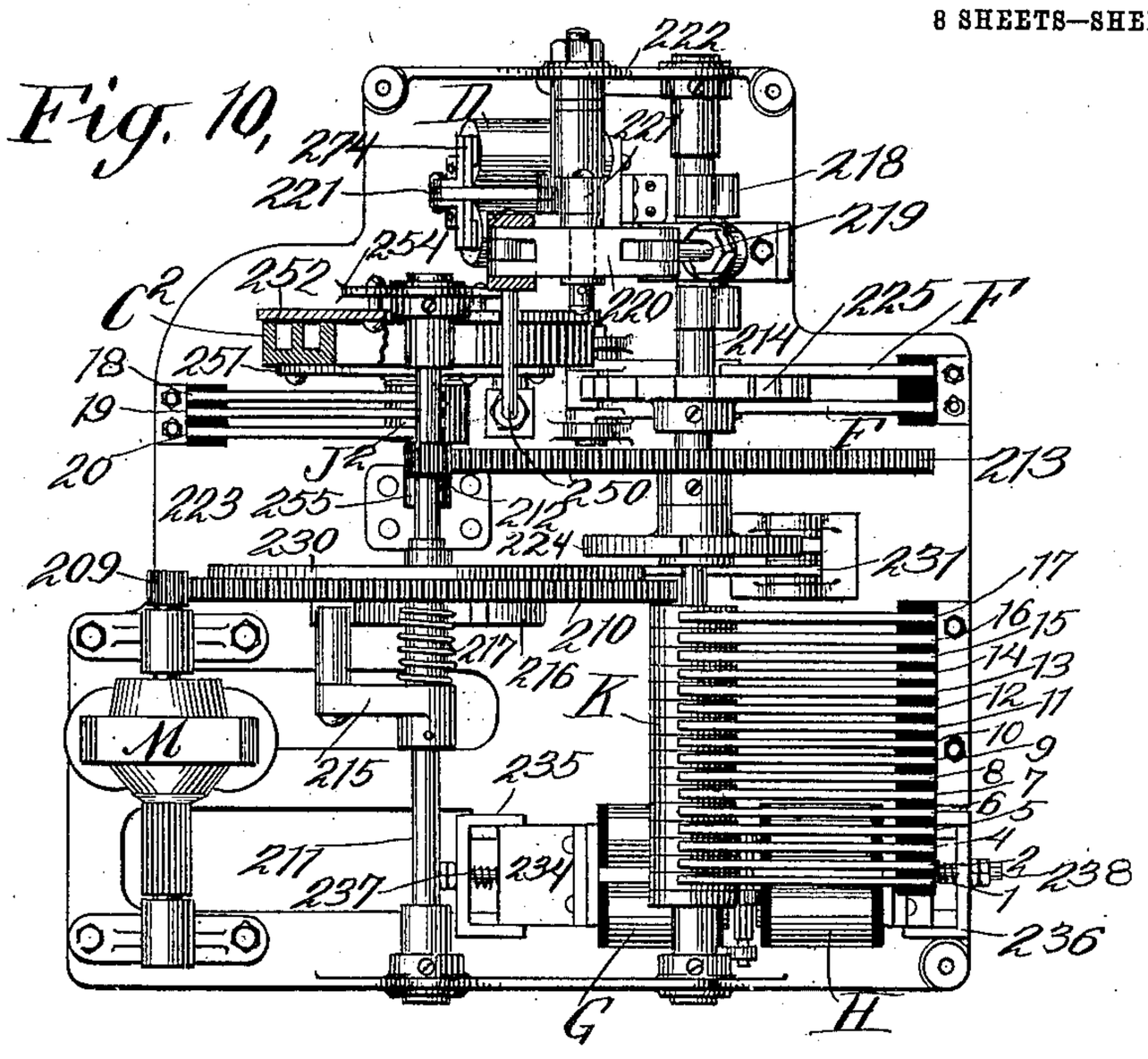


Fig. 8,

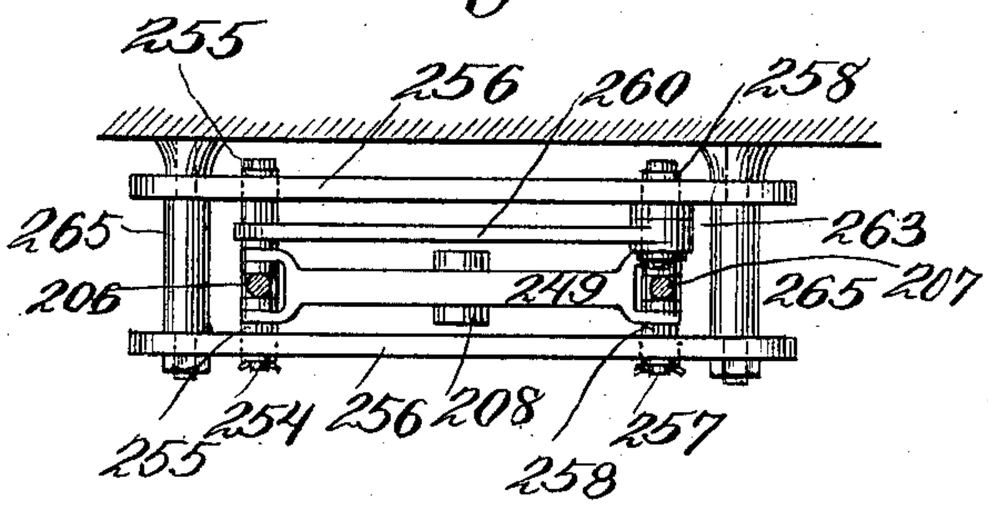
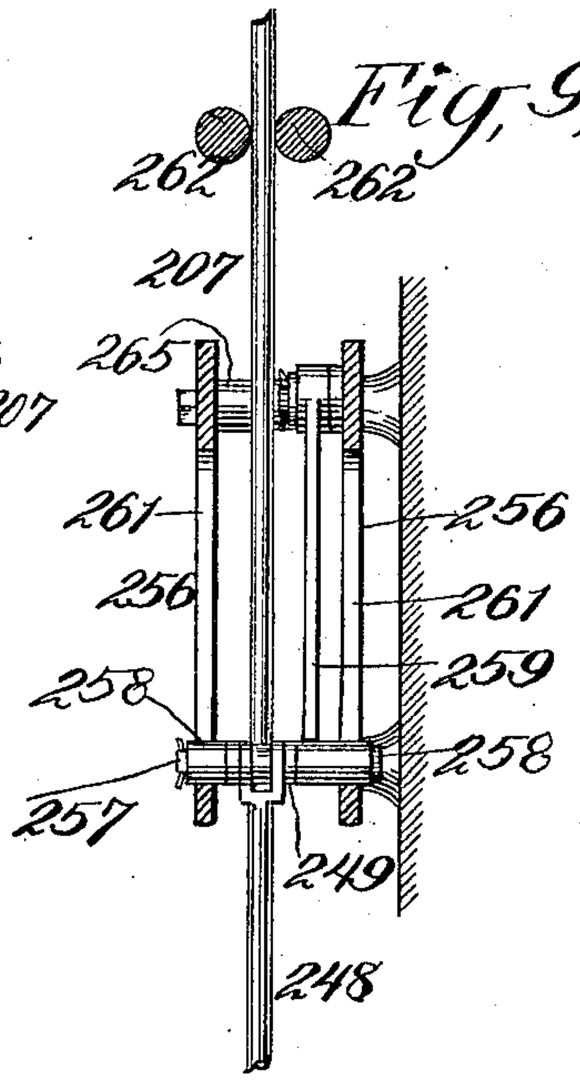


Fig. 9,



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RAILWAY SIGNALING SYSTEM.

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NO MODEL. 8 SHEETS—SHEET 6.

Fig. 11

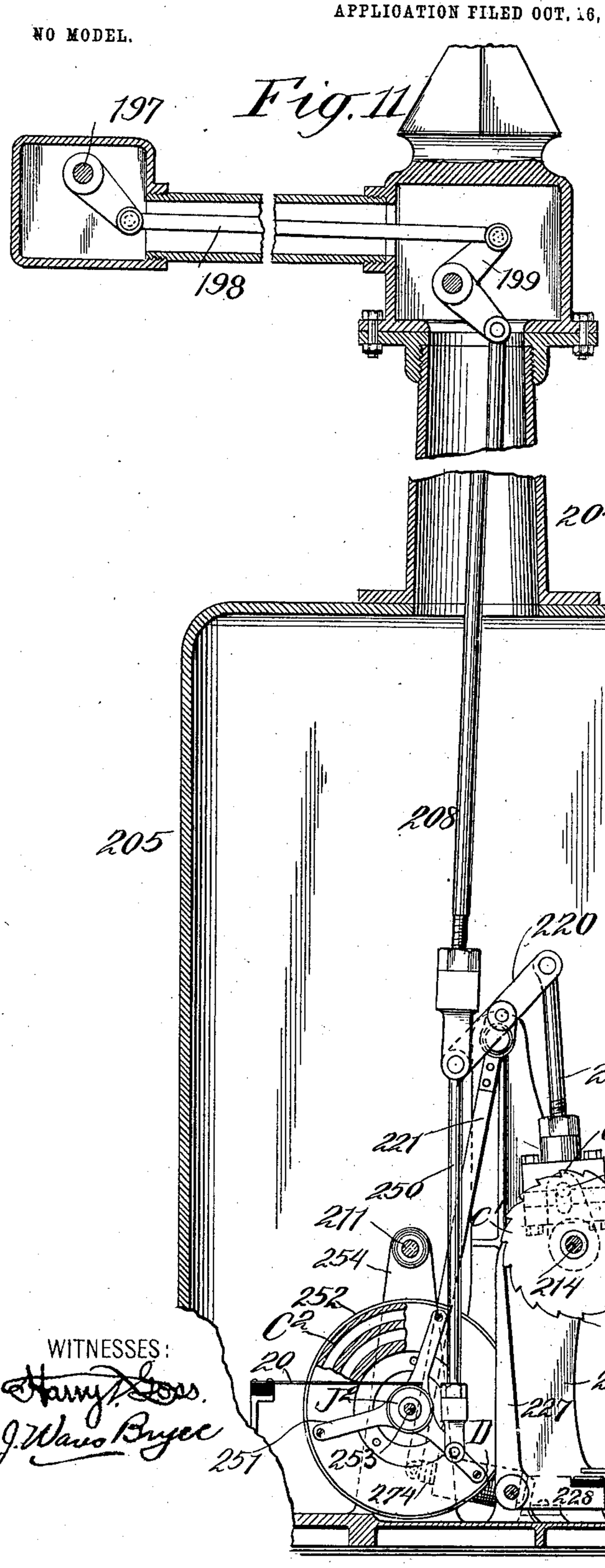
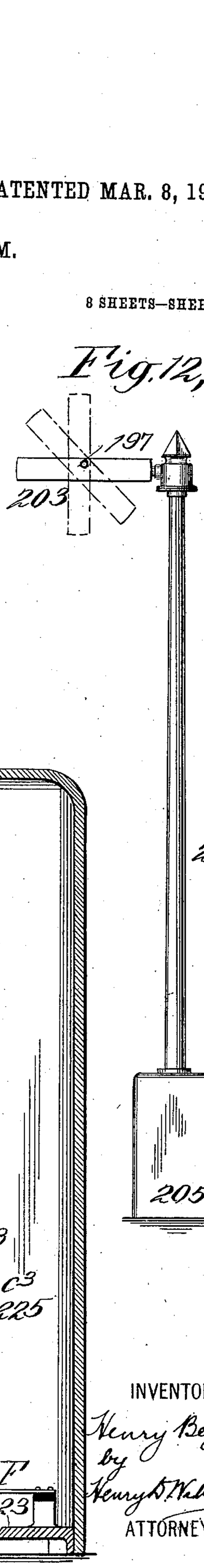


Fig. 12,



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RAILWAY SIGNALING SYSTEM.

APPLICATION FILED OCT. 16, 1901.

NO MODEL. 8 SHEETS—SHEET 7.

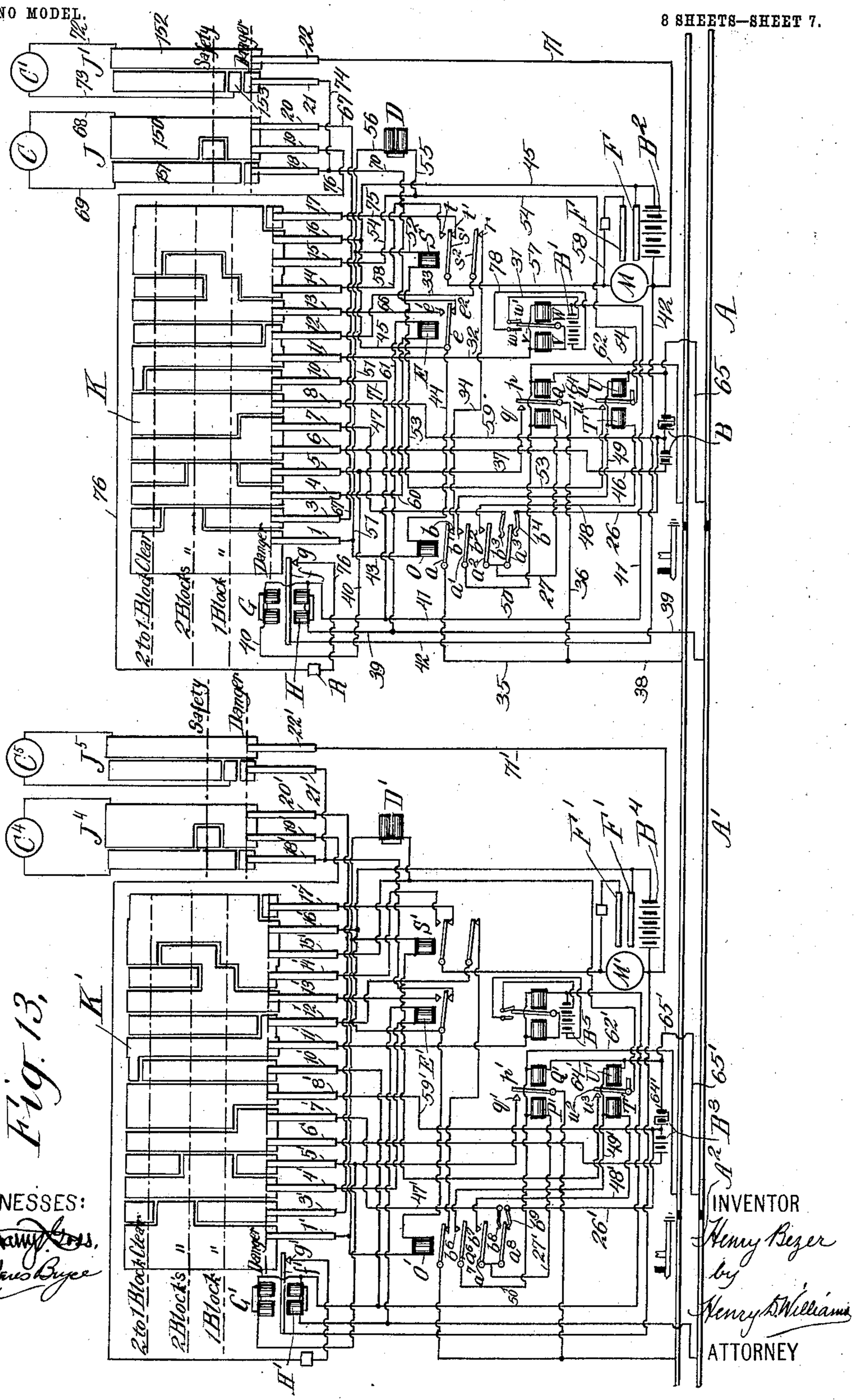

Fig. 13.

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RAILWAY SIGNALING SYSTEM.

APPLICATION FILED OCT. 16, 1901.

NO MODEL. 8 SHEETS—SHEET 8.

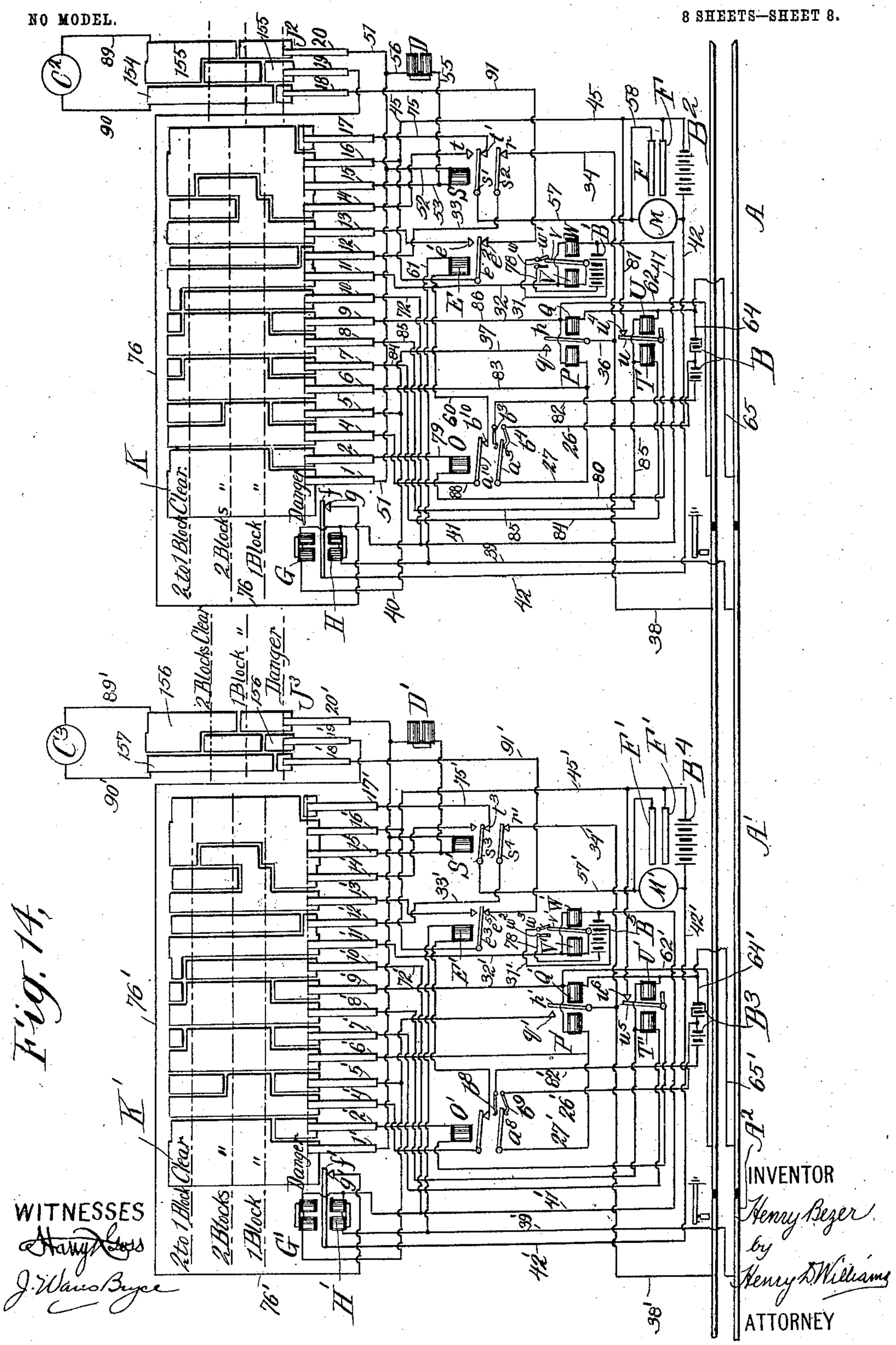

Fig. 14.

No. 754,362. Patented March 8, 1904.

UNITED STATES PATENT OFFICE.

HENRY BEZER, OF WESTFIELD, NEW JERSEY.

RAILWAY SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 754,362, dated March 8, 1904.

Application filed October 16, 1901. Serial No. 78,812. (No model.)

To all whom it may concern:

Be it known that I, HENRY BEZER, a subject of the King of Great Britain, residing at Westfield, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Railway Signaling Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to railway signaling systems, and has for its principal objects certainty of operation, reliability of operation, and simplicity of construction.

My invention consists in the provision of a slot or clutch on which is fulcrumed a part of the means connecting the actuating mechanism and the signal, and in the provision of means for forcing such clutch into engaging position, and in the provision of means for forcing the signal to "danger" should its counterweight fail to put it to "danger," such means for forcing the signal to "danger" not interfering with the free action of the counterweight to put the signal to "danger," and, further, in the provision of a pivoted clutch-lever and a part holding it at a distance from its pivot and a part of the means connecting the actuating mechanism and the signal fulcrumed on the clutch-lever in proximity to its pivot, and, further, in the provision of a pivoted clutch-lever and a part of the means connecting the actuating mechanism and the signal fulcrumed on the clutch-lever, so that the counterweight of the signal imparts a thrust to the clutch-lever at the fulcrum in a line nearly parallel to a line joining the center of the fulcrum and the pivotal center of the clutch-lever, and, further, in the provision of clutch or slot connections in which all of the parts are pivotally connected together.

My invention further consists in the provision of means for positively holding a signal at "danger," so as to prevent its movement to "safety" by the action of snow or other cause, and positively holding the signal at "safety" when moved to such position until the removal of the condition requiring it to be held at "safety" and effecting these operations independently of the actuating mechanism or gearing, and, further, in the provision of means for starting and actuating the actuating means or motor independently of the locking mechanism and discontinuing the power-supply under the control of the locking mechanism, and so that the engagement of the locking mechanism discontinues the power-supply and no reliance is had on momentum to complete the movement of the signal, and, further, in the provision of electric controlling means effecting such operations.

My invention further consists in the provision of a resilient connection between the actuating means and the signal, and, further, in the provision of a lock against forward movement of the actuating means, such lock being controlled by a loose part, and in the provision of means whereby the resilient connection controls the loose part and lock.

My invention further consists in the provision of railway signal-indicating means counterweighted to go to "danger" and constructed to give three different indications of the conditions of traffic—as "danger," "one block clear," and "two blocks clear"—and a single actuating part connected with such indicating means and effecting the giving of two of such indications by different portions of the movement of the actuating part, and, further, single clutch or slot controlling such counterweighted indicating means, and, further, the improved clutch or slot above referred to controlling such indicating means.

My invention further consists in the provision of an electromagnetic brake-clutch in place of the dash-pots and other retarding devices heretofore employed, and, further, in the provision of circuit-controlling devices whereby the power of the clutch controlling the movement toward "danger" is varied, and, further, in the provision of means whereby the movement of the signal controls the clutch through circuit devices, and, further, in the combination therewith of other circuit-controlling devices whereby the power of the clutch is varied, thus permitting the clutch to hold the signal stationary when desired as well as to retard and check its movement upon the approach to the danger position.

My invention further consists in the provision of means whereby two signals are ac-

tuated and controlled by a single actuating-rod, and, further, by a selecting connecting mechanism constructed to put the signals to "safety" successively in the movement from "danger" to "safety" and when the two signals are respectively a home signal and a distant signal constructed to first put the home signal to "safety" in such movement, and, further, to lock the distant signal at "danger" while the home signal is being put to "safety."

My invention further consists in the provision of a locking device coacting with a single actuating-rod controlling two signals, so as to lock one signal at "danger" while the other is being put to "safety" and to be unlocked by the final movement of the other signal toward safety position, and, further, in the provision of a single clutch or slot controlling the movements of both signals to "safety," and, further, in the provision of a brake-clutch or clutch controlling the movement to "danger" for each of the two signals, combined with a single clutch or slot controlling the movements of both signals to "safety."

My invention further consists in the provision of means whereby the up-and-down rods of two signals are actuated by a single actuating-rod, and, further, in guides whereby the two up-and-down rods mutually lock each other, and, further, in the combination therewith of a locking device for locking one signal at "danger" while the other is being put to "safety," and, further, embodying the other features of joint control of the two signals above referred to.

My invention further consists in various features of construction of signal mechanism and of the combination therewith of controlling-circuits therefor, as hereinafter fully described.

I will now particularly describe the circuits and apparatus illustrated in the accompanying drawings and embodying my invention and will thereinafter point out my invention in claims.

Figure 1 is a front elevation, partly in section, of signal mechanism for two signals—a home and a distant signal—the signal-box being shown in section and a lower part only of the post being shown. Fig. 1ª is an enlarged detail of the rear relay. Fig. 2 is a front elevation, partly in section and on a reduced scale, of the post, signal-box, and semaphores. Fig. 3 is an enlarged horizontal section taken on the line 3 3, Fig. 1. Figs. 4, 5, 6, and 7 are detached sectional elevations of the signal mechanism, illustrating different positions thereof. Fig. 8 is an enlarged detail plan of the guide-plates, cross-link, and adjacent parts. Fig. 9 is a vertical sectional elevation of the same. Fig. 10 is a plan view of a modified construction of signal mechanism for a single three-position signal. Fig. 11 is a front elevation of the same, partly in section. Fig. 12 is a reduced front elevation of the same. Fig. 13 is a diagrammatic view illustrating the commutators, relays, and circuit connections at the rear ends of two adjacent blocks. Fig. 14 is a similar view of a modified construction.

In the construction of signals and apparatus shown in Figs. 1 to 9, inclusive, and hereinafter particularly claimed two ordinary two-position semaphores 201 202 are employed, the semaphore 201 being the home signal and the semaphore 202 the distant signal. The signals are counterweighted to go to "danger" by spectacles, (not shown,) as well understood, and also by the weight of their up-and-down rods. In the modified construction (shown in Figs. 10 to 12, inclusive) a single three-position semaphore 203 is shown embodying the invention set forth and claimed in my Patent No. 602,792, issued April 19, 1898, this semaphore indicating "danger" by horizontal position, "one block clear" by oblique position, and "two blocks clear" by vertical position. This signal is counterweighted to go to "danger" by its own weight, its pivotal center being near the upper edge and is also thus counterweighted by the weight of its up-and-down rod. The day-signal semaphores only are shown; but these semaphores would of course be properly combined with lanterns to give the night-signals. The semaphore or semaphores are carried on posts 204, extending upward from signal-boxes 205, within which are located the signal-actuating mechanisms. In the construction employing two signals a separate up-and-down rod is provided for each signal, the rod 206 for the home signal and the rod 207 for the distant signal; but both of these rods are actuated by a single actuating-rod 208, extending upward from the signal mechanism through connecting means to be hereinafter described, while in the construction employing one three-position signal the actuating-rod 208 is also the up-and-down rod for the signal. In both constructions corresponding movements are imparted to the single actuating-rod 208 to produce corresponding indications, and the actuating-rod is similarly actuated and controlled, and both constructions provide signal-indicating means constructed to give three indications, "danger," "one block clear," and "two blocks clear."

A rotary electromotor M is shown as the driving means whereby the mechanism is actuated; but it is of course evident that any suitable form of motor could be employed for this purpose. The motor is suitably mounted on the bed-plate 223 and is connected by reducing-gears to a main or actuating shaft 214, this reducing-gear comprising a pinion 209, fixed on the motor-shaft, meshing with an intermediate gear 210, mounted loosely upon and having a resilient connection with an intermediate shaft 211, and a pinion 212, fixed on the

intermediate shaft and meshing with a gear 213, fixed on the main shaft 214. The resilient connection between the loose intermediate gear 210 and its shaft 211 is provided by an arm 215, fixed on the shaft and working between stops provided by the ends of a part ring 216, projecting from the front face of the intermediate gear and having a resilient device, shown as consisting of a spiral spring 217, secured at one end to the arm 215 and at the other end to the gear 210, so as to interpose a yielding resistance to the relative movements of the intermediate gear 210 and the arm 215 and to return these parts by its resilient action to normal relative position on the deënergization of the motor. The normal position is that shown in Fig. 1 and other views, with the rear end of the part ring against the pin, while in Fig. 5 the resilient connection is under stress and the front end of the part ring is against the pin. This resilient connection permits the motor to attain normal speed before actuating the intermediate and main shafts, and the movement resulting from this resilient connection and loose part is utilized in the control of an unlocking movement for the main shaft, as will be hereinafter described.

The main shaft 214 and the intermediate shaft 211 are suitably mounted in bearings on standards extending upward from the bed-plate 223. The main shaft 214 has secured thereon the actuating crank and pin 218, on which is pivotally connected with a slotted connection one end of the connecting-rod 219, the other end of which is pivotally connected to the cross-lever 220. The slot in the connecting-rod 219 allows a slight freedom of movement of the connecting-rod and prevents straining on the parts actuated thereby in the extreme upper and lower positions of the crank 218. The cross-lever 220, pivotally connected at one end, as aforesald, to the connecting-rod 219, is pivotally connected at its other end to the actuating-rod 208 and is medially fulcrumed upon the clutch-lever 221, being medially pivoted at the upper end of such clutch-lever 221, and the clutch-lever 221 is pivotally mounted in a standard 222, extending upward from the bed-plate 223 and also carrying the rear bearing for the main shaft 214. Thus the clutch-lever 221 has a stationary pivotal point, while the pivot or fulcrum of the cross-lever 220 is carried by the clutch-lever and movable therewith. The clutch-lever 221 has secured at its lower end the armature 274 of the holding clutch-electromagnet D. The medial pivot or fulcrum of the cross-lever 220 is in proximity to the stationary pivotal center of the clutch-lever 221, while the clutch-armature 274 is at a considerable distance from the pivotal center of the clutch-lever, thereby giving a great advantage of leverage to the pull of the clutch-electromagnet. Further, the direction of downward thrust or resistance exerted by the up-and-down rods is only slightly oblique to the center line of the clutch-lever pivot and cross-lever pivot. In consequence of this construction a comparatively small magnetic attraction of the holding-clutch magnet D will hold the clutch locked against a very great resistance to upward movement of the up-and-down rods. In the event, however, of the deënergization of the clutch-magnet D the thrust of one or both up-and-down rods will move the clutch-armature 274 away from its magnet D and the movable medial pivot or fulcrum of the cross-lever 220 downwardly independently of the main or actuating shaft 214, so as to permit the indicating means to go to "danger" by its counterweight. Further, when the actuating-shaft 214 approaches the normal position shown it forces and holds the clutch-armature 274 against its magnet D by upward pressure of the crank-pin 218.

Upon the main shaft 214 are secured two locking ratchet-wheels 224 and 225, the front ratchet-wheel 224 coacting with a lock-pawl 226 and the rear ratchet-wheel 225 coacting with a lock-pawl 227. The teeth of the rear ratchet-wheel 225 are arranged so that the coacting pawl 227 does not resist the forward movement of the main shaft, locking only against rearward movement, and this pawl is shown as held against the ratchet-wheel by a counterweighting foot-piece 228, this foot-piece having an insulated upper plate of conductive material arranged to come in contact with and electrictrically connect the flexible contacts F F as the pawl is lifted by the ratchet-teeth. This operation is utilized to effect each final opening of the motor-circuit at the flexible contacts F F instead of at the main commutator, whereby the spark of opening the motor-circuit is produced at a point not relied upon for the initial closing of the circuit, and as the rear ratchet-wheel 225 has a number of teeth—eighteen, as shown—and several of these teeth—at least four—pass under the pawl in each actuation of the signal the rubbing action resulting from the repeated movements of the pawl will keep the contact-surfaces clean.

The front ratchet-wheel 224 is shown as having only two teeth d^2 and d^4, and these teeth are arranged so that they coact with the pawl 226 to lock the main shaft against forward movement in two positions thereof, and means are provided for unlocking this pawl, such means consisting of a part ring 230, projecting from the rear face of the loose intermediate gear 210 and coacting with an actuating-arm 231, secured to the pawl 226, the cam-shaped end 229 of this part ring 230 acting on the actuating-arm 231 to move the pawl 226 out of engagement with a tooth of the front ratchet-wheel 224 during the initial movement of the intermediate shaft 211 under normal conditions or slightly earlier if the normal conditions are disturbed and the part ring

continuing to hold the pawl out of engagement until the tooth has moved clear of the pawl.

The main commutator K is secured upon the main shaft 214 and is provided with a number of plates which act in various positions of the commutator to electrically connect different brushes thereof. A number of fixed brushes is provided, (designated 1 to 17, inclusive,) not all appearing in any one construction shown. A movable brush *f* is also provided, this brush appearing in all constructions, and the movable brush *f* is carried by the armature-lever 232 of an electric translating device or compound rear relay. In the construction shown in Figs. 1 to 9, inclusive, this electric translating device comprises four pairs of opposed coils, the two pairs of opposed coils G and H constituting the home-signal rear relay and the two pairs of coils G^2 and H^2 constituting the switch rear relay, these relays being symmetrically disposed, four coils of the relay G H being in the middle and two coils of the relay G^2 H^2 at each end, thereby preventing twisting strains to the common armature from the separate actions of the relays. In the construction shown in Figs. 10 to 12, inclusive, this electric translating device is composed only of the two pairs of opposed coils G and H, constituting the home-signal rear relay. The main commutator K and commutator-brushes shown in Figs. 10 to 12, inclusive, correspond with those shown in Fig. 14.

The armature-lever 232 is shown as provided with a counterweight or tailpiece 233, which tends to move it backward away from the front coils G G^2 or G of the rear relay, and the adjustment of the backward position of the armature-lever is effected by an adjustable back-screw contact *g*, shown as threaded in a plug fixed in the base 234, which base should be of insulating material, as stone, and the screw-contact *g* is shown as provided with a spring to prevent loosening thereof. The adjustment of the extreme front position of the armature-lever is provided by adjustment of the relay and base as a whole, the base 234 being supported on ledges formed in uprights 235 236, the front upright 235 having guiding pins and springs 237 and the rear upright 236 having adjusting-screws 238, with jam-nuts thereon. The movable commutator-brush *f* is shown as a looped spring, the free leg of which comes against the surface of the commutator, and, as usual, a non-magnetic stop-pin will prevent contact of the armature with the poles of the front coils, and the adjustment will be such that the movable brush *f* will exert a slight spring-pressure against the commutator when in forward position.

For the purpose of cushioning the movements of the signals in their return to danger position under the action of their counterweights I provide electromagnetic brake-clutches. In the construction employing two signals each signal has an independent brake-clutch, the home signal 201 having the brake-clutch annular electromagnet C, carried on a spider 244, the spider being fitted to rotate on a stud 240, carried on a bracket 243, secured to the signal-box 205. The spider 244 has a connecting-rod 241, whereby it is connected to the home-signal up-and-down rod 206 at the joint of the same with the cross-link 249, which cross-link connects the two up-and-down rods. A fixed disk armature 242 is provided for this annular clutch-magnet C. This annular clutch-magnet is of the type known as "iron-clad" electromagnets and need not be particularly described. This home-signal brake-clutch C also performs the function of a holding-clutch under conditions such that the distant signal is returned to "danger" and the home signal maintained at "safety," as will appear from the description of the circuits.

The distant-signal brake-clutch electromagnet C′ and spider 245, mounted to rotate on the stud 246 of bracket 247 and having a connecting-rod 248 connected to the distant-signal up-and-down rod 207 at the joint of the same with the cross-link 249, and also the fixed disk armature 239 of this magnet are of the same construction as the parts just described of the home-signal clutch.

The three-position signal of the construction shown in Figs. 10 to 12, inclusive, has but one up-and-down rod, which is the actuating-rod 208, and a single brake-clutch, and the connecting-rod 250 of this brake-clutch is joined to the actuating up-and-down rod 208 at its joint with the cross-lever 220. The clutch-electromagnet C^2 is located lower down, near the base-plate, and is of the same annular or iron-clad construction as the other brake-clutches just described and is carried by a spider 251, secured upon a spindle 253, fitted to rotate in bearing-standards 254 and 255, and the disk armature 252 is fixed to the rear standard 254. This brake-clutch C^2 also acts as a retarding-clutch during the whole movement from two to one blocks clear, as will be hereinafter described.

Each of the brake-clutches carries a commutator insulated from and secured to the spider, the home brake-clutch C having the commutator J, with brushes 18, 19, and 20, the distant brake-clutch C′ having the commutator J′, with brushes 21 and 22, and the home and distant or three-position brake-clutch C^2 having the commutator J^2, with brushes 18, 19, and 20.

In the construction shown in Figs. 1 to 9, inclusive, employing two signals, a home and a distant signal, connecting and selecting mechanism is provided whereby the actuating-rod 208 imparts the necessary movements to the separate up-and-down rods of the two signals and whereby these movements are controlled. The cross-link 249 above referred to is pivotally connected at each end to one of the up-and-down rods and pivotally medially

connected to the actuating-rod 208. The home-signal-rod pivot-pin 254 at the left-hand end of the cross-link 249 is fitted in a yoke of the cross-link 249 and has mounted upon it the eye of the lower end of the home-signal up-and-down rod 206 and a yoke at the upper end of the home-signal brake clutch connecting-rod 241 and is shown as provided with friction-rollers 255, working against guide-surfaces in guide-plates 256, two of these guide-plates being shown, both of the same shape and bolted together and to the back of the signal-box 205 by tie-bars 265. (See Figs. 8 and 9.) The distant-signal-rod pivot-pin 257 is fitted in a yoke of the cross-link 249 and has mounted upon it the eye at the lower end of the distant-signal up-and-down rod 207 and a yoke at the upper end of the distant-signal brake-clutch connecting-rod 248 and is provided with friction-rollers 258, working in vertical grooves 261 in the guide-plates 256. A pivoted latch-lever is pivoted on a stud projecting from the rear guide-plate 256 and has a depending locking-arm 259, the lower end of which locks the distant-signal up-and-down rod 207 by contact with the friction-roller 258 on the distant-signal-rod pivot-pin 257 during the movement of the home signal to "safety." The latch-lever also has an actuating-arm 260 extending nearly at a right angle to the locking-arm, whereby the locking-arm is unlocked at the completion of the movement of the home signal to "safety." This latch-lever assures that the first movement of the actuating-rod from the normal danger position shall put the home signal to "safety" and that the distant signal may be put to "safety" after the home signal has been put to "safety." The weight of the latch-lever is sufficient to insure its return to normal position to hold the distant signal at "danger" upon the return of the actuating-rod to normal position, and in this normal position the locking-arm rests against the stop-pin 263. For the purpose of guiding the up-and-down rods and preventing displacement of the friction-rollers I provide guide-rollers 262, pivoted in lugs extending downward from the top of the signal-box, these rollers being arranged in front and in rear of the up-and-down rods and being of sufficient length to accommodate both rods. (See Figs. 1 and 9.)

I will now describe the operation of the signal mechanism in the giving of the various indications, describing first the construction employing two signals, a home and a distant signal. (Shown in Figs. 1 to 9, inclusive, and hereinafter particularly claimed.) The normal position of these signals is the horizontal position, indicating "danger," and the position of the controlling mechanism is as shown in Fig. 4. The holding-clutch electromagnet D is deënergized, but the armature 274 is against the poles of this magnet. The pawl 227 of the rear ratchet-wheel 225 on the main shaft is in engagement with the tooth c'. The pawl 226 is not in engagement with either tooth of its front ratchet-wheel 224. Both the signals are locked against being moved to "safety" by any outside influence—such, for example, as an undue collection of snow on the signal-blades—the actuating-rod 208 being locked against upward movement by the engagement of the back pawl 227 with the tooth c' of its ratchet-wheel 225, it being noted that any tendency to upward movement of the actuating-rod will tend to force down the connecting-rod 219 and tend to rotate the main shaft rearwardly and that such tendency to upward movement of the actuating-rod will not tend to move the holding-clutch armature 274 away from its magnet D, but, on the contrary, will tend slightly to press it against its magnet. The actuating-rod 208 being locked against upward movement and each of the pivot-pins 254 and 257 being at the bottom of its guides, both signals are locked against movement to "safety." The first step in the operation of the device is the closing of the circuit through the coils of the holding-clutch electromagnet D, whereby the armature 274 is magnetically held against these poles. The next step is the energization of the electromotor M. The motor starts, actuating the intermediate wheel 210 only and having to overcome only the resistance of the spring 217, and winds up this spring while attaining normal speed, and when the intermediate wheel has been rotated so that the forward end of the part ring 216 engages with the pin 215 motion will be transmitted to the intermediate shaft 211 and from this shaft to the main shaft 214, and the crank-pin 218 will actuate the connecting-rod 219 and pull down the right-hand end of the cross-arm 220, and as the clutch-magnet now holds the clutch magnetically locked the medial pivot of the cross-arm will be stationary and the left-hand end of the cross-arm 220 will be moved upward. As the distant-signal up-and-down rod 207 is now locked by the latch-lever 259 260, the movement of the actuating-rod 208 will be imparted only to the home-signal up-and-down rod 206, the cross-link 249 turning on the distant-signal-rod pivot-pin 257 as a fulcrum. The continuance of this movement will put the home signal to "safety," and as this position is nearly reached the home-signal-rod pivot-pin 254 will engage the end of the actuating-arm 260 of the latch-lever and will move the locking-arm 259 thereof clear of the distant-signal-rod pivot-pin 257, thereby unlocking the up-and-down rod 207 of the distant signal, so that the distant signal is free to be put to "safety" by further forward movement of the mechanism. The parts will now be in the position shown in Fig. 5. The main shaft is now locked against rearward movement by the back pawl 227, which has come into engagement with the tooth c^2, and

the home signal cannot force the distance signal to "safety" because of the control of the cross-link 249 by the vertical guide-grooves 261, as an upward movement of the distant-signal up-and-down rod 207 from the downward thrust of the home-signal up-and-down rod would require an approximately horizontal movement of the home-signal-rod pivot-pin 254, and this direction of movement is approximately at a right angle to the thrust of the home-signal up-and-down rod 206. Therefore the home signal is locked at "safety" so long as the holding-clutch magnet D is energized and the medial pivot of the cross-arm 220 thereby held stationary. It is to be noted, however, that should this holding-clutch be released then the downward thrust of the home-signal up-and-down rod would tend to move the left-hand end of the cross-lever 220 downwardly and to the right, and this would swing the clutch-lever 221 so as to bring the medial pivot of the cross-lever 220 to the right and downwardly and to permit the home signal to go to "danger." Further, with the home signal at "safety" and the distant signal at "danger," as in Fig. 5, should an undue collection of snow on the blade of the distant signal or other cause give to that signal a bias toward safety position, so that the distant-signal up-and-down rod 207 would tend to move upward when unlocked and to move the distant signal toward "safety," this tendency to movement will be resisted and such movement prevented by the engagement of the front pawl 226 with its tooth d^2 of the ratchet-wheel 224. It will be noted that the part ring 230 on the rear face of the intermediate wheel 210 is now clear of the arm 231 of the front pawl, so that the front pawl is now against its ratchet-wheel 224 and interposed in the path of the tooth d^2. If the conditions of traffic will not allow the distant signal to go to "safety," the motor will be deënergized by the movement of the front pawl 227 in dropping behind the tooth c^2, as hereinafter explained in the description of the circuits, and the spring 217 will reverse the movement of the intermediate wheel 210 and motor and will bring the pin 215 into contact with the rear end of the part ring 216. For the purpose of returning the intermediate wheel to normal position at the completion of each movement of the signal the gearing joining the intermediate shaft 211 and the main shaft 214 is so proportioned that each movement of the signal shall represent a number of complete revolutions of the intermediate shaft. In the construction shown each tooth of the back ratchet-wheel 225 represents one revolution of the intermediate shaft, and as the back ratchet has now been advanced five teeth, the tooth c^2 now being engaged by the back pawl, the intermediate shaft has made exactly five revolutions, and under usual conditions the intermediate wheel 210 will now be returned to a position exactly the same as the normal position shown in Fig. 4.

It will be noted that the reverse movement of the intermediate wheel 210 will not disturb the front pawl 226, the gap in the part ring 230 being sufficient to accommodate this movement. It will also be noted that this reverse movement retires the cam end 229 of the part ring, so that it is at a considerable distance from the actuating-arm 231. It will also be noted that a slight clearance is allowed between the front pawl 226 and its tooth d^2. Should weight of snow or other cause produce the slight forward rotation of the main shaft necessary to cause this clearance to be taken up and the tooth d^2 to press against the front pawl, the intermediate wheel will come to rest slightly in advance of the normal position shown, but the reverse movement thereof caused by the spring 217 retired the cam end 229 so far to the rear that there is no possibility that such movement will unlock the front pawl 226, and the front pawl cannot be unlocked until the motor is again actuated and the intermediate wheel thereby advanced, and when the motor is actuated and advances the intermediate wheel the cam end 229 will unlock the front pawl, and if the intermediate shaft 211 is in the exact normal position the unlocking movement will occur during the initial actuation of the main shaft while the tooth d^2 is moving forward through its clearance, or if the main shaft and intermediate shaft have been advanced by snow on the blade to take up this clearance then the unlocking movement will occur earlier in the movement of the intermediate wheel and before the initial actuation of the main shaft. Under all conditions, therefore, straining upon the front pawl 226 is prevented and unlocking by the signal itself is also prevented.

If the conditions of traffic permit the distant signal, as well as the home signal, to be put to the safety position, the actuation of the motor will continue after the home signal has been put to "safety" and the distant-signal-rod pivot-pin 257 has been unlocked. It will be noted that under these conditions the front pawl 226, which has fallen in prepared to engage the tooth d^2, will be moved away from the ratchet-wheel before the tooth d^2 takes up its clearance, and the continued actuation of the motor will move the connecting-rod 219 downward and the actuating-rod 208 upward, the medial pivot of the cross-lever 220 remaining fixed by reason of the continued energization of the coils of the holding-clutch magnet D. The cross-link 249 now moves upon the home-signal-rod pivot-pin 254 as a horizontal-moving fulcrum, the distant-signal-rod pivot-pin 257 moving vertically up in its grooves 261 and moving the distant signal to safety position. The latch-lever 259 260 is merely pushed farther out of the way by this upward movement. At the completion of the move-

ment of the distant signal to "safety" the back pawl 227 will engage with the tooth c^3, and this movement will deënergize the motor, and then the intermediate wheel and motor will be reversed and the intermediate wheel returned to normal position, the main shaft having rotated so that the rear ratchet-wheel 224 has advanced four teeth, and the parts will assume the position shown in Fig. 6, with both signals at "safety." Both signals are now held at "safety" so long as the energization of the holding-clutch D is continued, the back pawl 227 preventing rearward movement of the main shaft, so that the actuating-rod 208 cannot be moved downwardly, and each signal-rod pivot-pin locking the other signal-rod pivot-pin, because both these pins are at the tops of their grooves or guides.

I have provided for returning the distant signal to "danger" and leaving the home signal at "safety" should the second block in advance become occupied by a train after the distant signal had been put to "safety." Under such conditions the holding-clutch D will be deënergized and simultaneously the home-signal clutch C energized more powerfully than for a brake-clutch, so as to become a holding-clutch and to hold the home signal at "safety." The distant signal will, however, be free to go to "danger," its movement being checked as it approaches the danger position by its brake-clutch C'. The motor will also be energized and will by forward rotation of the main shaft force the distant signal to "danger" should its counterweight fail to put it to "danger," and the actuation of the motor will be continued until the rear ratchet-wheel has advanced five teeth, and then the engagement of the back pawl 227 with the tooth c^4 will deënergize the motor, the intermediate wheel will be reversed and restored to normal position, and the parts will be in normal position, (shown in Fig. 7,) with the distant signal at "danger" and the home signal at "safety." The forward rotation of the main shaft 214 will have produced an upward thrust on the connecting-rod 219, which will tend to move the clutch-lever 221 and its armature against the holding-clutch magnet D, assuring that at the conclusion of this movement the clutch-armature will be against the magnet. The holding-clutch D is now energized and the home-signal clutch C deënergized, and the holding-clutch D will now hold stationary the medial pivot or fulcrum of the cross-lever 220, and the front pawl 226 will now be interposed in the path of the tooth d^4, so that the downward pressure of the home-signal up-and-down rod is resisted by the engagement of this tooth and pawl. Should an undue collection of snow on the distant-signal blade or other cause tend to force upward the up-and-down rod 207 thereof, this tendency to movement will be resisted by the engagement of the back pawl 227 with its tooth c^4. The signals are therefore locked against movement so long as the holding-clutch D is energized. The signals will be free to return to "danger" under the action of their counterweights from the several positions of safety indication above described upon the deënergization of the holding-clutch D. When this holding-clutch is deënergized, the magnetic lock upon its armature is released, and the clutch-lever 221 is free to swing on its pivot, so as to carry the clutch-armature 274 to the left and upward and the medial pivot of the cross-lever 220 to the right and downward. All of the movements to "safety" were dependent upon the energization of the holding-clutch D, and the deënergization of this clutch at any time will permit the signals to go to "danger" under the action of their counterweights, and their movement will be retarded as they approach "danger" by their respective brake-clutches. Further, should the contacts for deënergizing the motor fail to operate and the motor continue to revolve the signals will nevertheless be free to go to "danger" as soon as the holding-clutch D is deënergized, and the continued rotation of the motor will merely swing the clutch-lever 221 on its pivot, forcing it to normal position at the completion of each revolution of the main shaft 214 by the upward movement of the crank-pin 218. Further, should the distant signal fail to go to "danger" the home signal is free to go to "danger," the guide-slot for the home-signal-rod pivot-pin 254 being a large rectangular slot which will permit this pin to move freely to "danger" from any position of the cross-link 249, and with the home signal at "danger" an engineer would disregard the safety indication of the distant signal. I provide, however, that simultaneously with the deënergization of the holding-clutch D the motor will be energized and will cause a forward rotation of the main shaft to the normal position, (shown in Fig. 4,) and this movement will force the signals to "danger" should the counterweight fail to act, and the final upward movement of the crank-pin 218 will force the clutch-lever 221 to normal position should the action of the counterweight have swung the clutch-lever away from normal position. In the return to normal danger position of the home signal only where the home signal only has been put to "safety," as shown in Fig. 5, the release of the clutch-lever permits it to swing freely, so that the forward rotation of the main shaft will not cause any upward movement of the distant-signal up-and-down rod 208, and consequently the distant signal will not be put to "safety" and then returned to "danger" during this movement. Should the distant signal refuse to return to "danger" by its counterweight or the motor be unable to force it to "danger," it will be impossible to restore the main shaft to normal position, because the actuating-rod 208 cannot move downward and the connect-

ing-rod 219 upward beyond the position which they would assume with the home signal at "danger" and the distant signal at "safety," such position corresponding to that shown in Fig. 7 as to the cross-lever 220, connecting-rod 219, and main shaft 214, but with the distant-signal-rod pivot-pin 257 in upper position and the home-signal-rod pivot-pin 254 in lower position, which would be their positions with the distant signal at "safety" and the home signal at "danger." Therefore it will be impossible to restore the signal-actuating mechanism to normal position, and therefore impossible to put the home signal again to "safety," so long as the distant signal refuses to go to "danger." It will be noted that the engineer, seeing the home signal at "danger," would disregard the safety indication of the distant signal. Thus the impossibility of putting the home signal to "safety" under these conditions nullifies the error of the refusal of the distant signal to go to "danger."

In the construction shown in Figs. 10 to 12, inclusive, in which a single three-position signal 203 is employed, the actuating-rod 208, which in this construction is also the up-and-down rod of the signal, is shown as connected to the signal-spindle 197 by a bell-crank 199 and connecting-rod 198. The actuating-rod 208 is actuated in the same manner to put the signal to the oblique or one-block-clear or home safety position and to the vertical or two-blocks-clear or distant safety position, as heretofore described relative to the two-signal construction. In the movement from two to one block clear, equivalent to putting the distant signal to "danger" and leaving the home signal at "clear," the holding-clutch magnet D is deënergized, as in the corresponding movement in the two-signal construction, but simultaneously the single brake-clutch C^2 is energized, so as to retard the movement of the signal, and the motor is energized, and the clutch remains energized during the entire movement, thereby compelling the motor to move the signal against the resistance of the brake-clutch C^2 and causing the crank-pin 218 of the actuating-shaft to exert an upward pressure against a resistance to downward movement of the actuating-rod throughout the entire movement, which resistance will hold the holding-clutch armature 224 against its magnet D, so that at the conclusion of the movement when the holding-clutch magnet is again energized the signal will be held thereby in the one-block-clear position. The proper operation of the signal in this movement will be initially under the action of its counterweight retarted by the brake-clutch, and the movement will be continued and completed by the forcing action of the motor; but should the motor fail to act the counterweight of the signal can nevertheless move the signal to the danger position, retarded in the movement from two to one block clear by the brake-clutch, while should the counterweight fail to act the signal will be forced by the motor from the two-blocks-clear position to the one-block-clear position. The movement of the actuating-shaft is exactly the same for all of these operations as in the two-signal construction, and the locks effected by the back pawl 227 and the front pawl 226 against the counterweight and against movement from external causes, as snow at one side of the blade opposing the counterweight, and also the forced movements of the signal by the motor in the event of failure of the counterweight and freedom of the counterweight to put the signal to "danger" independently of the motor and to hold it at "danger" notwithstanding continued revolution of the main or actuating shaft caused by failure to deënergize the motor, are the same as already described relative to the two-signal construction.

It will be noted that in the constructions above described embodying my invention the several parts connecting the actuating-rod 208 and the main or actuating shaft 214 are all pivotally connected together. The effects of wear will not therefore impair the power of the holding-clutch to hold or release, only affecting the amount of movement imparted to the signal. No delicate adjustment is therefore required, and the wear of parts may be carried to an extreme condition without substantially impairing the efficiency of the mechanism, since a slight variation in the position of the signal is unimportant. It will also be observed that there is no dependence upon the friction of the gearing to hold or lock the signal or signals in any position, and no dependence whatever upon the gearing to hold or lock the signal or signals in any position, the back pawl and front pawl effecting such holding or locking of the signal or signals in a positive manner not only against the counterweight, but also against external causes, as snow on the signal-blade, tending to put the signal or signals to "safety." Further, the locking effected by the front pawl is dependent upon the deënergization of the motor, the continued movement of the motor positively moving this pawl out of locking position or unlocking this pawl without straining of the parts. It will also be noted that the action of the holding-clutch is independent of both of the locking-pawls, and the deënergization of this clutch will permit the signal or signals to be put to "danger" by its or their counterweight or counterweights. The locking-pawls do not, therefore, interfere with the putting of the signals to "danger" so long as either the motor alone operates or the counterweights alone operate. The effects of failure of the counterweight would be overcome by the operation of the motor or the effects of the failure of the motor would be overcome by the operation of the counterweights.

In Figs. 13 and 14 of the drawings I have

illustrated controlling-circuits for the signal mechanism above described, and while my present invention includes certain combinations of such circuits with the signal mechanism above described I do not otherwise herein claim the circuits shown and hereinafter described, such circuits being claimed in a separate application for Letters Patent filed as a division hereof on February 4, 1903, Serial No. 141,858. In these diagrammatic illustrations of the circuits the rails of the track are represented in plan, and in each view the rails of one block A′ and at the advance end of the block A in rear thereof and at the rear end of the block A^2 in advance thereof are represented. For convenience in description I shall refer to the rail which is the upper rail in these plan views as the "upper" rail and the rail which is the lower one in these views as the "lower" rail. In these diagrammatic drawings the several commutators are shown in development, the outlines of the several conductive plates and the separating spaces being shown. It will of course be understood that these conductive plates are secured upon sleeves of insulating material, so as to be electrically insulated from each other.

In addition to the rear or track relays (shown in Figs. 1 to 12, inclusive) I provide other relays, as two front relays, P Q and T U, each having opposed coils and an armature between the opposed coils and which are hereinafter collectively referred to as a "front" translating device, and also compound relays V W, having opposed coils and an armature between the opposed coils and distant-signal rear relays E and switch-controlling relays I and other controlling-relays O and S. The several relays are in many constructions provided with a plurality of movable fingers insulated from each other and all actuated by the armatures of the relays, and these fingers are conventionally represented in proximity to their controlling-coils, but sufficiently separated for clear illustration. The movable commutator-brush *f* is also represented diagrammatically as contacting with the edge of its commutator-plate, this slight distortion being necessary for clear illustration of the circuit connections.

I will now describe the circuits and apparatus illustrated in Fig. 13, such circuits being constructed and arranged for controlling the signal mechanism shown in Figs. 1 to 9, inclusive, except that the switch rear relay G^2 H^2 is omitted, and the circuits therefor are also omitted. For the block A (shown as the first block to the right) one of the front relays has opposed electromagnets P Q and the other has opposed electromagnets T U, the relay having the opposed electromagnets P Q being operated by the presence of a train in the block in rear of the block A and both these front relays being operated by the presence of a train in the block A. I therefore designate the relay having the opposed electromagnets P Q as the "home" and "rear" blocks front relay, and the relay having the opposed electromagnets T U as the "home-block front" relay. For the block A′ in advance of the block A a corresponding home and rear blocks front relay P′ Q′ and a corresponding home-block front relay T′ U′ are provided, and I will first describe the normal track-circuits of the block A′, as this description will equally apply to the track-circuits of all other blocks except the front end block of a system, wherein no front relays would be required. The coils of the opposed electromagnets P′ Q′ of the home and rear blocks front relay are in a normally closed circuit from a part of the track-battery B^3, this track-battery being shown as having two of its cells connected in multiple with the coils of such relay, so that the current flows from the two cells in multiple of the battery B^3 through wire 26′, flexible contact b^9, armature-finger a^8, wire 27′, through coils P′ and from coils P′ in two paths, one through the coils Q′ and wire 64′ back to battery and the other through the wire 62′ to the upper rail and from rail to rail through the grounded conductors of variable resistance formed by the ties and from the lower rail by wires 65′ 64′ back to battery. It will be noted, however, that the rails of the block are bridged at the rear end of the block by metallic conductors extending from a battery B′, located at the rear end of the block and which will be termed the "opposing" battery, through which the current may be assumed to flow as follows: from one cell of the opposing battery B′, by wire 31, contacts w' v, front coils V of a compound relay V W^2 and from the coils V in two paths, one through the back coils W and back to battery and the other by wire 32, brushes 11 12, wire 33, contacts s^2 r, wire 34, contacts b a, wires 35 38 to upper rail and from lower rail by wire 39, coils H, wire 41 back to battery. As the path for the track-battery B^3 through these conductors is in opposition to the polarity of the opposing battery B′, the flow of current from battery B′ will normally be substantially through the grounded conductors of variable resistance formed by the ties, and the flow of current from the track-battery B^3 will also normally be substantially through such grounded conductors. The coils Q′ are of high resistance and the coils P′ of low resistance, and the current normally flowing through these circuits will retain the armature-lever p' in rearward position. The armature will be attracted toward the front coils P′ by the presence of a train in the block A, which will cause the coils of the home-signal rear relay G H and of the distant-signal rear relay E to be connected in multiple and with the rails at the rear end of the block A′. The coils of the home-block front relay T′ U′ are normally deënergized, and the armature-lever u^2 of this relay is normally held by gravity

in rearward position, a foot-piece being shown as provided for such purpose, and the home-block front relay is energized by the actuation of the corresponding home and rear blocks front relay P′ Q′ resulting from the approach of a train.

I will now describe the operation, assuming first that a train has entered the block in rear of the block A. The entrance of a train in this block will cause the coils of a home-signal rear relay at the rear end of the block A (not shown) corresponding to the home-signal rear relay G H and the coils of a distant-signal rear relay (not shown) at the rear end of the block A corresponding to the distant-signal rear relay E to be connected in multiple and with the rails at the rear end of the block A, as will appear from a description hereinafter given of a similar operation of the corresponding circuits at the rear end of the block A′. This operation will cause the armature-lever *p* of the home and rear blocks front relay P Q to close upon the contact *q* and will close the normally open circuit of the home-block front relay T U, but will not cause the armature-lever *u* of the home-block front relay to close upon its front contact *u′*. The circuits whereby this operation is effected will now be described. The circuit wherein the coils of the home-signal rear relay and the distant-signal rear relay at the rear end of the block A are connected to the rails at the rear end of the block A in multiple is as follows: from two cells in multiple of the battery B, by wire 26, contacts b^4 a^3, wire 27, front coils P, and from the front coils P through the back coils Q back to battery, and also from the front coils P, by wire 62, to the upper rail of the block A and through the ties and ground to some extent to the lower rail and by wire 65 back to battery and from the upper rail through contacts at the rear end of the block A corresponding to the contacts *p q* and through the coils of the rear relays at the rear end of the block A corresponding to the home-signal rear relay G H and the distant-signal rear relay E in multiple. The opposing battery at the rear end of the block A corresponding to the opposing battery B′ will not be in this circuit. The joint resistance of this circuit will be such that the attraction of the front coils P will preponderate over that of the back coils Q. The armature-lever P will be caused to close on its front contact *q*. The closing of the contacts *p q* of the home and rear blocks front relay closes a circuit from a part (shown as one cell) of the opposing battery B′ and through the front coils G of the home-signal rear relay of block *a′*, and thereby causes the movable brush *f* to come in contact with the commutator K. This circuit is as follows: from one cell of the opposing battery B′, by wire 31, flexible contact *w′*, armature-lever *v*, and front coils V of the compound relay V W, wire 32, brushes 11 and 12, wire 33, contacts s^2 *r*, wire 34, contacts *b a*, wires 35 36, contacts *p q*, wires 37 40, front coils G, and wire 41 back to battery. It will be observed that the circuit just described has a path branching from the junction of the wires 35 and 36, by the wire 38, to the upper rail, through the upper rail to the front end of the block, through the wire 62′, coils P′, wire 27′, contacts a^8 b^9, wire 26′, two cells in multiple of the track-battery B^3 at the front end of the block A′ in opposition to the polarity thereof and by wires 64′ 65′ to the lower rail and through the ground to some extent from the upper rail to the lower rail and also through the coils Q′ and wires 64′ 65′ to the lower rail, all of these connections being in multiple, and from the lower rail, by wire 39 and back coils H to the wire 41, wherein it meets the other path above described and proceeds back to battery. If the block A′ were clear of trains, the joint resistance of these last-described circuits would be such that a more powerful current would flow through the front coils G than through the back coils H and the movable brush *f* would be moved into contact with the commutator K. If, however, a train were in the block A′, the circuit last described through the back coils H would have its resistance greatly diminished by the train, which would connect the rails of the track A′ by its wheels and axles, forming a path of low resistance from the upper rail to the lower rail and cutting out the joint resistance of the multiples through the coils P′ and Q′ and of the battery B^3, the current for the back coils H then flowing as follows: from one cell of the opposing battery B′, through wires 31, contacts *w′ v*, coils V, wire 32, brushes 11 12, wire 33, contacts s^2 *r*, wire 34, contacts *b a*, wires 35 38, upper rail, wheels and axles of train, lower rail, wire 39, back coils H and wire 41 back to battery. This circuit, in multiple with that through the front coils G above described, will hold back the movable brush *f* and prevent its contact with the commutator. The presence of a train in the block A′ will also shunt the current of the track-battery B^3 and prevent this track-battery from actuating the rear relay. If there is no train in the block A′, and therefore the movable brush *f* is brought into contact with the commutator K, the movable brush will close a circuit from the main battery B^2 through wire 42, movable brush *f* and fixed brush 1, wire 43, coils of relay O, and wires 44 45 back to battery. The circuit thus closed actuates the armature of relay O and opens at the contacts *a b* the circuit above described, whereby the opposing battery B′ placed the movable brush *f* in contact with the commutator; but the movable brush will be maintained against the commutator by current flowing from the two cells in multiple of the track-battery B^3 at the front end of the block A′, by wire 26′, contacts b^9 a^8, wire 27′, coils P′, wire 62′, upper rail, wires 38 36, con-

tacts p q, wires 37 40, front coils G and back coils H in series, wire 39, lower rail, wires 65′ 64′ back to battery. The maintenance of the movable brush f against the commutator by the current from the advance track-battery B^3 puts the signal-controlling means of the home-signal at the rear end of the block A′ in the safety condition. The energization of the coils of relay O will also effect the closing of contacts a^3 b^3 and a^2 b^2 and a' b', and the home-block front-relay coils T U will be connected in multiple with the home and rear blocks front-relay coils P Q through the following circuit, including the whole of the track-battery B: from track-battery B, by wire 46, brushes 6 7, wire 47, contacts b^3 a^3 and a^2 b^2, wire 48, coils T and U in series, and wires 64 back to battery, and from coils T, by wire 49, contacts b' a', wires 50 62, to upper rail and through the joint resistance of relays at the rear end of block A corresponding with the home-signal rear relay G H and the distant-signal rear relay E, through circuits hereinafter described, and to the lower rail, and by wires 65 64 back to battery. The coils of the home and rear blocks front relay P Q are now in multiple with the coils T U in a circuit having the full power of the battery B, such circuit branching from that just described between the contacts a^3 b^3 through wire 27 and coils P and Q to wire 64 and through coils P only to wire 62. Although the coils of the home-block front relay T U are now in multiple with the coils of the home and rear blocks front relay P Q the armature of the home-block front relay is not attracted, because of the resistance in the circuit, and will not be attracted until the train enters the block A. This operation of the relay O, resulting in the connection of both front relays with full battery power, has put the full battery power of the track-battery B onto the track-circuit through the rails of block A, this full battery power being necessary to clear the distant signal at the rear end of the block A. From the above description it will be evident that this could not have been done if there were a train in the block A′, and therefore that the conditions in the block A′ must be such as to permit the home signal at the rear end of that block to go to "safety" to indicate one block clear in order that the distant signal at the rear end of the block A may go to "safety," and thereby indicate two blocks clear, and this control is exerted through the controlling means whereby the home signal at the rear end of the block A′ would be put to "safety," so that the home signal at the rear end of block A′ must be in condition to go to "safety" before the distant signal at the rear end of block A can go to "safety" and indicate that the block A′ is clear of trains. When the train enters the block A, it will close a shunt across the rails, which will cut out the joint resistance of coils at the rear end of the block A corresponding with the home-signal rear-relay coils G H and the distant-signal rear relay E, and this short circuit of low resistance across the rails will cause the attraction of the front coils T of the home-block front relay to preponderate, and the armature-lever u of this relay will be moved against the contact u', the armature-lever p of the other front relay still remaining against the contact q. The closing of the contacts u u' will close an actuating-circuit for the signal at the rear end of the block A′ through the coils of relay S. The movable brush f is already against the commutator, as before described, there being no train in the block A′ to shunt the advance track-battery B^3. The circuits now to be described are dependent upon the maintenance of the movable brush f against the commutator and would be opened should a train back into or otherwise enter the block A′. The holding-clutch circuit is as follows: from home battery B^2 by wire 42, movable brush f, fixed brush 1, wires 51 56, clutch-coils D, wires 55 54, brushes 15 16, and wire 45 back to battery. The home-signal circuit closed at the contacts u u' is as follows: from main battery B^2 by wire 42, movable brush f, fixed brush 1, wires 51 52, coils S, wire 53, contacts u' u, wire 54, brushes 15 16, and wire 45 back to battery. The energization of the coils S closes a motor-actuating circuit for putting the home signal to "safety" by closing the contacts s' t. The motor-actuating circuit is as follows: from main battery B^2 directly to the motor M, wire 57, contacts s' t, wire 58, brushes 14 16, and wire 45 back to battery. The motor and holding-clutch will now be energized and the home signal will be moved to the safety position, the commutator advancing so that the brushes rest upon the dotted line marked "1 block clear." As the commutator K approaches this position and before the break in the commutator-plate of the brush 14 passes thereunder the pawl 227 is lifted by the tooth c^2 of the ratchet-wheel 225, and thereby the foot-piece 228 of the pawl will come in contact with the brushes F F and complete the following motor-circuit: from battery B^2 through the motor M, wire 58, brushes F F, and wire 45 back to battery. This construction obviates any dependence upon momentum to carry the break in the commutator-plate past the brush 14 and the motor-circuit is continued until the tooth c^2 passes clear of the pawl 227 and the pawl drops behind the tooth. This movement of the pawl opens the motor-circuit just described which was closed by the pawl, and the motor-circuit through the brush 14 is already open at the break in the commutator-plate, and should there be a train in the block A^2, so that the distant signal will not be put to safety position, the actuation of the signal mechanism will terminate at this point. It will be observed that the opening of the motor-circuit occurs at the brushes F F and any sparking in-

cident thereto occurs at these brushes, and as these brushes are not required to again close a circuit until they have been subjected to a rubbing action resulting from the actuation of the pawl by several teeth of the ratchet-wheel any fouling from the effects of sparking will be removed. The commutator-brushes are now upon the line marked "1 block clear." In consequence of this movement the circuit above described which was closed through the brushes 6 7, whereby the two front relays were connected in multiple with the full power of the track-battery B, is now opened between the brushes 6 and 7; but a circuit through these two front relays from the two cells in multiple of the track-battery B is closed through the brushes 8 7, as follows: from the two cells in multiple of the battery B through wire 59, brushes 8 7, wire 47, and contacts b^3 a^3 and through the two front relays in multiple, as before described. The brush 7 bridges the break, so that the maintenance of a circuit through the front relays is continuous, thereby continuing in closed condition the circuits maintained through and by the contacts p q and u u', and therefore continuing the energization of the holding-clutch coils D, and thereby holding the home signal at "safety." Thus the entrance of the train upon the block A effects a change from the connection of the full battery-power of the track-battery B to the connection of the two cells in multiple thereof to the rails, thereby preventing the short-circuiting of the full power of the battery, as the shunt-circuit closed by the wheels and axles of the train will have the full battery-power removed therefrom while the train is in proximity to the rear end of the block. With the commutator in this position, the brushes being at the line marked "1 block clear," a circuit will be closed, whereby the coils of the distant-signal rear relay E and the coils of the home-signal rear relay G H will be connected in multiple and to the rails of the block A', this circuit being as follows: from two cells in multiple of the battery B^3 by wire 26', contact b^9 a^8, wire 27', front coils P', and wire 62' to upper rail and from upper rail by wires 38 36, contacts p q, and wire 37 and branching from the wire 37 in one path through brush 5 and in the other path through the wire 40, the circuit through the path first mentioned proceeding from brush 5 to brush 4 and by wire 60 to coils of relay E and by wire 61 to wire 39 and the circuit through the other path being from wire 40 through the coils of rear relay G H in series to wire 39 and these branches uniting at wire 39 and proceeding therethrough to the lower rail of the block A' and from this lower rail through wire 65' back to battery. The above description omits the multiples heretofore described through the back coils Q' and from rail to rail through ground and ties. With these two rear relays thus connected in multiple the joint resistance of this circuit is such that the front coils P' of the home and rear blocks front relay P' Q' attract the armature p', and thereby a circuit such as above described is closed, providing there is no train in the block A^2, which will put the movable commutator-brush f' against its commutator K', and thereby close a circuit of the coils O' corresponding to that already described for the coils O, and thereby connect both front relays of the block A' in multiple with the full power of the battery B^3, and this full battery-power will be applied to the rails of block A' and will flow through the coils of the home-signal rear relay G H and of the distant-signal rear relay E, and the relay E will then be energized sufficiently to attract its armature, thereby closing the contacts e e'. The closing of the contacts e e' will complete the following circuit for the motor: from main battery B^2, through motor M, wire 57, contacts s' t, wire 58, brushes 14 13, wire 66, contacts e' e, wire 45 back to battery. The circuit for the holding-clutch D still remains closed, as it is maintained through the movable brush f and fixed brush 1, as before described, and the signal is therefore moved toward the two-blocks-clear position. As the longitudinal break in the commutator-plate of the brush 15 passes under the brush 15 circuits are set up for the relay-coils S and the clutch-coils D through the brushes 15 and 13, replacing those which flowed through the brushes 15 and 16, the brush 15 bridging the break in the commutator-plate, so that the flow of current to the relay-coils S and to the clutch-coils D is continuous. These circuits are as follows: for the relay-coils S from main battery B^2 by wire 42, movable brush f, fixed brush 1, wires 51 52, coils S, wire 53, contacts u' u, wire 54, brushes 15 13, wire 66, contacts e' e, wire 45 back to battery and for the clutch-coils D from battery B^2 through wire 42, brushes f and 1, wires 51 56, clutch-coils D, wires 55 54, brushes 15 13, wire 63, contacts e' e, wire 45 back to battery. As the signal approaches the position of two blocks clear the break in the commutator-plate of brush 14 passes under this brush; but before this break passes under the brush the pawl 227 is lifted by the tooth c^3 of the ratchet-wheel 225, and thereby the foot-piece 228 of the pawl will come in contact within the brushes F F and complete a motor-circuit, as above described, and this motor-circuit will be continued until the tooth c^3 passes clear of the pawl and the pawl drops against the bottom of the tooth. This movement of the pawl opens the motor-circuit and the commutator comes to rest with the brushes on the line marked "2 blocks clear" and the distant signal in the safety position indicating two blocks clear, the coils S and the holding-clutch coils D still remaining energized and the holding-clutch therefore maintaining the signals in

this position. Should the block A^2 become occupied by a train after the distinct signal has given the two-blocks-clear indication to the train in the block A and before the last-mentioned train passes out of block A, the train in the block A^2 will shunt the rail-circuit of the home-signal rear relay G' H' and the movable brush f' will fall away from its commutator K' and the relay O' will be de-energized, thereby opening at the points a^8 b^8 the circuit whereby the full power of the track-battery B^3 was applied to the rails of the block A' and restoring the connection with two cells in multiple of such battery through the contacts a^8 b^9, and in consequence of this operation the current flowing through the rear-relay coils G H and E will be reduced. Under this reduced current the home-signal rear relay G H will still hold its armature forward and will maintain the movable commutator-brush f against the commutator K; but the distant-signal rear-relay coils E will not hold their armature, and therefore their armature-lever e will fall, opening the contacts e e', and thereby deënergizing the relay-coils S and the holding-clutch coils D and closing the contacts e e^2, and thereby closing a circuit whereby the home-signal clutch C becomes a holding-clutch; but the current of these two cells in multiple of the battery B^3 through the home-signal rear-relay coils G H will maintain the movable brush f against the commutator, and the circuit whereby the home-signal clutch C will become a holding-clutch will be closed through the brushes f and 3, as follows: from battery B^2 by wire 42, movable brush f, brush 3, wire 67, brush 20 of home-signal commutator J and the plate 150 of such commutator, wire 68, metallically connected to this plate, coils of home-signal clutch C, wire 69, and the plate 151 of commutator J, with which plate the wire 69 is metallically connected, brush 18, (which is now at the line marked "Safety,") wire 70, contacts e^2 e, and wire 45 back to battery. The current flowing through this circuit will be more powerful than that flowing through these coils when they act as a brake-clutch, as will be hereinafter described, and will be sufficient to hold the home signal in the safety position. The distant signal is now free to go to "danger" under the action of its counterweight, and as it approaches nearly to the danger position its movement is slowed down by its brake-clutch C' through a circuit closed for a sufficient interval to perform this function, this circuit being as follows: from the main battery B^2 by wire 71, brush 22 of the commutator J' of this brake-clutch C', plate 152, wire 72, clutch-coils C', wire 73', plate 153, brush 21, wires 74 70, contacts e^2 e, and wire 45 back to battery. This circuit is opened at the brush 21 as the distant signal reaches the danger position. The deënergization of the coils S, which resulted from the opening of the contacts e e', caused the closing of the contacts s' t', completing a circuit for the motor by which the distant signal would be forced to "danger" if its counterweight failed to put it to "danger" and by which the commutator will be moved until the brushes are on the line marked "2 to 1 block clear" and by which the circuit above described which made the home-signal clutch C a holding-clutch is opened, and at the same time the holding-clutch coils D are again energized, so that the holding-clutch D replaces the home signal clutch C and maintains the home-signal at "safety." The forcing-circuit for the motor is as follows: from battery B^2 through motor M, wire 57, contacts s' t', wire 75, brushes 17 16, and wire 45 back to battery. The actuation of the motor moves the commutator so that the brushes approach the line marked "2 to 1 block clear," and as the commutator approaches this position the break in the plate of the brush 3 opens the circuit whereby the home-signal clutch became a holding-clutch, and simultaneously the break in the plate of the brush 15 restores the original circuit above described whereby the home-signal was put to "safety," this circuit including the relay-coils S and the energization of these relay-coils S breaking the motor-circuit through contacts s' t'. Before, however, this break in the commutator-plate passes under the brush 15 the pawl 227 is lifted by the tooth c^4 of the ratchet-wheel 225, and thereby the foot-piece 228 of the pawl is brought into contact with the brushes F F and a motor-circuit completed, as above described, and continued until the tooth passes clear of the pawl.

The conditions above described will continue until the train above described as in the block A enters the block A' and closes a short circuit between the rails of the block A', cutting off the advance track-battery B^3 from the home-signal rear relay G H and from the distant-signal rear relay E. The movable brush f then falls away from the commutator and the circuits for the relays S and O are opened and the clutch-coils D are deënergized. The home signal is now free to go to "danger" under the action of its counterweight, and as it nearly approaches the danger position the brake-clutch circuit is completed for the home-signal clutch C, as follows: from main battery B^2 by wire 42, movable brush f, back contact g of brush f, wire 76, including resistance R, brush 19 of commutator J, commutator-plate 150, wire 68, clutch C, wire 69, plate 151, brush 18, wire 70, contacts e^2 e, and wire 45 back to battery. The current flowing through this circuit is reduced by the resistance R to produce the brake-clutch action of the home-signal clutch C, the circuit for the holding-clutch action, as previously described, having in it no resistance other than that of the clutch-coils C and necessary conductors. The forcing-circuit is also completed for the mo-

tor to restore the commutator K to normal position, and should the counterweight fail to restore the home signal to the danger position the motor will perform this operation. This forcing-circuit has been heretofore described and is as follows: from main battery B^2 through motor M, wire 57, contacts s' t', wire 75, brushes 17 16, and wire 45 back to battery. As the commutator approaches the normal danger position, in which position the brushes will be on the line marked "Danger," the break in the commutator-plate of the brush 17 opens the motor-circuit above described; but before this motor-circuit is opened another motor-circuit is closed as a result of the action of the ratchet-tooth c' on the pawls and the foot-piece 228 of the pawl connects the brushes F F to close such motor-circuit, and this circuit is continued until the pawl passes clear of the tooth c', and therefore the motor-circuit is finally opened at the brushes F F. Should both the home signal and the distant signal be in the safety position when the train enters the block A′ from the block A, in which case the brushes would be on the line marked "2 blocks clear," or should the distant signal have remained at "danger," in which case the brushes would be at the line marked "1 block clear," the entrance of the train in the block A′ will cut out the advance track-battery B^3, deënergizing the home signal rear-relay coils G H and the distant signal rear-relay coils E, as above described, and the movable brush f will fall away from the commutator, thereby deënergizing the relays O and S. The signals are then free to go to "danger" under the influence of their counterweights, and failing this the motor will force them to "danger" by the forcing circuit heretofore described, as follows: from main battery B^2, through motor M, wire 57, contacts s' t', wire 75, brushes 17 16, and wire 45, back to battery, and this circuit will remain closed until the break in the commutator-plate of the brush 17 passes under this brush, and simultaneously therewith a motor-circuit will be closed through the brushes F F, as formerly described, and the motor-circuit will be finally opened at this point. As the signals nearly approach the danger position the movement of the home signal is checked by its brake-clutch through the circuit heretofore described, as follows: from main battery B^2 by wire 42, movable brush f, back contact g, wire 76, including resistance R, brush 19, plate 150, wire, 68, clutch-coils C, wire 69, plate 151, brush 18, wire 70, contacts e^2 e, wire 45, back to battery. The brake-clutch circuit for the distant signal is from main battery B^2 by wire 71, brush 22, plate 152, wire 72, coils of clutch C′, wire 73, plate 153, brush 21, wires 74 70, contacts e^2 e, and wire 45, back to battery. In the movement of the commutator toward the danger position a circuit is closed through the brushes 11 10, the function of which is to operate the compound relay V W, so that upon the signals going to "danger," the full power of the opposing battery B′ is put in circuit with the rails of the block A′. This circuit is as follows: from one cell of the opposing battery B′ through wire 31, contacts w' v, coils V, wire 32, brushes 11 10, and wires 77 41, back to battery. This causes the attraction of the coil V to preponderate and move the armature-lever v forward, closing the contacts v w, and thereby closing a circuit having the full power of the opposing battery B′, wherein the current flows from the opposing battery B′, through the wire 78 and contact w, to the armature-lever v, and thereafter as above described. As the commutator continues to move toward normal position, this circuit is opened at the brush 10; but simultaneously a circuit is closed through the brush 12, as follows: from opposing battery B′ through wire 78, contacts w v, coils V, wire 32, brushes 11 12, wire 33, contacts s^2 r, wire 34, contacts b a, wires 35, 38, upper rail, wheels, and axles of train, lower rail, wire 39, back coils H, wire 41, back to battery. The function of this circuit is to connect the full power of the opposing battery B′ with the rails of the block A′, so that when the train leaves the block A′, whether to enter the next succeeding block A^2 or to pass out at a siding, the short-circuit through the wheels and axles of the train will be removed, and the current from the opposing battery B′ will flow from the upper rail at the front end of the block A′ through wire 62′, back coils Q′ of home and rear blocks front relay, wire 64′, also in multiple by wires 62′ 50′, contacts a^6 b^6, wire 49′, and back coils U′ of the home block front relay to wire 64′, and also in multiple therewith by wire 62, front coils P′ of home and rear blocks front relay, wire 27′ to contacts a^8 b^8, and also in multiple from wire 62′ by wire 50′, contacts a^6 b^6, wire 49′, front coils T′ of home block front relay, wire 48′, contacts b^7 a^7 to contacts a^8 b^8, and thence by wire 47′, brushes 7′ 8′, wire 59′, opposing two cells in multiple of battery B^3 to wire 64′, and thence the four multiples having all united by wire 65′ to lower rail of block A′ and at the rear end of the block A′ from lower rail by wire 39, back coils H of home signal rear relay and wire 41, back to battery. By this circuit the back coils Q′ and U′ of the two front relays will be energized in the same direction as by their track-battery B^3, and the front coils P′ and T′ will be energized in the opposite direction. The back coils will be energized by the full power of the opposing battery B′, but the path of the current of this battery through the front coils will be in opposition to the current of the track-battery B^3. Therefore the preponderance of the back coils which would follow the exit of the train will be assured by this extra battery power in opposition, and the rear-

ward movement of the armature-levers p' and u^2 will be assured. The assurance of this operation of the front relays is important, for the reason that under extreme wet weather conditions the resistance of the ground-circuit from rail to rail might be so lowered that the back coils in multiple with this ground resistance might not sufficiently preponderate over the front coils to cause the rearward movement of the armatures, although under all conditions of weather the back coils would hold the armatures in rearward position after such movement.

The circuits above described for the opposing battery B′, which come into operation upon the exit of the train from the block A′, are normally of such resistance that the multiple circuit through the back coils W of the compound relay V W will cause the attraction of these back coils W to preponderate and move the armature-lever v rearwardly, thereby opening the circuit above described, whereby the full power of the opposing battery B′ was applied to the rails, and restoring the normal connection, heretofore described, of one cell of the battery B′ to the rails; but the full power of the opposing battery B′ will have operated the front relays, as above described, before this reduction to normal lesser battery power is effected. Under extreme wet weather conditions it is possible that the coils V would continue to hold their armature forward after the train had left the block, thereby maintaining the contacts $v\ w$ in closed condition and continuing the connection of the full power of the battery B′ to the rails; but except under unusual wet weather conditions the increased resistance due to the exit of the train from the block would cause the coils W to preponderate and open the contacts $v\ w$, thereby leaving in circuit with the rails only one cell of the battery B′. Therefore the consumption of battery will usually be very slight.

The opening of the contacts $p'\ q'$, resulting from the exit of a train from the block A′ by passing out at a siding, deënergizes the rear relays at the rear end of the block A^2, and in case the train passes out of the block A′ into the block A^2 the train also shunts the track-circuit of these rear relays. The movable brush f' then falls away from the commutator, thus deënergizing the relays O′ and S′, and the circuit of the coils S′ is also opened at the points $u^2\ u^3$ and the signal or signals go to "danger."

I have described the operations which result from the exit of a train from the block A′. In the same manner when the train passes out of the block A a battery at the rear end of the block A, corresponding to the opposing battery B′, will assure the preponderance of the back coils of the front relays P Q and T U, and thus compel the opening of the contacts p and q and of the contacts u and u'. If the train leaves the block A by a siding, this operation restores the signal-indicating means at the rear end of the block A′ to the danger condition. The resulting operation of the commutator will cause the full power of the battery B′ to be connected to the rails of the block A′, as above described. Should there be no train in the blocks A′ or A^2 when the train leaves the block A, and therefore both signals at the rear end of the block A′ be at safety, the opposing battery B′ will encounter the full power of the track-battery B^3, but will sufficiently oppose the current of this battery to assure the opening of the contacts p' q', as above described.

It will be noted from the above description that the compound relay V W controls the opposing battery B′, so as to connect either a part thereof (shown as one cell) or the whole battery to the rails at the rear end of the block. The contacts w' and w are following contacts, so that the circuit through one of them is maintained until the circuit through the other is closed, thereby assuring that the coils V W shall not at any time be deënergized. It will also be noted that the relay O controls the track-battery B, the full power of this battery being on a normally open circuit controlled by this relay through the contacts $a^3\ b^3$. The contacts b^3 and b^4 are also following contacts, so that the normally closed circuit of the two cells in multiple of the track-battery shall not be opened at the point b^4 until the normally open circuit of the full power of this battery shall be closed at the point b^3, and vice versa, so that in the change from the lesser to the greater battery power or from the greater to the lesser battery power the home block front relay P Q shall not at any time be deënergized.

In the construction shown in Fig. 14 I have shown arrangements of circuits and apparatus whereby the home signal of the second block in advance of that occupied by the train is compelled to give the safety indication before the distant signal at the rear end of the block in advance of the train can give the indication of two blocks clear in contrast with the construction just described and shown in Fig. 13, in which the circuits for putting the home signal of the second block in advance to "safety" were first put in condition to move that home signal to the safety position and then the distant signal at the rear end of the block in advance of the train was moved to the safety position. This arrangement diminishes the number of points of the relay O and adds the commutator-brush 9, and slightly varies the circuits. I have also shown in Fig. 14 a modified arrangement of circuits for controlling a single three-position signal, this arrangement dispensing with the separate brake-clutches C and C′ and replacing them by a single brake-clutch C^2 and replacing the commutator-brush 3 by the commutator-brush 2, and otherwise slightly varying the circuits.

In this construction the entrance of a train into the block in rear of the block A will cause the signal at the rear end of the block A′ to give the one-block-clear indication, providing there is no train in the block A′, and similarly the entrance of a train into the block A will cause the signal at the rear end of the block A^2 to give the one-block-clear indication, providing there is no train in the block A^2. The presence of a train in the block in rear of the block A will cause the front coils P of the home and rear blocks front relay at the front end of the block A to attract the armature-lever p as a result of the connecting with the rails of the block A in multiple of the coils of the home-signal rear relay and distant-signal rear relay at the rear end of the block A, as heretofore described. The closing of the contacts p q will cause the signal at the rear end of the block A′ to give the one-block-clear indication, closing a circuit to put the movable brush f against the commutator, and the movable brush f will be held against the commutator by the advance track-battery B^3, as heretofore described, and the movable brush f will energize the relay-coils S by the following circuit: from the main battery B^2 by wire 42, movable brush f, fixed brush 1, wires 51 52, coils S, wire 53, brushes 15 16, and wire 45, back to battery, and in multiple with the relay-coils S through the holding-clutch coils D by a path branching from the circuit just described at the wire 51 through the wire 56, clutch-coils D, and wire 55, back to wire 53 of the circuit just described. The energization of the relay-coils S opens the contacts s' t' and s^2 r and closes the contacts s' t, and then the advance track-battery B^3 maintains the movable brush f against the commutator by a circuit, as above described, through the home-signal rear-relay coils G and H in series. The closing of the contacts s' t completes a motor-circuit, as above described, and the holding-clutch circuit having been already closed the signal is moved to the one-block-clear position, and at the conclusion of this movement the motor-circuit is opened, as above described, and the commutator K comes to rest with the brushes on the line marked "1 block clear," and the signal is held in the one-block-clear position by the continued energization of the holding-clutch coils D, while the continued energization of the relay-coils S prevents the closing of a motor-circuit to further actuate the signal. When the commutator reaches the position in which the brushes are on the line marked "1 block clear," as above described, the relay-coils O will be energized by the following circuit closed at the brush 2: from the main battery B^2 by wire 42, movable brush f, brush 2, wire 79, relay-coils O, wire 80, contacts u u^4, wires 81 45, back to battery. The energization of the relay-coils O opens the contacts a^{10} b^{10} and a^3 b^4 and closes the contacts a^3 b^3, and the closing of the contacts a^3 b^3 connects the full power of the track-battery B to the rails, and in consequence thereof the signal at the rear end of the block A would give the two-blocks-clear indication. The circuit whereby the full power of the track-battery B is connected to the rails is as follows: from battery B by wire 82, contacts b^3 a^3, wire 27, front coils P of the home and rear blocks front relay, wire 62 to upper rail, and also in multiple therewith from the wire 27 by wire 83, brushes 6 7, wire 84, front coils T of the home-block front relay, wire 85, brushes 8 9, wires 86 62, to upper rail and from the lower rail by wires 65 64 back to battery, the current flowing also through the back coils Q and U of these relays in multiple, as before described. The means whereby the signal at the rear end of the block A is caused to give the two-blocks-clear indication will appear from the following description of the operation of similar circuits for the signal at the rear end of block A′. The front relays P Q and T U are now connected in multiple with the rails in a circuit having the full power of the track-battery B, as before described, the contacts p q remaining closed and the armature-lever u and back contact u^4 remaining closed. When the train enters the block A, the contacts p q will continue closed and the contacts u u^4 will be opened, the entrance of the train into the block having removed the joint resistance of the coils of the home-signal rear relay and distant-signal rear relay at the rear end of block A, as before described. The opening of the contacts u u^4 deenergizes the relay-coils O, thereby closing the contacts a^{10} b^{10} and a^3 b^4 and opening the contacts a^3 b^3. The power applied to the rails through the front relays in multiple is now altered to that of a part, shown as two cells in multiple, of the track-battery B, the current now flowing from this part of the battery through the wire 26 and contact b^4 to the armature-lever a^3 and from this armature-lever a^3, as before described. The closing of the contacts a^{10} b^{10} connects the distant-signal rear-relay coils E in multiple with the home-signal rear-relay coils G H to the rails of the block A′, the part of this circuit from rail to rail being as follows: from the upper rail, by wires 38 36, contacts p q, wire 37, brushes 5 4, wire 88, contacts a^{10} b^{10}, wire 60, distant-signal rear-relay coils E, wires 61 39, to lower rail, and in multiple therewith by a path branching from the wire 37, by the wire 40, through the home-signal rear-relay coils G and H and wire 39, to the lower rail. The joint resistance of the home-signal rear-relay coils G and H and the distant-signal rear-relay coils E is such that when they are connected in multiple with the rails the home and rear blocks front-relay coils P′ will attract the armature p', and the closing of the points p' q' will cause the signal at the rear end of block A^2 to give the one-block-clear indication, providing there is no

train in the block A^2, as before described, and this will connect to the rails of the block A' the full power of the advance track-battery B^3 with the front relays P' Q' and T' U' in multiple, as above described, relative to the track-battery B and front relays P Q and T U, and the distant-signal rear-relay coils E will then attract their armature, closing the contacts e e' and causing the actuation of the motor to put the signal at the rear end of the block A' to the position indicating two blocks clear, and the commutator K will be advanced so that the brushes will be on the line marked "2 blocks clear." Should the block A^2 become occupied by a train after the signal at the rear end of the block A^2 has given the one-block-clear indication and the signal at the rear end of the block A' has given the two-blocks-clear indication, the signal at the rear end of the block A^2 will go to "danger" because of the shunting of the track-battery circuit, whereby the home-signal rear-relay coils G' H' are energized and the movable brush f' held against the commutator, and the movable brush f' will fall away from the commutator, opening the circuits of the relay-coils O' and S' and of the holding-clutch D', and the signal is now free to go to "danger" under the influence of its counterweight. The deënergization of the relay-coils O' opens the circuit, whereby the full power of the advance track-battery B^3 is connected to the rails, and in consequence thereof the distant-signal rear-relay coils E will fail to hold up their armature, and the contacts e e' will open and e e^2 will close. Thereupon the signal at the rear end of the block A' may move from the two to the one block clear position under the influence of its counterweight. Before describing this operation I will first describe the means whereby the signal at the rear end of the block A^2 is forced by the motor to the danger position should its counterweight fail to move it to "danger," and the commutator of this signal is rotated to bring the brushes on the line marked "Danger." The deënergization of the coils S' closes the contacts s^3 t^3, completing the following circuit for the motor: from the advance main battery B^4, through motor M', wire 57', contacts s^3 t^3, wire 75', brushes 17' 16', wire 45', back to battery. This circuit completes the revolution of the commutator from the one-block-clear position to the danger position, the commutator moving forward through the intermediate positions "2 blocks clear" and "2 to 1 block clear" and the motor-circuit being finally opened at the brushes F' F', as before described. As the signal approaches nearly to the danger position, whether forced thereto or moving under the influence of its counterweight, a circuit is completed through the brake-coils C^3 to retard the movement of the signal, as follows: from the main battery B^4, through wire 42', brush f', back contact g', wire 76', brush 19' of brake-clutch commutator J^3, plate 156 of such commutator, wire 89', metallically connected with such plate, brake-clutch coils C^3, wire 90', plate 157 of brake-clutch commutator, brush 18', wire 91', contacts e^5 e^3, and wire 45', back to battery. This circuit is finally opened at the brush 18'. As the commutator K' in its movement passes the two to one block clear position and moves toward the danger position the circuit for the home-block front relay T' U' is opened at the brushes 7' and 9', restoring it to its normally deënergized condition. At the same time that the commutator opens the circuit of the home-block front relay T' U', as above described, it closes a circuit for the advance opposing battery B^5 through the brushes 11' 10', and this circuit remains closed for a short interval sufficient to effect the movement of the armature of the relay V' W' and is then opened at the brushes 11' 10'; but a circuit is simultaneously closed through the brushes 11' 12', which connects the full power of the advance opposing battery B^5 with the rails of the block A^2 for the purpose of providing a circuit which will when the train leaves the block A^2 assure the movement of the armatures of the front relays at the front end of the block A^2 to their rearward positions, as heretofore described relative to Fig. 16. The circuit closed through the brushes 11' 10' is as follows: from one cell of the opposing battery B^5, through wire 31', contacts w^3 v', coils V', wire 32', brushes 11' 10', wires 72' 41', back to battery. The circuit closed through the brushes 11' 12', including the full power of the opposing battery B^5, and applying that power to the rails of the block A^2, may be traced to and from such rails, as follows: from battery B^5, by wire 78', contacts w^2 v', coils V', wire 32', brushes 11' 12', wire 33', contacts s^3 r', wires 34' 38', to upper rail of block A^2 and from lower rail of block A^2, by wire 39', coils H', and wire 41', back to battery. As before described, the closing of the contacts e e^2 and the opening of the contacts e e' left the signal at the rear end of the block A' so that it could move from the two to the one block clear position under the influence of its counterweight, and this movement is accomplished under the control of the retarding action of the brake-clutch C^2 and the forward movement of the motor. The circuit for the brake-clutch C^2 is closed at the contacts e e^2 and is as follows: from the main battery B^2, through wire 42, movable brush f, fixed brush 1, wire 51, brush 20 of brake-clutch commutator J^2, (the brake-clutch commutator J^2 being in the two-blocks-clear position,) plate 155 of such commutator, wire 89, metallically connected to such plate, clutch-coils C^2, wire 90, plate 154, metallically connected to such wire, brush 18, wire 91, contacts e^2 e, and wire 45, back to battery. This circuit is closed during the movement of the signal from the two-blocks-clear to the one-

block-clear position. The motor circuit is closed by the opening of the contacts $e\,e'$ and the consequent dëenergization of the coils S, and the holding-clutch coils D are also dëenergized by the opening of the contacts $e\,e'$. The motor-circuit is from the main battery B^2, through motor M, wire 57, contacts $s'\,t'$, wire 75, brushes 17 16, and wire 45 back to battery. The circuit for the holding-clutch coils D remains open until the commutator K has been moved by the motor nearly to the two to one block clear position, and is then closed through the brushes 15 16, as follows: from main battery B^2, through wire 42, movable brush f, fixed brush 1, wires 51 56, holding-clutch coils D, wires 55 53, brushes 15 16, and wire 45, back to battery. The mechanical operation whereby the retarding movement of the brake-clutch C^2 in connection with the forward movement of the motor causes the signal to attain the one-block-clear position with the holding-clutch armature against its magnet D has been already described. After the holding-clutch coils D have been energized and just before the signal reaches the one-block-clear position the brake-clutch commutator J^2 opens the circuit of the brake-clutch coils C^2 at the brush 20. At the same time that the holding-clutch coils D are energized the relay-coils S are energized by a circuit closed at the brushes 15 16, as follows: from main battery B^2, by wire 42, movable brush f, fixed brush 1, wires 51 52, coils S, wire 53, brushes 15 16, and wire 45, back to battery. The energization of the relay-coils S opens the motor-circuit at the contacts $s'\,t'$; but the motor-circuit is simultaneously temporarily closed and finally opened at the brushes F F, as before described. When the train enters the block A′ or leaves the block A at a siding, the circuits under the control of which the movement is effected of the signal to the danger position are the same whether the signal and commutator K are at the two-blocks-clear position or the signal is at the one-block-clear position and the commutator K at the two to one block clear position. When the train leaves the block A at a siding, it removes from a circuit, such as has been described relatively to the block A′, the shunting action of its wheels and axles and permits the current of the opposing battery at the rear end of the block A to assure the opening of the contacts $p\,q$ and the closing of the contacts $u\,u^4$, and the opening of the contacts $p\,q$ opens the track-circuit of the home-signal rear relay G H, and the movable brush f leaves the commutator K, opening the circuits of the relay-coils S and the clutch-coils D, and the signal is now free to go to "danger" under the influence of its counterweight, retarded in its movement by the brake-clutch C^2 through the following circuit, closed at the back contact g and brake-clutch commutator-brush 19: from the main battery B^2, through wire 42, movable brush f, back contact g, wire 76, brush 19, commutator-plate 155, wire 89, coils of brake-clutch C^2, wire 90, commutator-plate 154, brush 18, wire 91, contacts $e^2\,e$, and wire 45, back to battery. A motor-circuit is also closed at the contacts $s'\,t'$, which completes the revolution of the main commutator to the danger position, and would force the signal to "danger" if its counterweight failed to move it to "danger," as above described, and as the brush 10 meets the break in its commutator-plate and is joined to the brush 11 the following circuit is completed: from one cell of the opposing battery B′, by wire 31, contacts $w'\,v$, coils V, wire 32, brushes 11 10, wires 72 41, back to battery. This causes the coils V to attract their armature and closes the contacts $v\,w$ and the full power of the opposing battery B′ is applied to the rails of the block A′ when the brushes 11 and 12 are connected by the commutator, the part of this circuit to and from the rails being as follows: from the opposing battery B′, by wire 78, contacts $w\,v$, coils V, wire 32, brushes 11 12, wire 33, contacts $s^2\,r$, wires 34 and 38, to upper rail and from lower rail, through wire 39, coils H, and wire 41, back to battery. It will be observed that this circuit corresponds to that already described of the opposing battery B^5, and the function of this circuit is to assure the opening of the contacts $p'\,q'$ and the closing of the contacts $u^5\,u^6$ and the consequent restoration of the signal at the rear end of the block A^2 to "danger," which was put to the one-block-clear position when the train entered the block A. Should the train pass from the block A into the block A′, its wheels and axles would shunt the current of the track-battery B^3 through the home-signal rear relay G H and the distant-signal rear relay E and by thus causing the movable brush f to leave the commutator K cause the operation above described, except that the train being in the block A′ would prevent the opening of the contacts $p'\,q'$ and closing the contacts $u^5\,u^6$, assured by the action of the opposing battery B′, as above described, until the train left the block A′.

It is evident that various modifications other than those shown and above described may be made in the construction and arrangement of the various circuits and apparatus within the spirit and scope of my invention.

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

1. The combination, with signal-indicating means counterweighted to go to danger, of actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and having a movable part, and means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the movable part of the clutch, the counterweighted signal-indicating means being free to go to danger independently of the actuating mechanism when the clutch is

released, and the actuating mechanism controlling the signal-indicating means to force the indicating means to danger should the clutch or counterweight fail.

2. The combination, with signal-indicating means counterweighted to go to danger, of actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and having a movable part, and means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the movable part of the clutch, the counterweighted signal-indicating means being free to go to danger independently of the actuating mechanism when the clutch is released, the actuating mechanism controlling the signal-indicating means to force the danger indication should the counterweight fail and the actuating mechanism controlling the movable part of the clutch to force the clutch into engaging position.

3. The combination, with signal-indicating means, of actuating mechanism therefor, a clutch controlling the movement of the indicating means and having a part pivoted on a stationary fulcrum and a cross-lever having a movable fulcrum on such pivoted part of the clutch and connected to the actuating mechanism and the indicating means.

4. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a clutch controlling the movement of the indicating means and having a part pivoted on a stationary fulcrum, and a cross-lever having a movable fulcrum on such pivoted part of the clutch and connected to the actuating mechanism and to the signal-indicating means, the counterweighted signal-indicating means being movable to danger independently of the actuating mechanism by actuation of the cross-lever when the clutch is released.

5. The combination, with signal-indicating means, of actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and including a pivoted clutch-lever, and means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the pivoted clutch-lever, the pivoted clutch-lever being freely movable to permit the danger indication when the clutch is released.

6. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and including a pivoted clutch-lever, and means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the pivoted clutch-lever, the counterweighted signal-indicating means being free to swing the clutch-lever on its pivot and go to danger independently of the actuating mechanism when the clutch-lever is released.

7. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and a cross-lever having a movable fulcrum on the clutch and connected to the actuating mechanism and to the signal-indicating means, the counterweighted signal-indicating means being free to go to danger independently of the actuating mechanism by actuation of the cross-lever when the clutch is released, and the actuating mechanism controlling the signal-indicating means through the cross-lever to force the danger indication should the counterweight fail.

8. The combination, with signal-indicating means, of actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and including a pivoted clutch-lever, and a cross-lever fulcrumed on the clutch-lever and connected to the actuating mechanism and to the signal-indicating means.

9. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and including a pivoted clutch-lever, and a cross-lever fulcrumed on the clutch-lever and connected to the actuating mechanism and to the signal-indicating means, the counterweighted signal-indicating means being free to swing the clutch-lever on its pivot and go to danger independently of the actuating mechanism when the clutch-lever is released.

10. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and including a pivoted clutch-lever, and a cross-lever fulcrumed on the clutch-lever and connected to the actuating mechanism and to the signal-indicating means, the counterweighted signal-indicating means being free to swing the clutch-lever on its pivot and go to danger independently of the actuating mechanism when the clutch-lever is released, and the actuating mechanism controlling the clutch-lever through the cross-lever to swing the clutch-lever into engaging position.

11. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and including a pivoted clutch-lever, and a cross-lever fulcrumed on the clutch-lever and connected to the actuating mechanism and to the signal-indicating means, the counterweighted signal-indicating means being free to swing the clutch-lever on its pivot and go to danger independently of the actuating mechanism when the clutch-lever is released, and the actuating mechanism controlling the signal-indicating means through the cross-lever to force the danger indication should the counterweight fail.

12. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a clutch controlling the movement to clear and clear indication and including a pivoted clutch-lever, and a cross-lever fulcrumed on the clutch-lever and connected to the actuating mechanism and to the signal-indicating means, the counterweighted signal-indicating means being free to swing the clutch-lever on its pivot and go to danger independently of the actuating mechanism when the clutch-lever is released, the actuating mechanism controlling the signal-indicating means through the cross-lever to force the danger indication should the counterweight fail, and the actuating mechanism controlling the clutch-lever through the cross-lever to swing the clutch-lever into engaging position.

13. The combination of signal-indicating means counterweighted to go to danger, means for actuating the same, and a clutch controlling the movement to clear and clear indication and comprising a pivoted clutch-lever coacting therewith, and a stationary retaining and releasing part therefor, the means for actuating the signal-indicating means being held by the pivoted clutch-lever in operative condition to put the signal-indicating means to safety when the pivoted clutch-lever is held by the stationary part, the counterweighted signal-indicating means being free to swing the clutch-lever away from the stationary part and go to danger independently of the actuating means when the clutch is not held by the stationary part, and the actuating means controlling the clutch-lever to swing the clutch-lever into engaging position relatively to the stationary part.

14. The combination of signal-indicating means counterweighted to go to danger, means for actuating the same, and a clutch controlling the movement to clear and clear indication and comprising a stationary electromagnet and a pivoted clutch-lever carrying an armature, the actuating means being held by the clutch-lever in operative condition to put the signal-indicating means to safety when the clutch-electromagnet is energized, the counterweighted signal-indicating means being free to swing the clutch-lever armature away from the stationary electromagnet and go to danger independently of the actuating means when the clutch-electromagnet is deënergized, and the actuating means controlling the clutch-lever to force the clutch-lever armature into engaging position relatively to the stationary electromagnet.

15. The combination of signal-indicating means counterweighted to go to danger, means for actuating the same, and a clutch controlling the movement to clear and clear indication and comprising a pivoted clutch-lever and a stationary retaining and releasing part therefor, the means for actuating the signal-indicating means being held by the clutch-lever in operative condition to put the signal-indicating means to safety when the clutch-lever is held by the stationary part, the counterweighted signal-indicating means being free to swing the clutch-lever away from the stationary part and go to danger independently of the actuating means when the clutch is not held by the stationary part, the actuating means controlling the signal-indicating means to force the danger indication should the counterweight fail, and the actuating means controlling the clutch-lever to swing the clutch-lever into engaging position relatively to the stationary part.

16. The combination of signal-indicating means counterweighted to go to danger, means for actuating the same, and a clutch controlling the movement to clear and clear indication and comprising a stationary electromagnet and a pivoted clutch-lever carrying an armature, the actuating means being held by the clutch-lever in operative condition to put the signal-indicating means to safety when the clutch-electromagnet is energized, the counterweighted signal-indicating means being free to swing the clutch-lever armature away from the stationary electromagnet and go to danger independently of the actuating means when the clutch-electromagnet is deënergized, the actuating means controlling the signal-indicating means to force the danger indication should the counterweight fail, and the actuating means controlling the clutch-lever to force the clutch-lever armature into engaging position relatively to the stationary electromagnet.

17. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a pivoted clutch-lever, a releasable holding part for the clutch-lever located at a point distant from the pivot of the clutch-lever, and means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the clutch-lever in proximity to the pivot of the clutch-lever.

18. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a pivoted clutch-lever carrying an armature located at a distance from the pivot of the clutch-lever, a clutch-electromagnet cöoperating with such armature, means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the clutch-lever in proximity to the pivot of the clutch-lever.

19. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a clutch including a pivoted clutch-lever, and means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the clutch-lever with the direction of thrust of the counterweighted signal-indicating

means upon the clutch-lever at such fulcrum nearly parallel to a line joining the center of such fulcrum and the pivotal center of the clutch-lever.

20. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a pivoted clutch-lever carrying an armature, a clutch-electromagnet coöperating with such armature, and means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the clutch-lever with the direction of thrust of the counterweighted signal-indicating means upon the clutch-lever at such fulcrum nearly parallel to a line joining the center of such fulcrum and the pivotal center of the clutch-lever.

21. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a pivoted clutch-lever, a releasable holding part for the clutch-lever located at a point distant from the pivot of the clutch-lever, and means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the clutch-lever in proximity to the pivot of the clutch-lever with the direction of thrust of the counterweighted signal-indicating means upon the clutch-lever at such fulcrum nearly parallel to a line joining the center of such fulcrum and the pivotal center of the clutch-lever.

22. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, a pivoted clutch-lever carrying an armature located at a distance from the pivot of the clutch-lever, a clutch-electromagnet coöperating with such armature, and means connecting the actuating mechanism and the signal-indicating means and including a part fulcrumed on the clutch-lever in proximity to the pivot of the clutch-lever with the direction of thrust of the counterweighted signal-indicating means upon the clutch-lever at such fulcrum nearly parallel to a line joining the center of such fulcrum and the pivotal center of the clutch-lever.

23. The combination of signal-indicating means counterweighted to go to danger, actuating means therefor, a clutch controlling the movement to clear and clear indication and a lever connection of the indicating means and actuating means pivotally connected to the clutch and pivotally connected to the indicating means and pivotally connected to the actuating means, such clutch and lever connection being freely movable to permit the danger indication when the clutch is released.

24. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, a clutch controlling the movement to clear and clear indication and including a pivoted clutch-lever, a cross-lever fulcrumed on the clutch-lever, a connecting-rod pivotally connected to the cross-lever and connecting the same to the actuating part, and an actuating-rod connected to the signal-indicating means and having a pivotal connection with the cross-lever.

25. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, a pivoted clutch-lever, a releasable holding part for the clutch-lever located at a point distant from the pivot of the clutch-lever, a cross-lever fulcrumed on the clutch-lever in proximity to the pivot of the clutch-lever, a connecting-rod pivotally connected to the cross-lever and connecting the same to the actuating part, and an actuating-rod connected to the signal-indicating means and having a pivotal connection with the cross-lever.

26. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, a pivoted clutch-lever carrying an armature located at a distance from the pivot of the clutch-lever, a clutch-electromagnet coöperating with such armature, a cross-lever fulcrumed on the clutch-lever in proximity to the pivot of the clutch-lever, a connecting-rod pivotally connected to the cross-lever and connecting the same to the actuating part, and an actuating-rod connected to the signal-indicating means and having a pivotal connection with the cross-lever.

27. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, a clutch including a pivoted clutch-lever, a cross-lever fulcrumed on the clutch-lever, a connecting-rod pivotally connected to the cross-lever and pivotally connected to the actuating part, and an actuating-rod connected to the signal-indicating means and pivotally connected to the cross-lever with the direction of thrust of the counterweighted signal-indicating means upon the clutch-lever at such fulcrum nearly parallel to a line joining the center of such fulcrum and the pivotal center of the clutch-lever.

28. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, a pivoted clutch-lever carrying an armature, a clutch-electromagnet coöperating with such armature, a cross-lever fulcrumed on the clutch-lever, a connecting-rod pivotally connected to the cross-lever and connecting the same to the actuating part, and an actuating-rod connected to the signal-indicating means and pivotally connected to the cross-lever with the direction of thrust of the counterweighted signal-indicating means upon the clutch-lever at such fulcrum nearly parallel to a line joining the center of such fulcrum and the pivotal center of the clutch-lever.

29. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, a pivoted clutch-lever, a releasable holding part for the clutch-lever located at a point distant from the pivot of

the clutch-lever, a cross-lever fulcrumed on the clutch-lever in proximity to the pivot of the clutch-lever, a connecting-rod pivotally connected to the cross-lever and connecting the same to the actuating part, and an actuating-rod connected to the signal-indicating means and pivotally connected to the cross-lever with the direction of thrust of the counterweighted signal-indicating means upon the clutch-lever at such fulcrum nearly parallel to a line joining the center of such fulcrum and the pivotal center of the clutch-lever.

30. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, a pivoted clutch-lever carrying an armature located at a distance from the pivot of the clutch-lever and a clutch-electromagnet coöperating with such armature, a cross-lever fulcrumed on the clutch-lever in proximity to the pivot of the clutch-lever, a connecting-rod pivotally connected to the cross-lever and connecting the same with the actuating part, and an actuating-rod connected to the signal-indicating means and pivotally connected to the cross-lever with the direction of thrust of the counterweight of the signal upon the clutch-lever at such fulcrum nearly parallel to a line joining the center of such fulcrum and the pivotal center of the clutch-lever.

31. The combination of signal-indicating means counterweighted to go to danger, a rotating actuating part therefor, connecting mechanism from the actuating part to the counterweighted signal-indicating means arranged to impart a backward thrust to the rotating actuating part when the signal-indicating means is in safety condition and a self-locking mechanism locking against backward movement of the actuating part but permitting forward movement thereof.

32. The combination of signal-indicating means counterweighted to go to danger, a rotating actuating part therefor, connecting mechanism from the actuating part to the counterweighted signal-indicating means arranged to impart a backward thrust to the rotating actuating part when the signal-indicating means is in safety condition and also to impart a backward thrust to the rotating actuating part when the signal-indicating means is in danger condition by any tendency to move to safety, and a locking mechanism for preventing backward movement of the actuating part from either of such thrusts.

33. The combination of signal-indicating means counterweighted to go to danger, a rotating actuating part therefor, connecting mechanism for the actuating part to the counterweighted signal-indicating means arranged to impart a backward thrust to the rotating actuating part when the signal-indicating means is in safety condition, and a pawl having a stationary pivot and a ratchet fixed upon the rotating actuating part with its teeth arranged to coact with the pawl to prevent backward movement of the actuating part but permit forward movement thereof.

34. The combination of signal-indicating means counterweighted to go to danger, a rotating actuating part therefor, connecting mechanism from the actuating part to the counterweighted signal-indicating means arranged to impart a backward thrust to the rotating actuating part when the signal-indicating means is in safety condition and also to impart a backward thrust to the rotating actuating part when the signal-indicating means is in danger condition by any tendency to move to safety, and a pawl and ratchet for preventing backward movement of the actuating part from either of such thrusts.

35. The combination, with signal-indicating means and signal-actuating means, of a part moving with the signal-indicating means in its movement to clear, and means for controlling the power-supply of the actuating means and including power-discontinuing means, such power-discontinuing means being controlled by the part moving with the signal-indicating means but being movable independently thereof in its power-discontinuing movement.

36. The combination, with signal-indicating means and electrically-controlled signal-actuating means, of a part moving with the signal-indicating means in its movement to clear, and current-controlling means including a pivoted circuit-opening lever controlled by the part moving with the signal but movable independently thereof in its circuit-opening movement, such current-controlling means controlling the signal-actuating means.

37. The combination with signal-indicating means and signal-actuating means, of a ratchet-wheel moving with the signal-indicating means in its movement to clear, and power-controlling means for the signal-actuating means including a pawl-lever controlled by such ratchet-wheel but movable independently thereof.

38. The combination, with signal-indicating means and electrically-controlled signal-actuating means, of a ratchet-wheel moving with the signal-indicating means in its movement to clear, and current-controlling means including a circuit-opening pawl-lever controlled by such ratchet-wheel but movable independently thereof in its circuit-opening movement, such current-controlling means controlling the signal-actuating means.

39. The combination of signal-indicating means, a part moving with the signal-indicating means in the movement to clear, a locking mechanism for such part, and means for starting and continuing the actuation of the signal-indicating means independently of the locking mechanism and completing and discontinuing the actuation of the signal-indicat-

ing means subject to the control of the locking mechanism.

40. The combination of signal-indicating means counterweighted to go to danger, a motor connected thereto, a part moving with the signal-indicating means in the movement to clear, locking mechanism for such part, the locking mechanism being constructed to lock the signal-indicating means against going to danger by its counterweight but not to oppose the movements of the motor to put the signal-indicating means to safety or danger, and motor-controlling means for starting and actuating the motor independently of the locking mechanism and completing the movement thereof and discontinuing the power-supply of the motor by the locking engagement of the locking mechanism.

41. The combination of signal-indicating means, an electromotor therefor, a part moving with the signal-indicating means in the movement to clear, a locking mechanism for such part, and means for energizing the electromotor independently of the locking mechanism and continuing the energization thereof subject to the control of the locking mechanism and for deënergizing the electromotor by the locking engagement of the locking mechanism.

42. The combination of signal-indicating means, a motor therefor, a ratchet-wheel moving with the signal-indicating means in the movement to clear, a pawl adapted to engage with the teeth of the ratchet-wheel, and electric-circuit make-and-break devices for starting and actuating the motor independently of the pawl and completing the movement of the motor subject to the control of the pawl and discontinuing the power-supply of the motor by the engagement of the pawl with a tooth of the ratchet-wheel.

43. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, connecting mechanism from the actuating part to the signal-indicating means connected to the signal-indicating means with the thrust of the signal-indicating means, when in the safety condition, in the direction of movement of the actuating part, a self-locking mechanism for preventing such movement of the actuating part, a motor connected to such actuating part, and motor-controlling means in part controlled by the self-locking mechanism.

44. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, connecting mechanism from the actuating part to the signal-indicating means connected to the signal-indicating means with the thrust of the signal-indicating means, when in safety condition, in the direction of movement of the actuating part, a self-locking pawl and ratchet for preventing such movement of the actuating part, a motor connected to such actuating part, and motor-controlling means in part controlled by the pawl.

45. The combination of signal-indicating means counterweighted to go to danger, an actuating part therefor, connecting mechanism from the actuating part to the signal-indicating means connected to the signal-indicating means with the thrust of the signal-indicating means, when in safety condition, in the direction of movement of the actuating part, a locking mechanism for preventing such movement of the actuating part, a motor connected to such actuating part, and means for starting and actuating the motor independently of the locking mechanism and completing the movement thereof subject to the control of the locking mechanism and discontinuing the power-supply of the motor by the locking engagement of the locking mechanism.

46. The combination of signal-indicating means counterweighted to go to danger, a rotating actuating part therefor, connecting mechanism from the actuating part to the indicating means arranged so that when the indicating means is in safety condition the counterweight of the signal tends to rotate the actuating part backwardly, a pawl and ratchet for preventing such backward movement of the actuating part, a motor connected to such actuating part, and means for starting and actuating the motor independently of the pawl and completing the movement thereof subject to the control of the pawl and discontinuing the power-supply of the motor by the engagement of the pawl with a tooth of the ratchet-wheel.

47. The combination of signal-indicating means, a motor therefor, a part moving with the signal-indicating means in the movement to clear, a locking mechanism for such part, a commutator also moving with the signal-indicating means in the movement to clear and commutator-brushes therefor and other circuit-completing and make-and-break devices coacting therewith and with the locking mechanism to start and actuate the motor independently of the locking mechanism and to complete the movement thereof subject to the control of the locking mechanism and to open a circuit and thereby discontinue the power-supply of the motor by the locking engagement of the locking mechanism.

48. The combination of signal-indicating means, a motor therefor, a ratchet-wheel moving with the signal-indicating means in the movement to clear, a pawl adapted to engage with the teeth of the ratchet-wheel, a commutator also moving with the signal-indicating means in the movement to clear, and commutator-brushes and circuit-completing and make-and-break devices coacting therewith and with the pawl to start and actuate the motor independently of the pawl and to complete the movement thereof subject to the control of the pawl and to open a circuit and thereby

discontinue the power-supply of the motor by the engagement of the pawl with a tooth of the ratchet-wheel.

49. The combination of signal-indicating means and means for actuating the same, such actuating means including a resilient connection interposed as a power-conveying device and connected at one end to the power and at the other end to the resistance and adapted to yield to a limited extent to forward movement of the actuating means and to react upon the discontinuance of the forward movement of the actuating means.

50. The combination of signal-indicating means and means for actuating the same, such actuating means including a resilient connection interposed as a power-conveying device and having parts movable relatively to each other and respectively connected to the power and the resistance and stops to the forward and backward relative movements of the parts, the resilient connection being adapted to yield and contact with the front stop upon the forward movement of the actuating means and to react and contact with the back stop upon the discontinuance of the forward movement of the actuating means.

51. The combination of signal-indicating means, an actuating-shaft for the same, a motor and gearing connecting the motor and actuating-shaft, such gearing including a part connected to the actuating-shaft, a loose part connected to the motor and moving between stops on the part connected to the actuating-shaft and a resilient connection controlling the loose part and adapted to yield to the actuation of the motor and to reverse the movement of such loose part upon the discontinuance of the power-supply of the motor.

52. The combination of signal-indicating means, motive means therefor, a part moving with the signal-indicating means in the movement to clear, a loose part moving with the motive means and having movement independently of the part moving with the indicating means, and a locking device for locking the part moving with the indicating means against forward movement, such locking device being controlled by the loose part.

53. The combination of signal-indicating means, motive means therefor, a ratchet moving with the indicating means in the movement to clear, a loose part moving with the motive means and having movement independently of the ratchet, and a pawl coöperating with the ratchet to lock the same against forward movement, such pawl being controlled by the loose part.

54. The combination of signal-indicating means, motive means therefor, a part moving with the indicating means in the movement to clear, a loose part moving with the motive means and having movement independently of the part moving with the indicating means, and a resilient connection controlling the independent movement of the loose part and adapted to yield to a limited extent to forward movement of the actuating means and to react upon the discontinuance of the forward movement of the actuating means, and a locking device for locking the part moving with the indicating means against forward movement, such locking device being controlled by such loose part.

55. The combination of signal-indicating means, a rotating part connected thereto, signal-actuating means, gearing connecting the actuating means and rotating part, such gearing including a loose part connected to the actuating means and a resilient connection controlling the same and adapted to yield to a limited extent to forward movement of the actuating means and to react upon the discontinuance of the forward movement of the actuating means, and a locking device for locking the rotating part against forward movement, such locking device being controlled by such loose part.

56. The combination of signal-indicating means, motive means therefor, a ratchet moving with the indicating means in the movement to clear, a loose part moving with the motive means and having movement independently of the ratchet, and a resilient connection controlling the independent movement of the loose part and adapted to yield to a limited extent to forward movement of the actuating means and to react upon the discontinuance of the forward movement of the actuating means, and a pawl coöperating with the ratchet-wheel to lock the same against forward movement, such pawl being controlled by the loose part.

57. The combination of signal-indicating means, a rotating part connected thereto, signal-actuating means, gearing connecting the actuating means and rotating part and including a loose gear-wheel having stops thereon, a resilient connection between the loose gear-wheel and its shaft, and an arm fixed on such shaft and working between such stops.

58. The combination of signal-indicating means, a rotating part connected thereto, signal-actuating means, gearing connecting the actuating means and rotating part and including a loose gear-wheel having stops thereon, a resilient connection between the loose gear-wheel and its shaft, an arm fixed on such shaft and working between such stops, a ratchet-wheel on the rotating part, and a pawl coöperating with the ratchet-wheel to lock the same against forward movement, the loose gear-wheel having a cam thereon and the pawl having an arm coöperating with such cam so as to be unlocked thereby.

59. The combination of railway signal-indicating means giving two different clear indications, actuating means therefor, and a single clutch controlling both of such clear indications and having a movable part, and means

connecting the actuating means and indicating means and including a part fulcrumed on the movable part of the clutch.

60. Railway signaling apparatus comprising counterweighted indicating means giving two different clear indications, actuating means therefor, means connecting the actuating mechanism and indicating means, and a single clutch controlling both clear indications and carrying a movable fulcrum of such connecting means, the counterweighted indicating means being free to go to danger from both clear indications independently of the actuating means when the clutch is released.

61. Railway signaling apparatus comprising counterweighted indicating means giving two different clear indications, actuating means therefor, and a single clutch controlling both clear indications, the counterweighted indicating means being free to go to danger from both clear indications independently of the actuating means when the clutch is released and the actuating mechanism controlling the indicating means to force the indicating means to danger should the clutch or counterweight fail.

62. Railway signaling apparatus comprising indicating means indicating danger, one block clear and a plurality of blocks clear, actuating means therefor, a single clutch controlling both of such clear indications and having a part pivoted on a stationary fulcrum, and connecting means between the actuating and indicating means including a part having a movable fulcrum on the pivoted part of the clutch.

63. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism for effecting the safety indication and an electromagnetic brake-clutch connected to the signal-indicating means independently of such actuating mechanism.

64. The combination of signal-indicating means counterweighted to go to danger, means for effecting the safety indication and an electromagnetic clutch to check the movement to danger, such clutch being connected to the indicating means independently of the means for effecting the safety indication.

65. The combination of signal-indicating means counterweighted to go to danger, means for effecting the safety indication, a clutch connected to the signal-indicating means and controlling the movement of the signal-indicating means toward danger, and circuit-controlling devices whereby the power of the clutch is varied to hold the indicating means or to retard the movement thereof.

66. The combination of signal-indicating means counterweighted to go to danger, means for effecting the safety indication, an electromagnetic clutch controlling the movement of the indicating means to danger, and circuit-controlling devices whereby the power of the electromagnetic clutch is varied to hold the indicating means or to retard the movement thereof.

67. The combination of signal-indicating means counterweighted to go to danger, means for effecting the safety indication, a clutch connected to the indicating means independently of the means for effecting the safety indication and circuit-controlling devices actuated by the movement of the indicating means and controlling the clutch.

68. The combination of signal-indicating means counterweighted to go to danger, means for effecting the safety indication, an electromagnetic clutch connected to the indicating means independently of the means for effecting the safety indication, and circuit-controlling devices actuated by the movement of the indicating means and controlling the electromagnetic clutch.

69. The combination of signal-indicating means counterweighted to go to danger, means for effecting the safety indication, a clutch controlling the movement to danger, circuit-controlling devices actuated by the movement of the indicating means and controlling the clutch, and other circuit-controlling devices controlling the power of the clutch.

70. The combination of two signals giving different indications, actuating mechanism therefor, and a single reciprocating actuating-rod connecting both signals to the actuating mechanism and actuating the different signals by different portions of the movement thereof.

71. The combination of a signal counterweighted to go to danger, another signal counterweighted to go to danger, the two signals giving different indications, actuating mechanism therefor, and a single reciprocating actuating-rod connecting both signals to the actuating mechanism and actuating the different signals by different portions of the movement thereof.

72. The combination of two signals giving different indications, a single reciprocating actuating-rod and actuating mechanism to which the actuating-rod is connected, self-acting controlling means connecting the single actuating-rod and the two signals and controlling the movements of the signals to put the signals to safety successively in the movement from danger to safety.

73. The combination of a home signal and a distant signal, both of such signals being counterweighted to go to danger, a single reciprocating actuating-rod, actuating mechanism to which the actuating-rod is connected and self-acting controlling means connecting the single actuating-rod and the two signals and controlling the movements of the signals to first put the home signal to safety in the movement from danger to safety.

74. The combination of a home signal and a distant signal, actuating mechanism therefor, a single reciprocating actuating-rod connect-

ing both signals to the actuating mechanism and a self-acting locking device for the danger position of the distant signal, operative during the movement of the home signal to safety.

75. The combination of two signals giving different indications, a single reciprocating actuating-rod, actuating mechanism to which the actuating-rod is connected, self-acting controlling means connecting the single actuating-rod and the two signals and controlling the movements of the signals to first put one signal to safety in the movement from danger to safety, and a self-acting locking device for the danger position of the other signal, operative during the movement of the first-mentioned signal to safety.

76. The combination of two signals giving different indications, actuating mechanism therefor, a single actuating-rod connecting both signals to the actuating mechanism, and a self-acting locking device for the danger position of one signal operative during the movement of the other signal to safety and released by the final movement of the other signal toward safety position.

77. The combination of a home signal, a distant signal, actuating mechanism therefor, a single clutch controlling the movements of both signals to safety and a single reciprocating actuating-rod connecting both signals to the actuating mechanism.

78. The combination of a signal counterweighted to go to danger, another signal counterweighted to go to danger, the two signals giving different indications, and means for moving the signals to safety including a single clutch controlling both signals and including a single reciprocating actuating-rod for both signals.

79. The combination of a home signal counterweighted to go to, danger, a distant signal counterweighted to go to danger, a single reciprocating actuating-rod for both signals and a single clutch controlling the movement of both signals to safety.

80. The combination of a signal counterweighted to go to danger and a clutch controlling its movement to danger, another signal giving a different indication and counterweighted to go to danger and a clutch controlling its movement to danger, and means for moving the signals to safety including a single clutch controlling both signals.

81. The combination of a signal counterweighted to go to danger and a clutch controlling its movement to danger, another signal giving a different indication and counterweighted to go to danger and a clutch controlling its movement to danger, a single actuating-rod for both signals, and a single clutch controlling the movement of both signals to safety.

82. The combination of a signal counterweighted to go to danger, another signal counterweighted to go to danger, means for moving the signals to safety including a single clutch controlling both signals, and a locking device for locking one signal at danger, such locking device being operative during the movement of the other signal to safety.

83. The combination of a signal counterweighted to go to danger, another signal counterweighted to go to danger, a single actuating-rod for both signals, a single clutch controlling the movements of both signals to safety, and self-acting controlling means connecting the single actuating-rod and the two signals and controlling the movements of the signals to put the signals to safety successively in the movement from danger to safety.

84. The combination of a signal counterweighted to go to danger, another signal counterweighted to go to danger, a single actuating-rod for both signals, a single clutch controlling the movements of both signals to safety, and a locking device for locking one signal at danger, such locking device being operative during the movement of the other signal to safety.

85. The combination of a signal counterweighted to go to danger, another signal counterweighted to go to danger, a single actuating-rod for both signals, a single clutch controlling the movements of both signals to safety, and mechanism connecting the single actuating-rod and the two signals and controlling the signals to first put one signal to safety in the movement from danger to safety and to lock the other signal at danger while the first-mentioned signal is being put to safety.

86. The combination of a signal counterweighted to go to danger, another signal counterweighted to go to danger, a single actuating-rod for both signals, a single clutch controlling the movements of both signals to safety, and a locking device controlling one signal to lock such signal at danger while the other signal is being put to safety and controlled in its unlocking movement by the final movement of the other signal toward safety position.

87. The combination of two signals, a single actuating-rod, means connecting the single actuating-rod and both signals, and a pivoted latch-lever having a locking part constructed to lock one signal at danger while the other signal is being put to safety and having an actuating part constructed to be engaged to unlock the locking part by the final movement of the other signal toward safety position.

88. The combination of a signal and an up-and-down rod therefor, another signal and an up-and-down rod therefor, a single reciprocating actuating-rod connected to both up-and-down rods, guides directing the movements of the up-and-down rods, and a locking device

for locking one signal at danger, such locking device being operative while the other signal is being put to safety.

89. The combination of a signal and an up-and-down rod therefor, another signal and an up-and-down rod therefor, a cross-link connected to both up-and-down rods, a single reciprocating actuating-rod connected to the cross-link, and guides directing the movements of the up-and-down rods and limiting the movements thereof.

90. The combination of a signal and an up-and-down rod therefor, another signal and an up-and-down rod therefor, a cross-link connected to the up-and-down rods, a single reciprocating actuating-rod connected to the cross-link, guides directing the movements of the up-and-down rods and limiting the movements thereof, and a locking device for locking one signal at danger such locking device being operative while the other signal is being put to safety.

91. The combination of a signal and an up-and-down rod therefor, another signal and an up-and-down rod therefor, a cross-link connected to both up-and down rods, a single reciprocating actuating-rod connected to the cross-link, guides directing the movements of the up-and-down rods and limiting the movements thereof, and a pivoted latch-lever having a locking part constructed to lock the up-and-down rod of one signal while the other signal is being put to danger and having an actuating part constructed to be engaged to unlock the locking part by the final movement of the other signal toward safety position.

92. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, connecting means between the actuating mechanism and signal-indicating means including a clutch controlling the clear indication, the actuating mechanism and connecting means being arranged to force the danger indication of the signal-indicating means should the counterweight fail, controlling means for the actuating mechanism subject to control in advance of the signal-indicating means, and clutch-controlling means combined with the means controlling the actuating mechanism to necessarily deënergize the clutch during the movement of forcing the danger indication.

93. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, connecting means between the actuating mechanism and signal-indicating means including a clutch controlling the clear indication, the actuating mechanism and connecting means being arranged to force the danger indication of the signal-indicating means should the counterweight fail, controlling means for the actuating mechanism subject to control in advance of the signal-indicating means and clutch-controlling means controlled independently of the movement of the signal-indicating means and combined with the means controlling the actuating mechanism to necessarily deënergize the clutch during the movement of forcing the danger indication.

94. The combination of signal-indicating means counterweighted to go to danger, actuating mechanism therefor, connecting means between the actuating mechanism and the signal-indicating means including a clutch controlling the clear indication, a rear relay of the block or section in advance of the signal-indicating means, such rear relay controlling the actuating mechanism to force the danger indication of the signal-indicating means should the counterweight fail, and clutch-controlling means controlled by such rear relay so that the clutch is deënergized by the actuation of the rear relay to force the danger indication independently of the operation of the signal-actuating means.

95. The combination of signal-indicating means counterweighted to go to danger, means for moving the same to safety constructed to permit the danger indication to be effected by the counterweight, a clutch adapted to control the movement to danger, a commutator moving with the signal-indicating means, and commutator-brushes therefor and other circuit-controlling devices coöperating therewith to control the clutch.

96. The combination of a signal counterweighted to go to danger, another signal counterweighted to go to danger, means for moving the signal to safety constructed to permit the signals to be put to danger by their counterweights, a separate clutch for each signal adapted to control the movement of its signal to danger, a commutator for each clutch moving with its signal, and commutator-brushes therefor and other circuit-controlling devices coöperating therewith to separately control the clutches.

97. The combination of railway signal-indicating means counterweighted to go to danger and constructed to indicate one block clear, two blocks clear and danger, electric clutch mechanism controlling the movement of the indicating means toward danger position, means for actuating the indicating means and permitting the indicating means to be moved by its counterweight toward the danger position, and circuit-controlling devices controlling the actuating means and clutch mechanism to actuate the clutch more powerfully in the movement from two to one block clear than in the movement from either clear position to danger.

98. The combination of railway signal-indicating means counterweighted to go to danger and constructed to indicate one block clear, two blocks clear and danger, electric clutch mechanism controlling the movement of the indicating means toward danger position, means for actuating the indicating means and

permitting the indicating means to be moved to danger by its counterweight, and a contact make and break device having a back contact and a front contact, the front contact being connected with the actuating means so that the closing thereof effects the movement of the indicating means toward safety, the back contact being connected with the clutch mechanism to actuate the same to check the movement toward danger, and the front contact being also connected with the clutch mechanism to more powerfully actuate the same to control the movement of the indicating means from two to one block clear.

99. The combination of railway signal-indicating means constructed to indicate one block clear, two blocks clear and danger, means for actuating the indicating means, a subdivided main commutator moving with the indicating means in the movement to clear, commutator-brushes therefor and other circuit-controlling devices coöperating therewith to control the movement of the indicating means and effect the movement from two to one block clear through circuits controlled by the commutator.

100. The combination of railway signal-indicating means counterweighted to go to danger and constructed to indicate one block clear, two blocks clear and danger, means for actuating the indicating means and permitting the indicating means to be moved by its counterweight toward danger position, and circuit-controlling devices controlling the actuating means to force the indicating means from two to one block clear in the event of the failure of the counterweight.

101. The combination of two signals counterweighted to go to danger, a clutch for each signal constructed to control the movement of the signal to danger, a commutator for each signal connected so as to move therewith and commutator-brushes therefor and other circuit-controlling devices coöperating therewith, means for actuating the signals, a main commutator connected to the signals so as to move therewith in the movement to clear and commutator-brushes therefor and other circuit-controlling devices coöperating therewith, the circuit for the distant signal being controlled by the main commutator in the movement from two to one block clear.

102. The combination of a home signal counterweighted to go to danger, a distant signal counterweighted to go to danger, a single actuating-rod, a connecting device joining the two signals to the single actuating-rod, and guides controlling the movements of the connecting device and shaped to afford no obstruction to the movement of the home signal to danger from any relative position of the two signals.

103. The combination of a home signal counterweighted to go to danger and an up-and-down rod therefor, a distant signal counterweighted to go to danger and an up-and-down rod therefor, a single actuating-rod, a cross-link connected to both up-and-down rods and to the single actuating-rod, and guides and other controlling means controlling the movements of the cross-link, the guides for the distant signal being shaped to prevent horizontal movement of the distant-signal up-and-down rod at the connection with the cross-link and the guides for the home signal being shaped to afford no obstruction to the horizontal movement of the home-signal up-and-down rod at its connection with the cross-link.

104. The combination of a home signal counterweighted to go to danger, a distant signal counterweighted to go to danger, a single reciprocating actuating-rod movable in one direction to put the signals to clear, actuating mechanism connected to the actuating-rod and dependent upon the return of the actuating-rod from the movement to clear for the further actuation thereof to put the signals to clear, and connecting means joining the two signals to the actuating-rod and connected thereto so that the completion of the return movement of the actuating-rod is dependent upon the return of the distant signal to danger.

105. The combination of a home signal and a distant signal, actuating means therefor, and a cross-link connected at its ends to the home signal and the distant signal, respectively, and engaging the actuating means at an intervening point.

106. The combination of a home signal and a distant signal, actuating means therefor, and a cross-link interposed between the signals and the actuating means and pivotally connected in proximity to its ends to the home signal and the distant signal, respectively, and pivotally connected at an intervening point to the actuating means.

107. The combination of a home signal counterweighted to go to danger and a distant signal counterweighted to go to danger, means for moving the signals to safety and permitting the signals to be put to danger by their counterweights, an electromagnetic clutch for each signal, each clutch being connected to the corresponding signal and constructed to control the movement of the signal to danger, a home-signal rear relay and a distant-signal rear relay controlling the means for moving the signals to safety, circuit-controlling devices actuated by the movements of each signal and controlling the corresponding clutch to check the movement of the corresponding signal to danger, and other circuit-closing devices controlled by the distant-signal rear relay to more powerfully energize the home-signal electromagnetic clutch, whereby the clutch becomes a holding-clutch to hold the home signal at safety while the distant signal is returned to danger by its counterweight.

108. The combination of a home signal a dis-

tant signal, actuating means therefor including a single clutch controlling the movements of each signal from danger to safety, and controlling means for returning the home signal to danger and maintaining the distant signal at safety.

109. The combination with signal-indicating means, of signal-actuating means, power initiating and continuing means for the actuating means, and a self-moving part for discontinuing the power-supply of the actuating means, such self-moving part being brought into action by the movement of the actuating means.

110. The combination with signal-indicating means, of signal-actuating means, power initiating and continuing means for the actuating means, and a pivoted weighted lever controlling the power-supply of the actuating means to discontinue such power-supply, and a part moving with the signal-actuating means and arranged to release such lever to permit the power-discontinuing movement thereof.

111. The combination, with signal-indicating means of a clutch controlling the clear indication, a part moving with the signal-indicating means in the movement to clear, and means for controlling the power-supply of the actuating means and including power-discontinuing means, such power-discontinuing means being controlled by the part moving with the signal-indicating means but being movable independently thereof in its power-discontinuing movement.

112. The combination with signal-indicating means, of signal-actuating means, a clutch controlling the clear indication, power initiating and continuing means for the actuating means, and a self-moving part for discontinuing the power-supply of the actuating means, such self-moving part being brought into action by the movement of the actuating means.

113. The combination with signal indicating means, of signal-actuating means, a clutch controlling the clear indication, power initiating and continuing means for the actuating means, and a pivoted weighted lever controlling the power-supply of the actuating means to discontinue such power-supply, and a part moving with the signal-actuating means and arranged to release such lever to permit the power-discontinuing movement thereof.

In testimony whereof I have affixed my signature in presence of two witnesses.

HENRY BEZER.

Witnesses:
HERBERT H. GIBBS,
HENRY D. WILLIAMS.