No. 847,157. PATENTED MAR. 12, 1907.

H. G. BROWN & E. DE M. MALAN.

SIGNALING APPARATUS.

APPLICATION FILED APR. 4, 1905.

3 SHEETS—SHEET 1.

Fig. 1d.

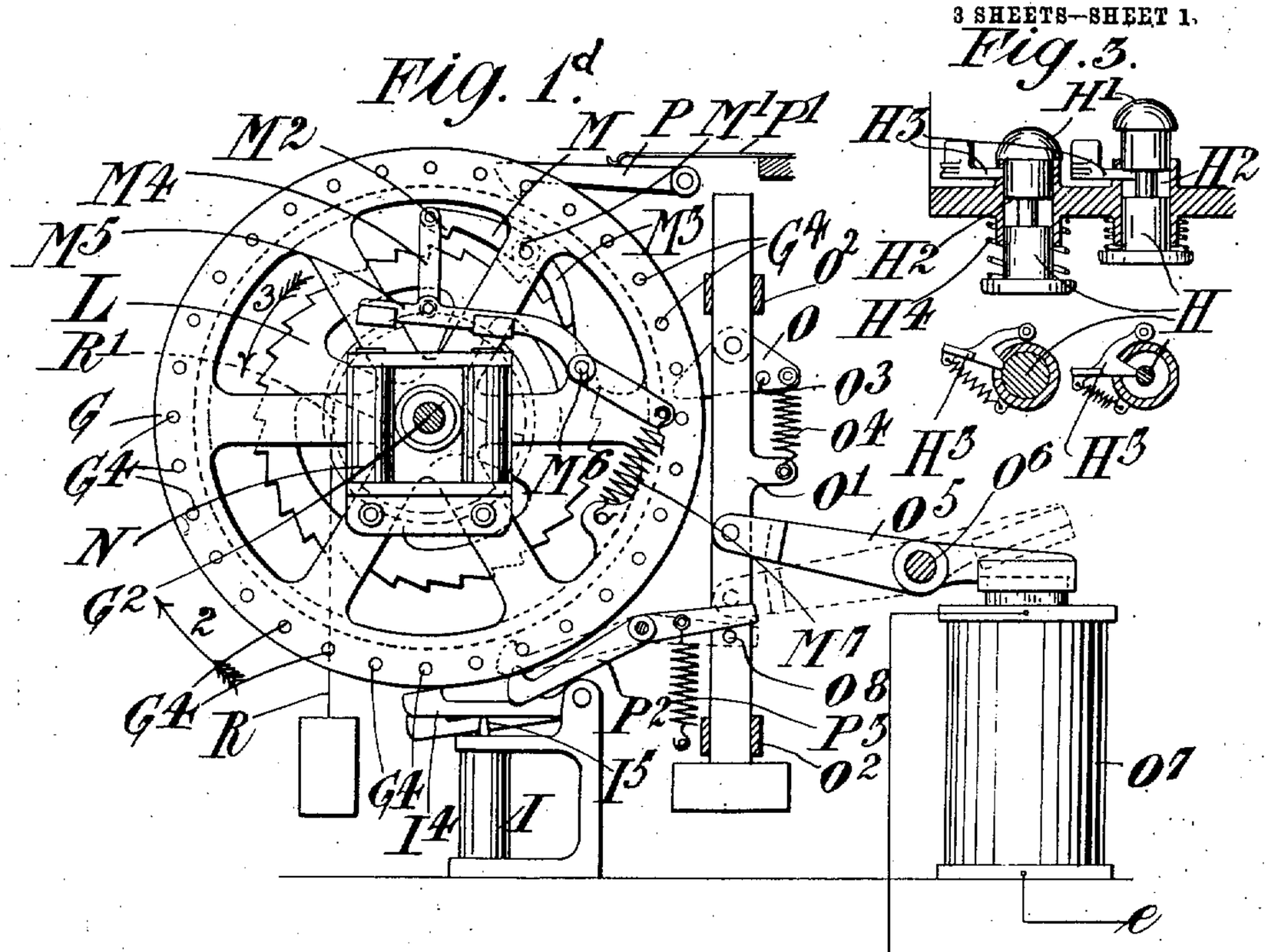


Fig. 4.

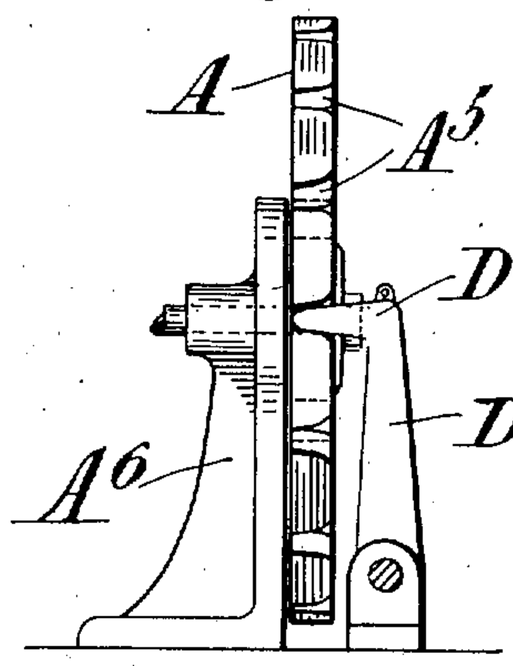
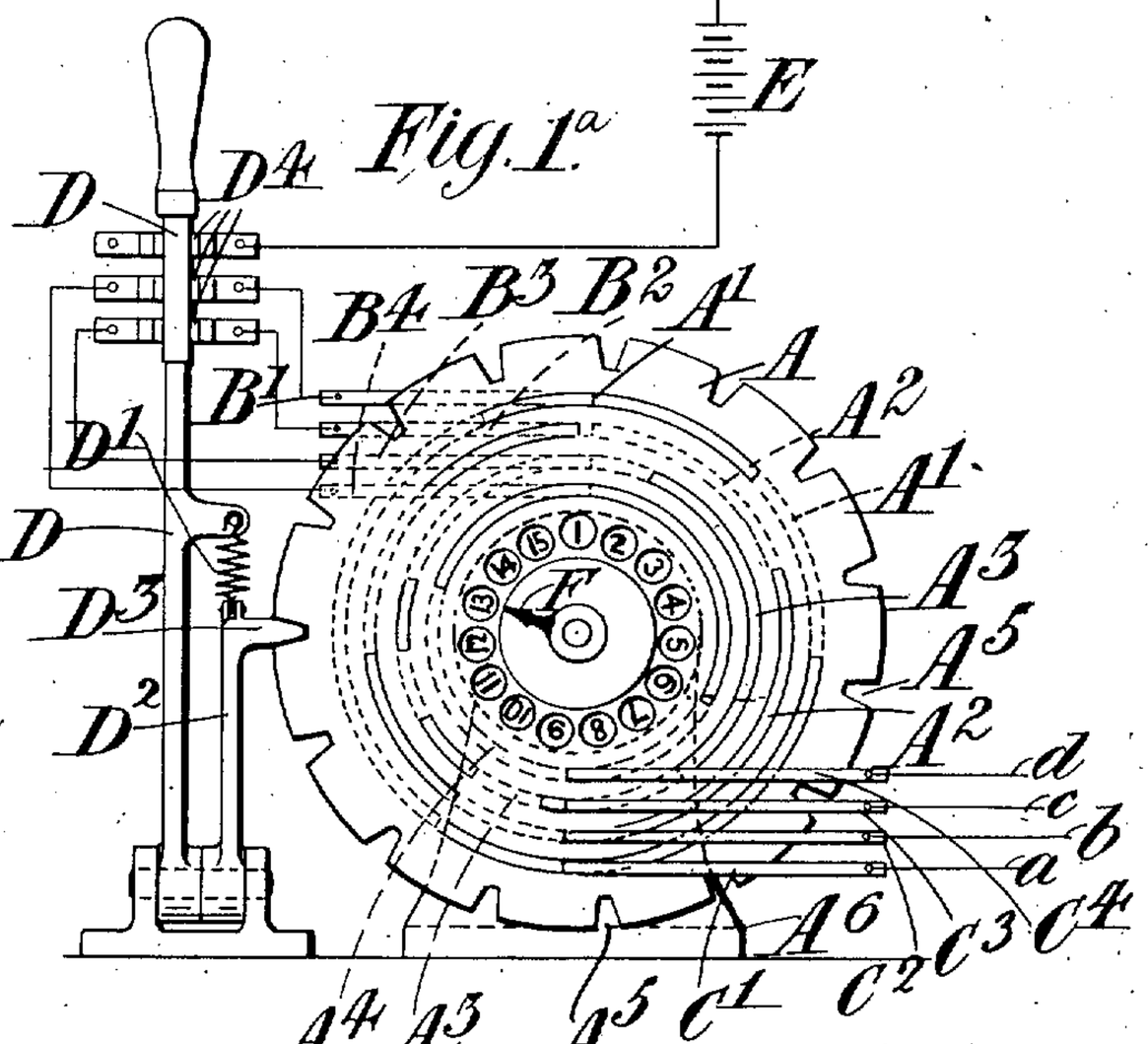


Fig. 1a.



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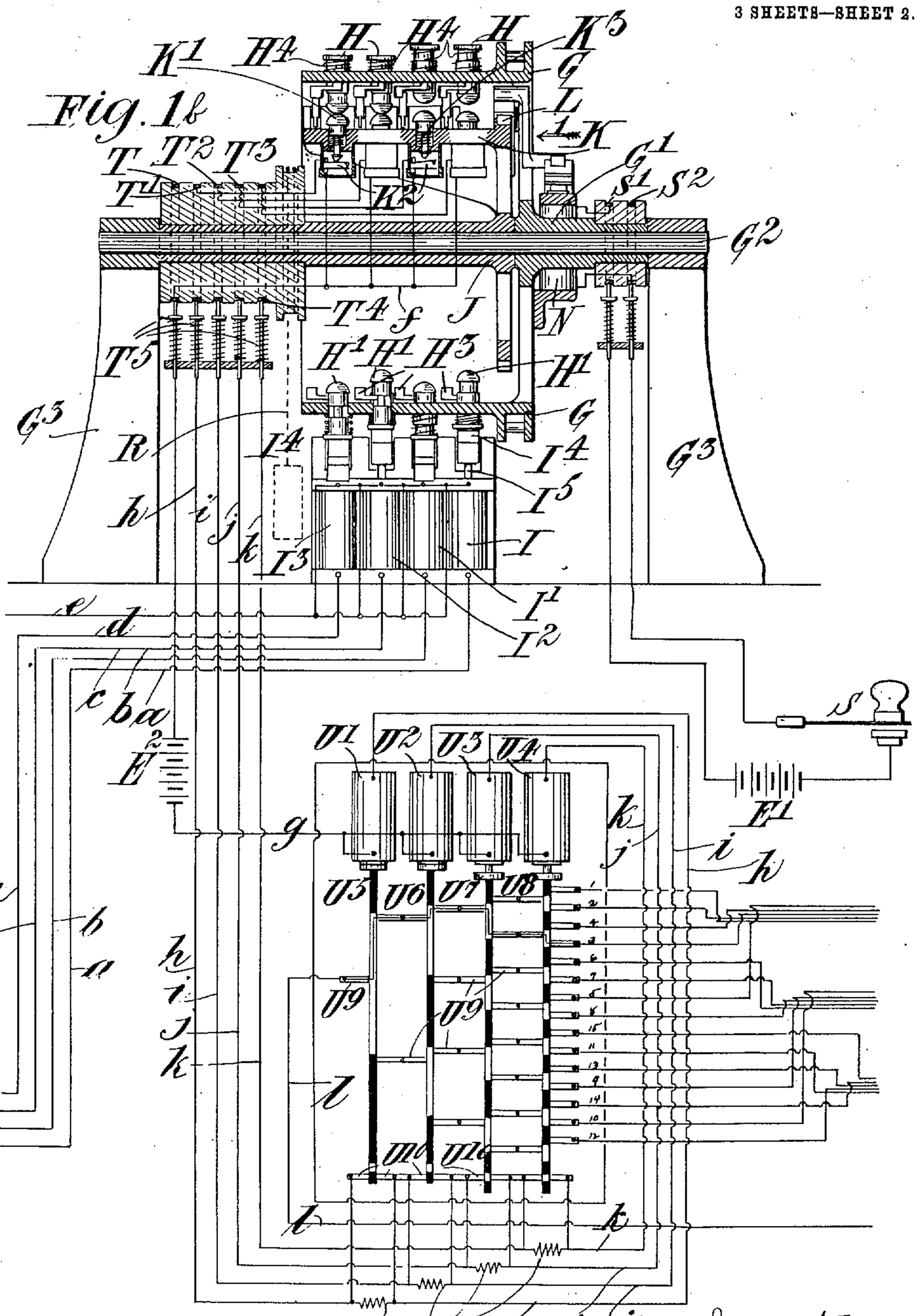
3 SHEETS—SHEET 2.

Fig. 1b



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3 SHEETS—SHEET 3.

Fig. 2.

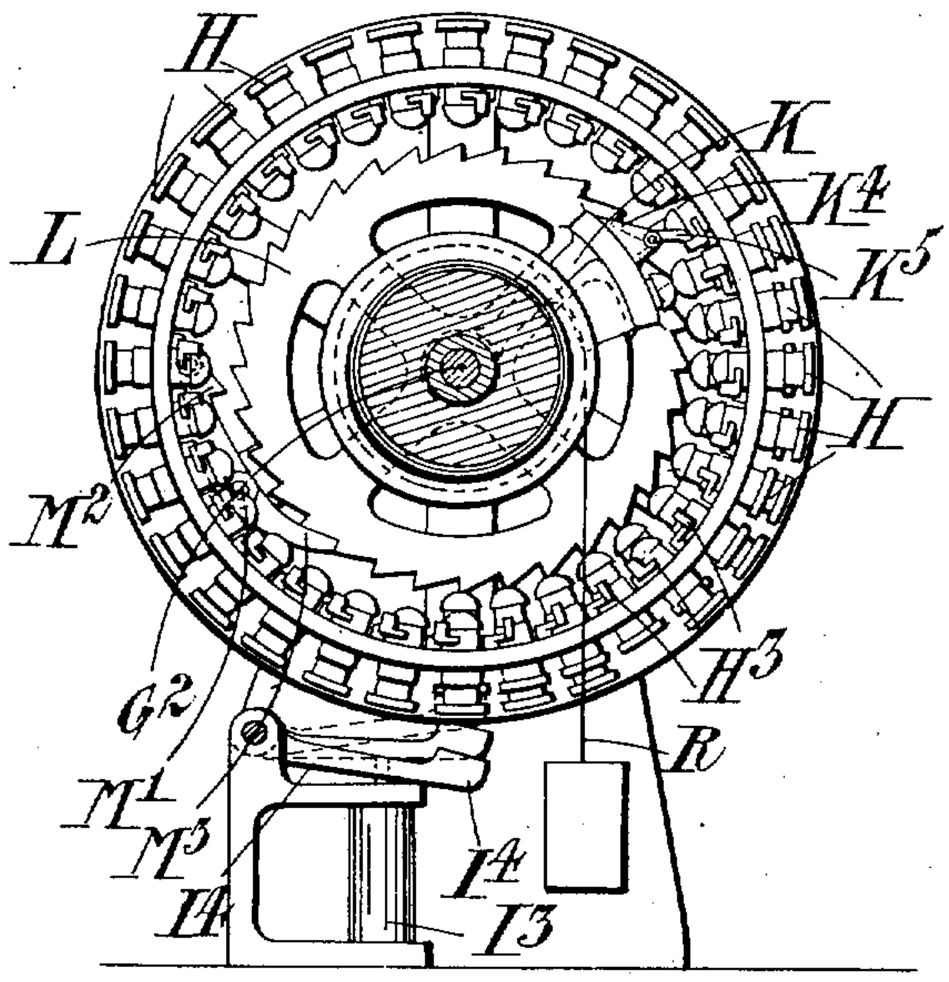

Fig. 5.

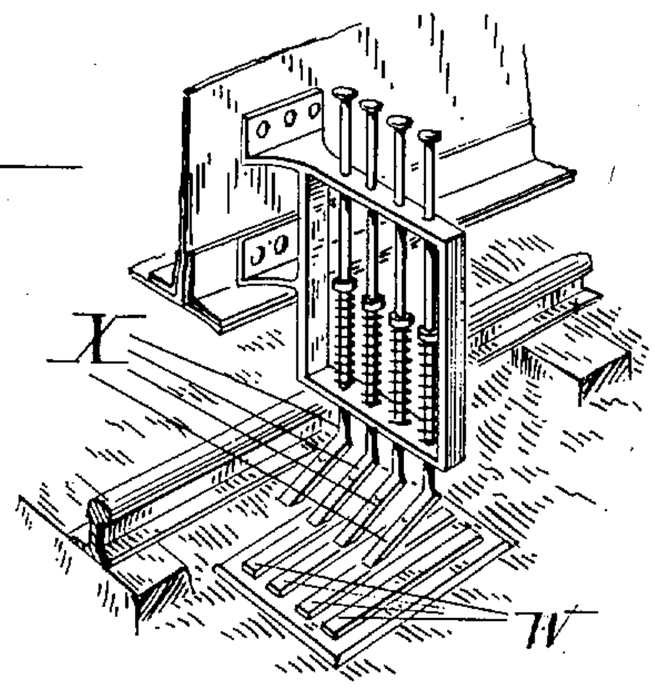

Fig. 1c

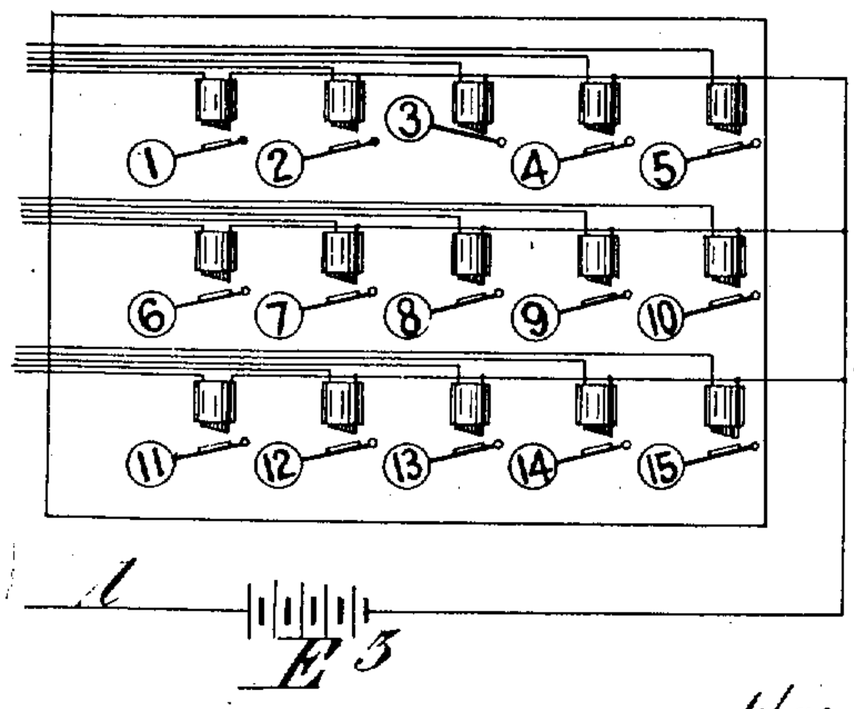

Fig. 3

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UNITED STATES PATENT OFFICE.

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SIGNALING APPARATUS.

No. 847,157. Specification of Letters Patent. Patented March 12, 1907.

Application filed April 4, 1905. Serial No. 253,849.

To all whom it may concern:

Be it known that we, HAROLD GILBERT BROWN, a citizen of the United States of America, and ERNEST DE MÉRINDOL MALAN, a subject of the King of England, residing, respectively, at West Ealing and Highgate, London, England, have invented certain new and useful Improvements in or Relating to Signaling Apparatus, of which the following is a specification.

This invention relates to signaling apparatus, and has particular reference to mechanism applicable, among other analogous uses, for signaling the description of a train from one signal-cabin to another.

The primary object of the invention, which is hereinafter described with particular reference to railway signaling, but only for convenience of description and by way of example and not by way of limitation, is the construction of what may be termed a "magazine-receiver"—that is, an instrument which can receive, store, and exhibit in the same sequence and individuality as that in which they were despatched—successive signals relating to a number of trains. The exhibition of the signals is preferably, though not necessarily, brought about by means of an annunciator working in combination with the magazine-receiver and announcing the stored signals in the same succession as that in which they were primarily despatched.

In its essential features signaling apparatus according to this invention comprises a frame, successively disposed groups of indicating members thereon, and means operating on the groups in succession and selectively on the indicating members of each group. The annunciator when employed is provided with sections adapted to coöperate with the indicating members of each group, and relative motion is produced by any convenient means between the groups of indicating members and the annunciator-sections.

The apparatus is preferably, though not necessarily, operated electrically and is so described in this specification.

A sending instrument or transmitter of any convenient type is, according to the present invention, combined with the magazine-receiver aforesaid and controls a number of circuits in the magazine-receiver, which in various combinations represent the train descriptions. The particular combination standing for a given description may be selected, say, by a commutator moving relatively to fixed contacts in the transmitter. For example, with four circuits—that is, four lines and a common return between the transmitter and the magazine-receiver—fifteen distinct combinations are available, and the transmitter is provided with fifteen operative positions, each position being labeled with a distinct train description.

The magazine-receiver is provided with movable members preferably in the form of plungers which are arranged in groups or rows, the number of members in each group corresponding to the number of circuits, so that in the example above taken there would be four movable plungers in each group.

Electromagnetic selective mechanism connected with the transmitter-circuits is arranged in the magazine-receiver, so that on the receipt of a signal the plungers in one row are moved relatively to their supporting-frame to correspond with the particular combination of circuits selected by the transmitter.

Relative motion can take place between the magazine-receiver frame and the electromagnetic mechanism, and preferably the frame is shifted step by step relatively to the fixed electromagnetic mechanism as each signal is received, so that each group of plungers is brought in turn into coöperative position with regard to the electromagnetic mechanism. Thus, for example, if five different signals are sent in succession they will be represented by five groups of plungers, one or more of the plungers in each group being moved relatively to the frame in accordance with the signal. The position of these plungers relatively to the frame is itself an indication of the signal sent—that is to say, it acts as a train description—but preferably each plunger when shifted by the electromagnetic mechanism is arranged to close either immediately or subsequently an electric circuit which operates either alone or in conjunction with the other circuits closed by the plungers in the same row to give a visible signal on an annunciator.

The annunciator is provided with sections adapted to coöperate with the plungers and having contacts closed by the plungers when

the latter are set in their signaling positions. These sections and contacts are conveniently carried upon a movable support forming part of the magazine-receiver and set initially so that the contacts are in juxtaposition with the group of plungers that is to be operated by the first-received signal. This support moves with the frame as signals are received and stored, but is moved step by step relatively to the frame when the received signals are sent onward from the magazine-receiver. Thus, supposing station A sends three train descriptions to station B, so long as B does not communicate any of these descriptions to C the support carrying the annunciator-contacts in B's receiver does not move relatively to the frame, but moves with the frame, that brought the plungers for these descriptions group by group into coöperation with the setting electromagnetic mechanism. As soon, however, as B transmits to C the first signal he has received from A the support carrying B's annunciator-contacts is moved one step relatively to the frame and in a direction opposite to that in which it moved with the frame. This movement brings the annunciator-contacts carried by the support into connection with the next row of previously-set plungers, so that the next stored signal is announced at B's station. The same relative movement of the support and the frame may be utilized to restore the preceding row of plungers to their normal position.

Conveniently the motion of the magazine-receiver frame is brought about by a step-by-step mechanism operated by a weight and controlled by an electromagnet, the circuit of which is closed by the transmitter at the sending station. This movement is communicated to the annunciator-contact-carrying support through a pawl and ratchet-wheel, and when as above described it is necessary for the support to move in the contrary direction relatively to the frame, this pawl and ratchet-wheel, which are controlled by a separate electromagnet, act as a step-by-step escapement and allow the required independent motion to be imparted to the support by means of, say, a weighted cord.

In the accompanying drawings, Figs. 1^a, 1^b, 1^c, and 1^d are four views illustrating diagrammatically one construction of signaling apparatus according to this invention. Fig. 2 is an elevation of a portion of the magazine-receiver. Fig. 3 illustrates in detail and on a larger scale the construction of the movable plungers. Fig. 4 is an elevation of part of the transmitting apparatus taken at right angles to the view in Fig. 1^a, and Fig. 5 is a diagram showing train-carried transmitting-contacts.

With reference first to Fig. 1^a, A is a transmitter-disk, of insulating material, having four conducting-rings A', A^2, A^3, and A^4, attached to one side of it. These rings are in permanent contact with springs B', B^2, B^3, and B^4, and portions of the rings project through the insulating-disk A, forming segmental conductors, which according to the position of the disk make electrical connection with other contact-springs C' C^2 C^3 C^4. The four contacts enable fifteen distinct signaling combinations to be used, and the disk A is provided with notches A^5 and numbers carried upon a fixed support A^6 and visible through holes in the disk, so that the disk, which is rotatable, may be readily placed in the right position to give any desired combination. Working in conjunction with the transmitter-disk is a switch-lever D, connected through a spring D' with a pivoted arm D^2, having a projection D^3, which enters one of the notches A^5 when the switch-lever is closed—*i. e.*, is brought into connection with contact-springs D^4. As will be seen from Fig. 1^a, when this switch is closed the springs B' B^2 B^3 B^4, and consequently the rings A' A^2 A^3 A^4, are brought into electrical connection with a transmitter-battery E, one pole of which is permanently connected to one of the switch-contacts D^4. A pointer F on the transmitter turns with the disk A and indicates by its position which of the fifteen combinations will be selected when the switch is closed. As will be seen by reference to the other view of the switch-lever, (shown in Fig. 4 of the drawings,) the notches A^5 are beveled at one side, so that should the setting of the disk not be quite accurate the projection D^3 may nevertheless enter when the switch is closed and will then itself bring about the final adjustment of the disk A.

The magazine-receiver is shown in Fig. 1^b in longitudinal vertical section and in Fig. 1^d in elevation looking in the direction of the arrow 1, Fig. 1^b. It comprises a frame in the form of a drum G, rotatably mounted, by means of a long bearing G', upon a shaft G^2, supported upon standards G^3. Round the periphery of this frame are a number of groups of indicating members in the form of plungers H, four in a group, and arranged so that they can slide radially in and out of the frame G. The details of construction of these plungers are shown in Fig. 3, where it will be seen that the inner end of each plunger is formed with a round face H' and that a recess H^2 is made approximately in the center of the length of the plunger into which recess a spring-controlled retaining-catch H^3 is automatically introduced when the plunger has been pushed in. The function of this catch H^3 is, as will be hereinafter described, to retain the plunger H in its inward position against the action of a spring H^4 until the signal represented by the plunger has been announced and canceled.

The movement of the plungers H rela-

tively to the frame G is brought about by electromagnets I, I′, I², and I³, which are fixed beneath the frame G and are provided with pivoted armatures I⁴, which when the electromagnets are energized are lifted up by plungers I⁵ and caused to push in the plungers H, which are opposite to them. These electromagnets I I′ I² I³ are joined, respectively, to the contacts C′ C² C³ C⁴ by the conductors *a*, *b*, *c*, and *d*.

Mounted upon a sleeve J on the shaft G is a segment-shaped member K. (Shown in elevation in Fig. 2.) This serves as a support for spring-controlled plungers K′, which coöperate with annunciator-contacts K², also carried upon the support K. The springs K³ normally press the contact-plungers K′ outward, and, as will be seen from the sectional view of the receiver in Fig. 1ᵇ, there is a space between the plungers K′ and the inner ends of the indicating-plungers H when the latter are in their normal position—that is to say, when they are not depressed against the action of the springs H⁴.

When one of the plungers H is pushed inward, as shown at the top left-hand portion of the sectional view of the magazine-receiver, its inner end comes into contact with the corresponding plunger K′, and the plunger H being retained, as previously mentioned by the catch H³, the annunciator-plunger K′ is depressed against the action of its spring K³ and the contact K² is closed, completing a circuit in an annunciator, hereinafter described.

Although the support K, with its plungers and contacts, is structurally part of the receiver, it is functionally a portion of the annunciator, and the plungers, with their contacts, are to be regarded as sections of the annunciator.

The support K is provided with a ratchet-wheel L, and a pallet M, pivoted, as at M′, to a portion of the side of the frame G, bears two pawls M² and M³, which form an escapement controlling the motion of the wheel L and the support K relatively to frame G and also constitute means for locking the support to the frame G when they are required to move together relatively to the selective devices I I′ I² I³. The pallet M is joined by a link M⁴ to a lever M⁵, forming the armature of an electromagnet N, mounted upon the side of the frame G. This lever M⁵ is pivoted to the side of the frame, as at M⁶, and its free end is controlled by a spring M⁷, which tends to keep the armature end of the lever M⁵ raised, as shown in elevation in Fig. 1ᵈ, thus causing the pawl M³ to keep in engagement with the teeth of the ratchet-wheel L. Thus it will be seen that with the mechanism in this position the frame G and the annunciator section-support K are locked and would rotate together if the frame were driven in the direction of the arrow 2 in Fig. 1ᵈ. Motion of the frame in this direction is necessary to bring the groups of plungers H successively into coöperation with the selective electromagnets I I′ I² I³ and is brought about in the following way: The frame G is provided with pins G⁴, corresponding in number to the rows of plungers H. Engaging with these pins is a pawl O, pivoted to a weighted rod O′, sliding in vertical guides O². This pawl is provided with a stop-pin O³ and is controlled by a spring O⁴. To the weighted rod O′ is connected one end of a lever O⁵, pivoted, as at O⁶, and bearing at its other end the armature of an electromagnet O⁷. One end of the winding of this electromagnet O⁷ is joined by a conductor *e* to all the electromagnets I I′ I² I³, and the other end is joined to the battery E, so that the electromagnet O⁷ is energized whenever the switch D is closed, and the consequent movement of the armature-lever O⁵ raises the weighted rod O′, causing the pawl O to slip over one of the pins G⁴. On the opening of the sending-circuit the armature-lever O⁵ is released, the weighted rod O′ descends, and the pawl O, now kept rigid by its stop O³ bearing against the rod, engages with the pin G⁴ directly beneath it and drives the frame G in the direction of the arrow 2, thus bringing the next set of plungers H over the armature I⁴ ready for selective setting. To limit the movement of the frame G two pawls are provided. One, P, near the top of the frame, is controlled by a spring P′ and prevents any motion of the frame in a direction opposite to that of the arrow 2. The other, P², near the lower portion of the frame, is controlled by a spring P³ and forms part of a lever, the other end of which rests against a stop O⁸ on the rod O′. Normally—*i. e.*, when the electromagnet O⁷ is not energized—this pawl P², controlled by its spring P³, occupies the position shown in dotted lines in Fig. 1ᵈ and prevents any rotation of the frame G in the direction of the arrow 2; but when the rod O′ is raised, as previously described, the stop-pin O⁸ causes the pawl P² to move down out of engagement with the pin G⁴, as shown in full lines in the drawings. As the rod O′ descends the pawl P² rises and ultimately engages with the next pin G⁴, so that the rotation of the frame is limited to an amount equal to the distance between two adjacent pins G⁴. It is to be understood that as far as this part of the invention is concerned the essential feature is the production of relative motion between the groups of indicating members and the selective mechanism—*i. e.*, between the groups of plungers H and the electromagnets I, I′, I², and I³. In the construction shown in the drawings this is accomplished, as described, by causing the frame G carrying the plungers to rotate relatively to the fixed electromagnets I, I′, I², and I³.

As previously mentioned, the pawl M^3 by its engagement with the teeth of the ratchet-wheel L locks the support K to the frame G, so that the support moves with the frame in the direction of the arrow 2.

For certain functions hereinafter more fully described it is necessary for the support K to move relatively to the frame G. This independent movement of the support K takes place in the direction of the arrow 3 in Fig. 1^a and is brought about by a weighted cord R, attached to a pulley R', mounted on the sleeve J. The electromagnet N when energized pulls down the armature-lever M^5 against the action of the spring M^7. This causes the pawl M^3 to disengage the teeth of the ratchet-wheel L, and as soon as this disengagement takes place the weight shifts the wheel in the direction of the arrow 3 slightly. The movement, however, is limited by the pawl M^3, which has now been brought down into the path of the teeth. On the release of the armature of the electromagnet N the pawl M^3 descends again and comes into engagement with the next tooth, so that the one complete movement of the lever M^5 down and up again allows the support K to rotate under the influence of the weighted cord R for an amount equal to one tooth of the ratchet-wheel L. The number of teeth is equal to the number of pins G^4—that is, to the number of rows of plungers H. Therefore the result of this independent movement of the support K is to bring the annunciator-plungers K', carried by the support, into operative position from one row of plungers H to the other.

It will be seen on reference to Fig. 2 and to the sectional view of the magazine-receiver in Fig. 1^b that the support K carries in brackets K^4 four fingers or wipers K^5. These fingers are in the path of the tails of the catches H^3, so that when the support K rotates independently of the drum G the fingers K^5 come into contact with any of the catches H^3 which have entered the recesses H^2 in the plungers H and move them against the action of their springs, thus allowing the plunger-springs H^4 to replace the plungers in their normal outward positions.

The energizing of the electromagnet N necessary for the independent movement of the frame K is brought about from a battery E', which is joined through a key S at the receiving-station to slip-rings S' S^2. These rings are mounted upon a suitable support on the sleeve G' and are connected to the ends of the winding of the electromagnet M^5.

In the drawing the key S is shown as a simple key and may be termed an "announcing" and "canceling" key, as its function is to bring about the rotation of the support K, and consequently the announcement and cancellation in succession of the indications previously given at the receiving-station. When, however, the signals are to be passed on from one receiving-station to another, the circuit of the battery E' would be closed by or at the same time as the closing of the transmitter-switch D, so that the transmission of a previously-received signal from one receiving-station to the next would automatically cancel the indication at the first receiving-station and also cause the indication at that station of the next stored signal.

As previously mentioned, the positions of the plungers H relatively to the frame G themselves indicate the signal sent from the transmitting-station, and if no other indication is required the plungers K' and contacts K^2 may be dispensed with and the independent rotation of the support K used simply for cancellation. It is, however, preferred to have a separate annunciator working in conjunction with the plungers K' and contacts K^2, and the annunciating arrangements will now be described.

Mounted upon the sleeve J are five slip-rings T T' T^2 T^3 T^4. The ring T is joined by a conductor *f* to the lower contact of all the four contact-keys K^2, while the rings T' T^2 T^3 T^4 are joined severally to the upper contacts of those keys. Rubbing-contacts T^5 are provided for all the rings, and the ring T is connected to a battery E^2, the other pole of which is joined by a conductor *g* to one pole of the windings of four electromagnets U' U^2 U^3 U^4. The other ends of the windings of these electromagnets are joined by conductors *h*, *i*, *j*, and *k* to the rubbing-contacts in connection with the rings T', T^2, T^3, and T^4, respectively. Each of the electromagnets U' U^2 U^3 U^4 has an armature bearing a rod made up of conducting and insulating parts. These rods are shown diagrammatically in Fig. 1^b and are lettered U^5, U^6, U^7, and U^8, respectively, the insulating portions of each rod being indicated by the dark portions of the diagram. Adjacent to each rod are rubbing-contacts U^9, and the rod U^8 is provided with fifteen rubbing-contacts joined to conductors marked with the numbers "1" to "15," respectively, each of these conductors being joined to a separate annunciator electromagnet bearing a corresponding number. These electromagnets are joined, through a battery E^3, to a common return-conductor *l*, connected to the rubbing-contact U^9 in connection with the rod U^5.

It will be noticed that each of the rods U^5, U^6, U^7, and U^8 is provided with a conducting portion near its extremity, which when the armature is down—that is, unattracted—makes contact with the particular conductor *h i j k* belonging to the magnet-circuit through adjacent contact-pieces U^{10}. These contact-pieces are shunted by resistances U^{11}, and the object of the arrangement is to avoid waste of energy, so that a large current may be allowed to pass through, for example, the

conductor *h* to energize the magnet U′ and then when that magnet pulls its armature-rod U⁵ up the direct circuit is broken at U¹⁰ and the diminished current passing through the resistance U¹¹ serves to retain the armature in its raised position.

The operation of the apparatus is as follows: The transmitter-disk A is first turned until the pointer F, which moves with it, points to the number indicating the signal required. For example, in the drawing the pointer indicates the number "13." In this position it will be seen that the contact-springs C′ and C³ are in contact with the conducting-segments of the rings A′ and A³, and that the other two springs C² and C⁴ are not against their respective conductors. The switch D is now momentarily closed, and consequently current from the battery E flows through the conductors *a* and *c* to the electromagnets I and I², respectively. The armatures I⁴ of these magnets are consequently raised and operate against the plungers H adjacent to them, which are shown in the sectional view of the receiver in Fig. 1ᵇ pressed inward by the armatures I⁴. At the same time the electromagnet O⁷, which is in series with the electromagnets I I′ I² I³, is energized and lifts the rod O′, ready to shift on the frame G when it descends, a motion which takes place immediately after the current ceases to flow through the electromagnet O⁷. As will be understood from the previous description, the displaced plungers H in due course coöperate with the annunciator-plungers K′, carried on the support K, and for clearness of description it is convenient now to consider the upper portion of the receiver shown in section in Fig. 1ᵇ of the drawings, where two of the plungers H, which have been, through some previous signal, operated by the armatures of the electromagnets I³ and I², are shown in coöperation with their respective annunciator-plungers K′. These, it will be seen, are depressed, and consequently their spring-contacts K² are closed. Current therefore passes from the battery E² through the ring T to the conductor *f*, where the circuit divides, part of the current going through one contact K² to the ring T′ and thence by the conductor *h* to the electromagnet U′ back to the battery E², while the other part flows through another contact K², the ring T², conductor *i*, and electromagnet U² back to the battery. Thus the magnets U′ U² are energized and, as shown in the diagram, attract their respective armature-rods U⁵ U⁶. The result of this movement may be seen from that part of the diagram relating to the annunciator. Current from the battery E³ flows through the conductor *l* and rubbing contact U⁹ and thence, as indicated by the line passing through the conducting portion of the four rods U⁵ U⁶ U⁷ U⁸, out by the rubbing contact into conductor 3, whence it passes round the annunciator-magnet 3, which therefore attracts its armature, and back to the battery E³. It will be readily seen that any of the other fourteen combinations could be effected in a similar manner. Suppose now the receiving-station wishes to cancel the signal just announced. The key S is closed, the electromagnet N energized from the battery E′, and the support K rotated. The movement of the support K withdraws the annunciator-plungers K′ from coöperation with the previous set of plungers H, and consequently the contacts K² previously closed are opened, the electromagnets U′ U² deënergized, and the annunciator-armature 3 allowed to drop. The same movement, however, will bring the annunciator-plungers K′ into coöperation with the next set of plungers H, and should any of these be depressed—that is to say, should another signal have been stored—some one or more of the plungers K′ will be depressed and another annunciation made. As previously mentioned, the plungers H are mechanically replaced through the action of the wiper-fingers K⁵, which by the motion of the support K are brought into contact with the retaining-catches H³.

The number of groups of plungers H on the receiver-frame G should always exceed the capacity of the line between the receiving-station and the sending-station, so that the support K is never required to make a complete revolution relatively to the frame. The weighted cord R, operating the support K, will then never require winding, for the amount of cord unwound by each independent movement of the frame for annunciation or cancellation is rewound by the movement in the opposite direction produced by each description.

It will be appreciated that the essential feature necessary for the successive annunciation of previously-stored signals is that relative motion should be produced between the annunciator-sections and the indicating members, and this relative motion may be produced in any convenient way, although in the construction illustrated in the drawings the annunciator-sections are caused to move relatively to the indicating members. Further, the weighted cord R is only one example of a tension driving device for moving the annunciator-sections. Any such device operatively connected to the annunciator-sections—that is to say, to the support K—may be employed, and it may be wound up by either of the two parts that coöperate in the relative movement between the frame and the selective device. Thus in the construction illustrated the weighted cord is wound up by the frame G moving relatively to the electromagnets I, I′, I², and I³; but in a construction where the frame is stationary the movement of the selective device can be

utilized to wind up the weighted cord or otherwise store energy afterward used for causing the independent movement of the annunciator-sections.

It is within the present invention to employ upon a train adjustable contacts capable of transmitting impulses to the receiving-station in like manner and in like order to that in which they are transmitted, as above described, by manual movement of the transmitting apparatus. Fig. 5 of the drawings illustrates diagrammatically such an arrangement. Contacts W are placed on the road-bed and coöperate with brushes or spring-contacts X, which are carried by the train and are under the control of the driver. In like manner the circuit of the battery E′ may be closed automatically by a train instead of being manually operated, and in this case a train passing a given point would by operating a treadle or in any other well-known way cause the rotation of the support K, and consequently bring about the cancellation of one description and the annunciation of the description next in order.

The details of the construction of the various parts of the apparatus may be altered without departing from the spirit of this invention.

Although, as aforesaid, this invention is described with reference to the transmission, storage, and repetition of signals to indicate descriptions or route of successive railway-trains, it is applicable with equal advantage to the transmission, storage, and repetition of other series of signals or records.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In signaling apparatus the combination with a transmitter of a magazine-receiver and an annunciator that exhibits the transmitted signals in the same sequence and individuality as that in which they were primarily despatched.

2. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, and means operating on the groups in succession and selectively on the indicating members of each group.

3. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, means for operating selectively upon the indicating members of each group and means whereby relative motion is produced between the selective devices and the groups of indicating members.

4. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members in a circle thereon, a device for acting selectively upon the indicating members of each group, and means to produce relative circular motion between the frame and the selective device.

5. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon and electromagnetic mechanism operating on the groups in succession and selectively upon the indicating members of each group.

6. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, electromagnetic devices for operating selectively upon the indicating members of each group, and electromagnetic mechanism by which relative motion is produced between the selective devices and the groups of indicating members.

7. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, stationary electromagnetic devices for operating selectively upon the indicating members of each group, and electromagnetic mechanism by which the frame is rotated to produce relative motion between the selective devices and the groups of indicating members.

8. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, traveling electromagnetic devices for operating selectively upon the indicating members of each group, and electromagnetic mechanism by which the said devices are made to travel to produce relative motion between the selective device and the groups of indicating members.

9. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, means operating on the groups in succession and selectively on the indicating members of each group, an annunciator having sections adapted to coöperate with the indicating members of each group, and means by which relative motion is produced between the groups of indicating members and the annunciator-sections.

10. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, stationary electromagnetic devices for operating selectively upon the indicating members of each group, electromagnetic mechanism by which the frame is rotated to produce relative motion between the selective device and the groups of indicating members, an annunciator having sections adapted to coöperate with the indicating members of each group, and means to move the annunciator-sections from group to group of the indicating members.

11. In signaling apparatus the combination of a frame successively-disposed groups of indicating members thereon, means operating on the groups in succession and selectively on the indicating members of each group, and means for thereafter operating on the groups to restore the indicating members to their normal condition.

12. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, stationary electromagnetic devices for operating selectively upon the indicating members of each group, electromagnetic mechanism by which the frame is rotated to produce relative motion between the selective device and the groups of indicating members, and means for restoring the indicating members to their normal condition.

13. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, stationary electromagnetic devices for moving selectively the indicating members of each group in relation to the frame, electromagnetic mechanism by which the frame is rotated to produce relative motion between the selective device and the groups of indicating members, and means for replacing the members relatively to the frame.

14. In signaling apparatus the combination of a frame, successively-disposed groups of loaded indicating members thereon, means for moving selectively the indicating members of each group in relation to the frame, spring-operated catches for retaining the indicating members in their selected positions and means for disengaging the catches from the members to permit them to return to their normal position.

15. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, means for operating selectively upon the indicating members of each group and weight-actuated electromagnetically-controlled step-by-step driving mechanism whereby relative motion is produced between the selective devices and the groups of indicating members.

16. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, means operating on the groups in succession and selectively on the indicating members of each group, an annunciator having sections adapted to coöperate with the indicating members of each group, weight-actuated mechanism by which relative motion is produced between the groups of indicating members and the annunciator-sections and an electromagnetic escapement for controlling such motion.

17. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, means operating on the groups in succession and selectively on the indicating members of each group, weight-actuated electromagnetically-controlled step-by-step driving mechanism whereby relative motion is produced between the selective devices and the groups of indicating members, an annunciator having sections adapted to coöperate with the indicating members of each group, weight-actuated mechanism by which relative motion is produced between the groups of indicating members and the annunciator-sections and an electromagnetic escapement for controlling such motion.

18. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, stationary electromagnetic devices for operating selectively upon the indicating members of each group, weight-actuated electromagnetically-controlled step-by-step driving mechanism by which the frame is rotated to produce relative motion between the selective devices and the groups of indicating members, an annunciator having sections adapted to coöperate with the indicating members of each group, weight-actuated mechanism by which relative motion is produced between the groups of indicating members and the annunciator-sections and an electromagnetic escapement for controlling such motion.

19. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members in a circle thereon, a device for acting selectively upon the indicating members of each group, an annunciator having sections adapted to coöperate with the indicating members of each group, means to produce relative circular motion between the frame and the selective device, means for locking together and unlocking the frame and the annunciator-sections and means by which relative angular motion can be produced between the groups of indicating members and the annunciator-sections.

20. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members in a circle thereon, a device for acting selectively upon the indicating members of each group, an annunciator having sections adapted to coöperate with the indicating members of each group, means to produce relative circular motion between the frame and the selective device, means for locking together and unlocking the frame and the annunciator-sections and a tension driving device operatively connected with the annunciator-sections and wound up by one of the two parts that coöperate in the production of the relative circular motion aforesaid.

21. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, stationary electromagnetic devices for operating selectively upon the indicating members of each group, an annunciator having sections adapted to coöperate with the indicating members of each group, driving mechanism by which the frame is rotated to produce relative motion between the selective devices and the groups of indicating members, a support for the annunciator-sections, ratchet-teeth on

such support, a spring-controlled pawl pivoted to the frame and engaging with said teeth when the frame is moved by its driving mechanism, a weight tending to rotate the support and the annunciator-sections in a direction contrary to the motion of the frame and an electromagnet to disengage the pawl from the ratchet-teeth to allow such motion to take place.

22. In signaling apparatus the combination of a frame, successively-disposed groups of indicating members thereon, stationary electromagnetic devices for operating selectively upon the indicating members of each group, an annunciator having sections adapted to coöperate with the indicating members of each group, weight-actuated electromagnetically-controlled step-by-step driving mechanism by which the frame is rotated to produce relative motion between the selective devices and the groups of indicating members, a support for the annunciator-sections, ratchet-teeth on such support, a spring-controlled pawl pivoted to the frame and engaging with said teeth when the frame is moved by its driving mechanism, a weight tending to rotate the support and the annunciator-sections in a direction contrary to the motion of the frame and an electromagnet to disengage the pawl from the ratchet-teeth to allow such motion to take place.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HAROLD GILBERT BROWN.
ERNEST DE MÉRINDOL MALAN.

Witnesses:
HARRY B. BRIDGE,
ARCHD. J. FRENCH.