Sept. 4, 1928. 1,682,997

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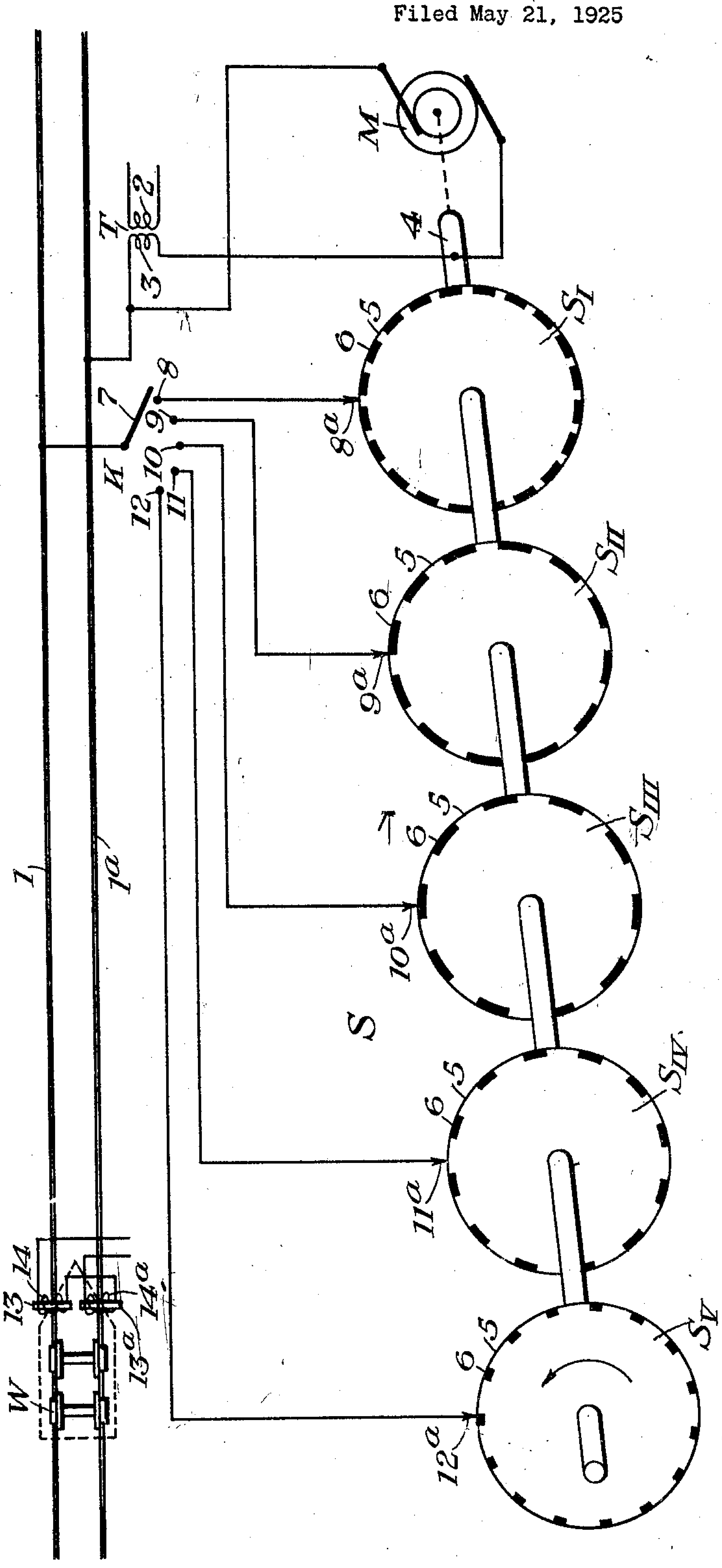
RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed May 21, 1925 3 Sheets-Sheet 1



Code	Code Wheel	Interval of Closed Circuit	Interval of Open Circuit
I	S_I	½ Second	1 Second
II	S_{II}	1 Second	1½ Seconds
III	S_{III}	1½ Seconds	1½ Second
IV	S_{IV}	1½ Seconds	1 Second
V	S_V	1½ Seconds	½ Second

Fig. 1.

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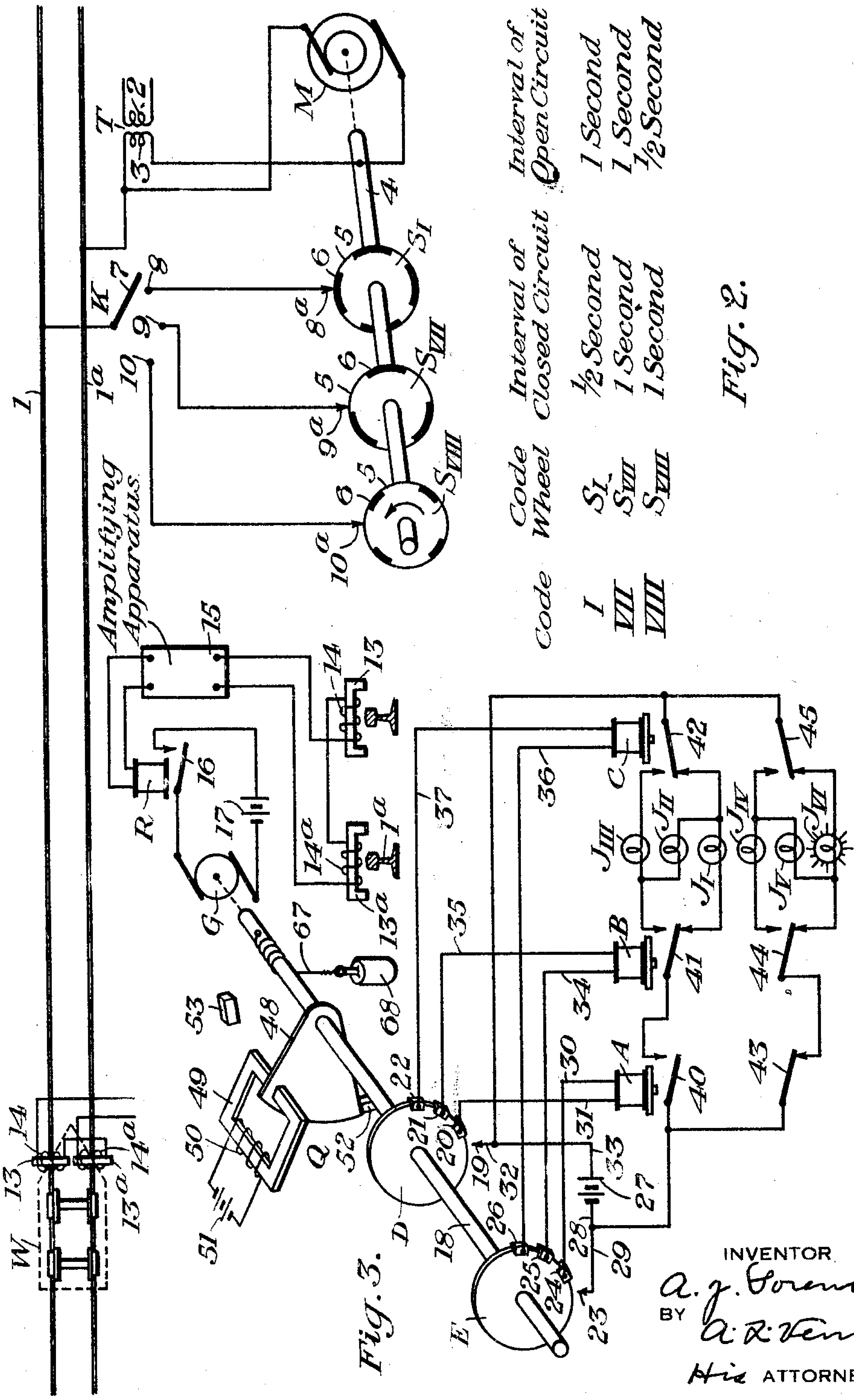
3 Sheets-Sheet 2



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Filed May 21, 1925 3 Sheets-Sheet 3

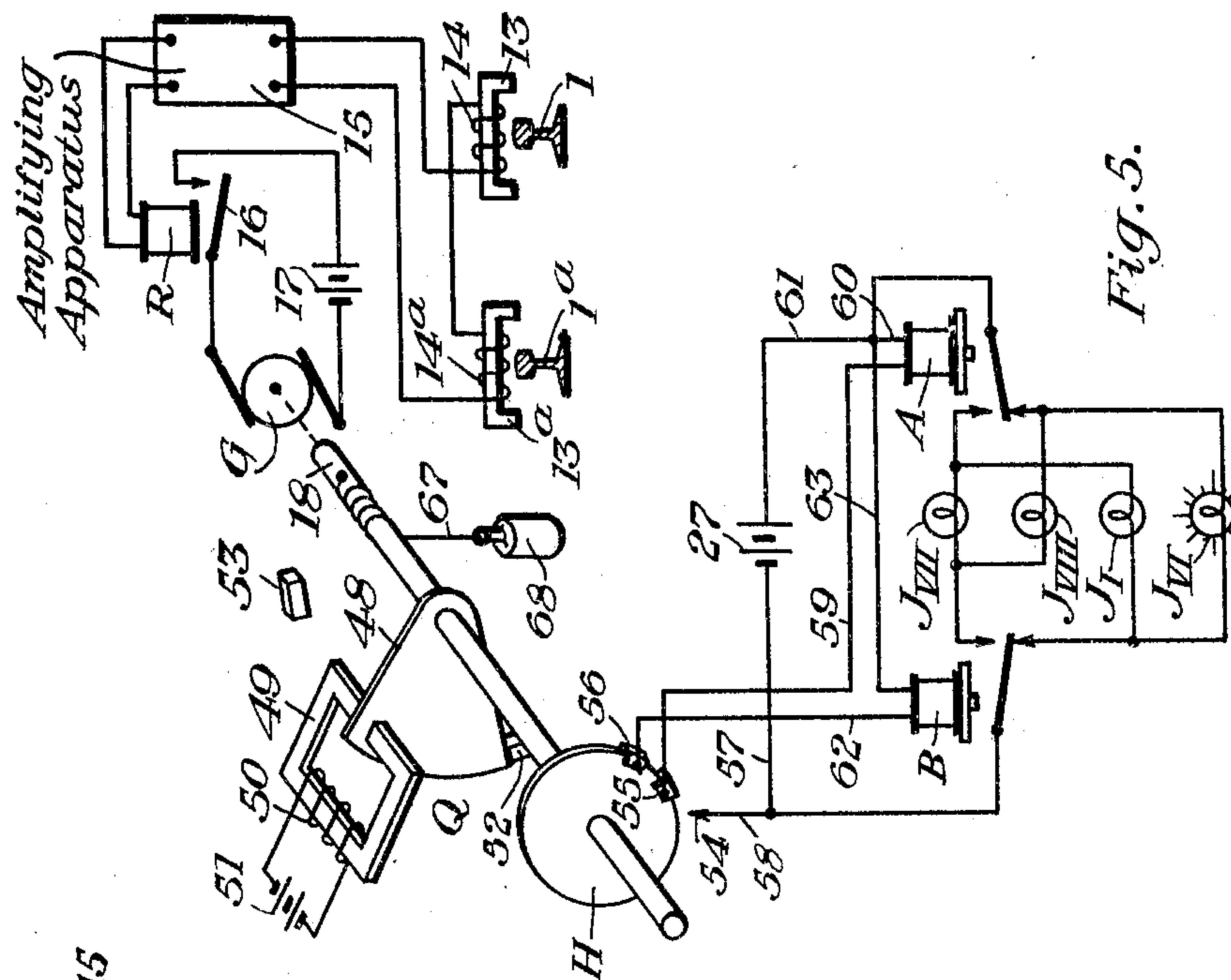

Fig. 5.

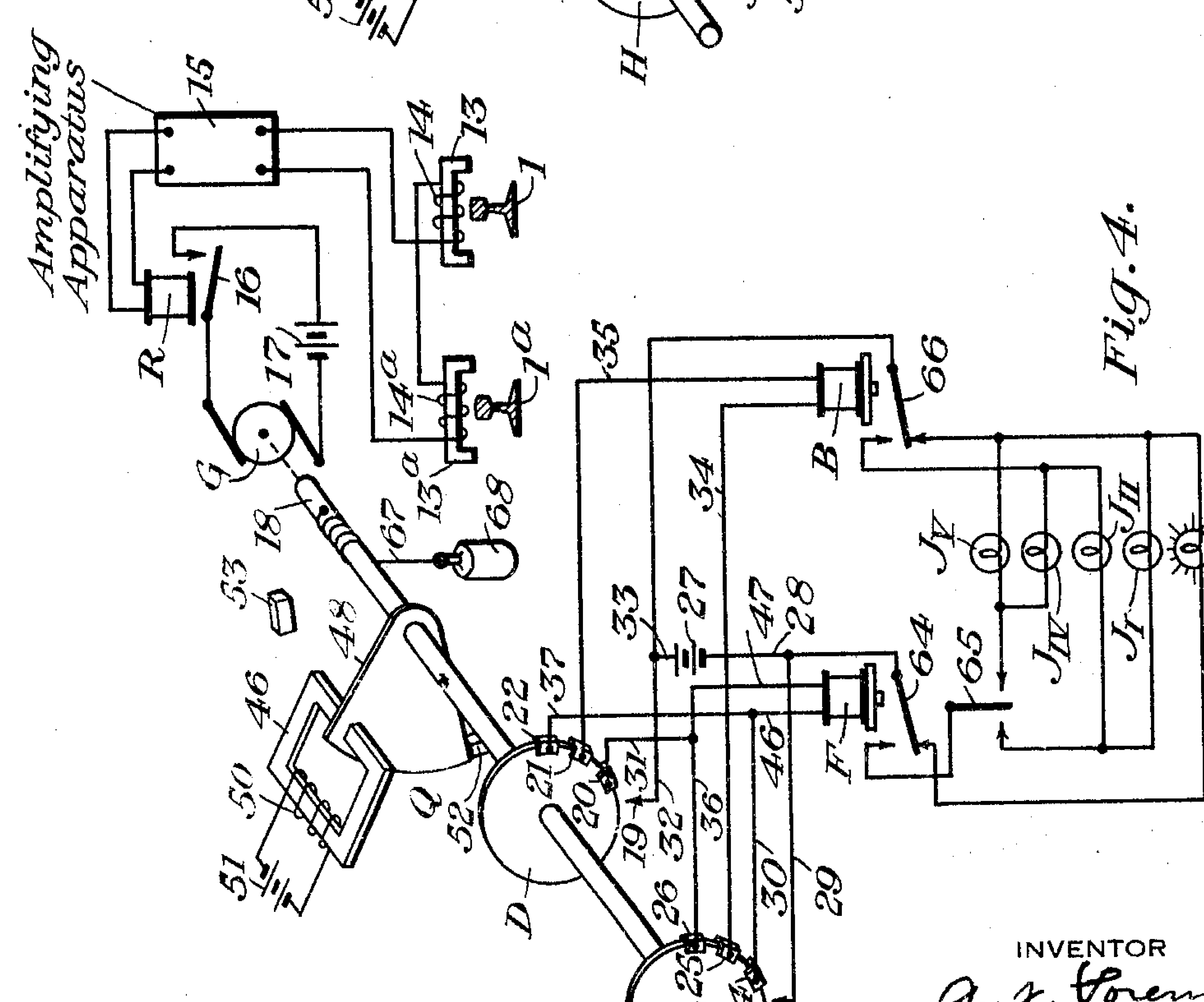

Fig. 4.

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Patented Sept. 4, 1928. **1,682,997**

UNITED STATES PATENT OFFICE.

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RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

Application filed May 21, 1925. Serial No. 31,754.

My invention relates to railway traffic controlling apparatus, and particularly to apparatus of the type comprising train carried governing means controlled by code impulse combinations received from the trackway.

I will describe several forms of railway traffic controlling apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a view partly diagrammatic, showing the trackway portion of one form of railway traffic controlling apparatus embodying my invention. Fig. 2 is a view showing a modified form of the trackway apparatus illustrated in Fig. 1. Fig. 3 is a view, also partly diagrammatic, showing one form of train carried governing means suitable for co-operation with trackway apparatus illustrated in Fig. 1. Fig. 4 is a view showing a modified form of the train carried governing means illustrated in Fig. 3. Fig. 5 is a view showing a modified form of train carried governing means suitable for co-operation with the trackway apparatus shown in Fig. 2.

Referring first to Fig. 1, the reference characters 1 and 1ª designate the track rails of a stretch of railway track. Means are provided for supplying these rails with current in the form of code impulse combinations, the immediate source of such currents being a transformer T, the primary winding 2 of which is constantly supplied with alternating current from a suitable source not shown in the drawing. The supply of energy from the transformer T to the rails 1 and 1ª is controlled by a transmitter designated in general by the reference character S, and comprising, in the form here shown, a rotatable shaft 4, connected with a constant speed motor M which is supplied with alternating current from secondary 3 of transformer T. The shaft therefore rotates at a uniform rate, such as one revolution each 30 seconds. Rigidly attached to shaft 4 and rotating therewith, are a plurality of code wheels designated by the reference character S with suitable distinguishing subscripts. Each code wheel is provided, at its periphery, with alternately disposed conducting segments 5 and insulating segments 6 which are of different lengths for different wheels. A circuit controller K comprises a movable contact arm 7 arranged to co-operate with a plurality of fixed contacts 8, 9, 10, etc., one for each code wheel. Each of these fixed contacts is constantly connected with a brush bearing on the edge of the associated code wheel and designated by the same reference character as the corresponding contact, with the exponent *a*. By moving the arm 7 into engagement with the proper contact, the secondary 3 of transformer T may be connected with the rails through any selected one of the code wheels. Although any reasonable codes may be used, I assume for the purpose of explanation that when contact 7—8 of circuit controller K is closed to connect transformer T with the rails through code wheel S_1 code impulse combinations are supplied to the track in the form of successive impulses each one half second long separated by time intervals of one second each. Current supplied in this manner I will call code I. With this example in mind, the characteristics of the various codes will be readily understood from the table accompanying Fig. 1. In this table there appears, for each code, designated by a Roman numeral; the code wheel which gives the code; the time of closed circuit, that is the length of each impulse; and the time interval of open circuit, that is, the length of the time interval between successive impulses.

Referring now also to Fig. 3, the train carried governing means comprises a pair of magnetizable cores 13 and 13ª carried in advance of the forward axle on a train W and disposed in inductive relation with the two track rails 1 and 1ª respectively. Core 13 is provided with a winding 14, and core 13ª is provided with a similar winding 14ª, the two windings 14 and 14ª being so connected in series that the voltages induced therein by alternating currents which flow in opposite directions in the two track rails at any instant are additive. These two windings 14 and 14ª are connected, preferably through suitable amplifying apparatus 15, with a relay R, which relay is therefore energized during each impulse, and de-energized between such impulses, in the code impulse combinations supplied to the trackway by transmitter S.

The train carried apparatus includes a selector comprising a rotatable shaft 18 supported by journals not shown in the drawing and operatively connected with a motor device G. The motor device G is provided with a circuit including a suitable source of energy such as a battery 17, and a front contact 16 of relay R. Motion of shaft 18 is retarded by a damping device Q comprising a damping vane 48 of electro conducting material. A U-shaped magnetizable core 49, provided with a winding 50 constantly supplied with energy from a suitable source such as a battery 51, includes vane 48 between its extended arms. The flux created in core 49 therefore passes through vane 48, and retards the motion of the vane in each direction as will be readily understood. A weight 68 attached to a flexible cord 67 wrapped around the shaft 18, biases the shaft to an initial position in which vane 48 engages a fixed stop 52. When relay R is energized, motor device G rotates shaft 18 in clockwise direction as viewed in the drawing. Motion in this direction is limited by a fixed stop 53 against which vane 48 abuts at the upper limit of its stroke.

The parts are so proportioned and arranged that when the motor device G is energized one and one half seconds are required for the shaft 18 to rotate to its extreme position in which vane 48 is in engagement with stop 53. When the motor device is de-energized the damping device Q so retards the motion of the vane that one and one half seconds are also required for the shaft to return to its initial position under the influence of gravity acting on weight 68.

Attached to shaft 18 and rotating therewith are two contact disks D and E. Disk D carries at its edge three contact members 20, 21 and 22 insulated from the disk and from each other, and spaced at intervals around the edge of the disk. Disk E carries three similar contact members 24, 25 and 26. A fixed contact member 19 is arranged to co-operate with contact members 20, 21 and 22 on disk D, and a similar fixed contact member 23 is arranged to co-operate with the contact members 24, 25 and 26. When shaft 18 is in the position illustrated in the drawing, that is, when motor device G is de-energized and the shaft is held in its initial position under the bias exerted by weight 68, all of the contacts controlled by disks D and E are open. If motor device G becomes energized, as by the closing of front contact 16 of relay R, shaft 18 is rotated in a clockwise direction as explained hereinbefore. If this motion continues until shaft 18 has completed about one fourth of its stroke, contacts 20—19 and 24—23 are closed. When the shaft has completed about one half of its stroke, contacts 21—19 and 25—23 become closed, and when the shaft has completed about three fourths of its stroke, contacts 22—19 and 26—23 become closed. At the upper limit of the stroke of vane 48 shaft 18 occupies a position in which all of the contacts controlled by disks D and E are open. When contacts 20—19 and 23—24 are closed current flows from a suitable source of energy, such as a battery 27, through wires 28 and 29, contact 23—24, wire 30, winding of a slow releasing relay A, wire 31, contact 20—19 and wires 32 and 33 back to battery 27. When contacts 21—19 and 23—25 are closed current flows from battery 27, through wires 28 and 29, contact 23—25, wire 34, winding of a second slow releasing relay B, wire 35, contact 21—19, and wires 32 and 33 back to battery 27. Similarly, when contacts 22—19 and 23—26 are closed current flows from battery 27, through wires 28 and 29, contact 23—26, wire 36, winding of a third slow releasing relay C, wire 37, contact 22—19 and wires 32 and 33 back to battery 27.

In explaining the operation of the apparatus I will first assume that contact 7—8 of circuit controller K in Fig. 1 is closed so that the trackway is being supplied with impulse combinations according to code I, that is with alternating current which is broken up by code wheel S_I into impulses of one half second duration separated by time intervals of one second each. The first impulse received by relay R energizes the relay and supplies current to motor device G to move shaft 18 in a clockwise direction as hereinbefore explained. This motion continues for one half second which is sufficient to close contacts 20—19 and 24—23 but is not sufficient to close contacts 21—19 and 25—23. At the expiration of this impulse relay R becomes de-energized and disconnects current from motor device G. During the one second interval which elapses before the reception of the next succeeding impulse, weight 68 returns the shaft to its initial position, which of course again opens the contacts controlled by disks D and E. The next impulse again operates motor device G and contacts 20—19 and 24—23 are again closed for a brief interval. It is therefore clear that as long as impulse combinations are supplied to the trackway according to code I, relay A is supplied with a surge of energy for each impulse of such code impulse combination. Due to its slow acting characteristics, this relay bridges the time intervals which elapse between successive energizations.

If circuit controller K is operated to close contact 7—9, transformer T is connected with the track rails through code wheel S_{II} and the trackway is then supplied with code impulse combination according to code II. During each impulse of this code motor device G is energized for one second and this time is sufficient to permit shaft 18 to move through approximately one half of its stroke so that contacts 20—19 and 24—23 are first closed for a brief interval, and subsequently contacts 21—19 and 25—23 are closed. During the time interval elapsing after the completion of one impulse and before the beginning of the next succeeding impulse the shaft 18 returns to its initial position. In returning to this position the contacts 21—19, 20—19, 25—23 and 24—23 are again closed for a brief interval in the reverse order from the order in which they were closed on the energized stroke of the shaft 18. It will, therefore, be seen that as long as the trackway is supplied with code impulse combinations according to code II, relays A and B are periodically supplied with surges of current. These relays, being slow releasing, remain in their energized condition as long as this periodical energization continues.

Similarly, if contact 7—10 of circuit controller K is closed so that the trackway is supplied with code impulse combinations according to code III, the shaft 18 makes its full stroke for each impulse, and returns to its initial position during each time interval between successive impulses. Each of the relays A, B and C is therefore supplied periodically with current and the parts are so proportioned that under these conditions each of these relays remains in its energized position.

When contact 7—11 of circuit controller K is closed the trackway is supplied with code impulse combinations according to code IV, through code wheel S_{IV}. Under these conditions the first impulse supplied to motor device G moves the shaft 18 through its entire stroke and during this motion each of the relays A, B and C receives a surge of energy. During the time interval of one second elapsing between successive impulses, however, shaft 18 is allowed to return through only a portion of its stroke under the influence of weight 68 so that contacts 22—19 and 21—19 controlled by disk D and contacts 26—23 and 25—23 controlled by disk E are closed but the remaining contacts remain open. The next succeeding impulse again moves shaft 18 to the limit of its stroke defined by stop 53 and the shaft therefore oscillates between the position in which the vane 48 engages stop 53 and the position in which fixed contact member 19 is intermediate members 20 and 21 on the edge of disk D and contact member 23 is intermediate the contact members 24 and 25 on the edge of disk E. As long as this code is received, therefore, relays B and C are intermittently energized and operate to maintain their front contacts closed, but relay A becomes de-energized.

Finally, I will assume that the trackway is supplied with code impulse combinations according to code V, by closing contact 7—12 of circuit controller K.

Since each impulse of energy is of one and one-half second duration, shaft 18 rotates till vane 48 engages stop 53 during each such impulse. During each time interval of one-half second between successive impulses, however, the shaft moves back, due to weight 68, thereby closing contacts 22—19 and 26—23, but the other contacts controlled by disks D and E remain open. When code V is supplied to the trackway, then, relay C is intermittently energized and holds its front contacts closed, but relays A and B are both deenergized.

The three relays A, B and C may be utilized to control traffic governing means of any desired type. As here shown these relays control a plurality of signal lamps which are designated by the reference character J with a suitable subscript consisting of a Roman numeral corresponding to the code by means of which the corresponding lamp is lighted. For example, when impulse combinations according to code I are transmitted to the trackway we have seen that relay A is energized and relays B and C are both de-energized. Under these conditions lamp J_I is energized by current from battery 27 over a circuit which includes front contact 40 of relay A, back contact 41 of relay B and back contact 42 of relay C. The circuits for the various lamps will be obvious from the drawing without tracing them in detail. It should be pointed out, however, that should the trackway be continuously supplied with alternating current or should the alternating current to the track rails be entirely discontinued, all of the contacts controlled by shaft 18 would be open, and all relays A, B and C would be de-energized. Under these conditions the closing of back contact 43 of relay A, back contact 44 of relay B and back contact 45 of relay C would complete a circuit for a sixth lamp J_{VI} to display a distinctive indication corresponding to this condition of the apparatus.

Referring now to Fig. 4 the train carried governing apparatus here shown differs from the apparatus shown in Fig. 3 only in the manner of controlling the signal lamps in accordance with the positions of shaft 18. Relay B is controlled in exactly the same manner as in Fig. 3 but relays A and C are replaced by a single slow releasing polarized relay F comprising a neutral contact 64 and a polarized contact 65. This relay is provided with one circuit from battery 27, through wires 28 and 29, contact 23—24, wires 30 and 46, winding of relay F, wires 47 and 31, contact 20—19, wires 32 and 33 back to battery 27. When this circuit is closed the current supplied to relay F is of such polarity that contact 65 is swung to the left. A second circuit for relay F may be traced from battery 27, through wires 28 and 29, contact 23—26, wires 36 and 47, winding of relay F, wires 46 and 37, contact 22—19, and wires 32 and 33 back to battery 27. When this circuit is closed the polarity of the current supplied to relay F is such that contact 65 is swung to the right.

For use in conjunction with the apparatus shown in Fig. 4 the transmitting apparatus illustrated in Fig. 1 is modified by removing code wheel S_{III}. The remaining parts of the apparatus function exactly as described in connection with preceding views. When code impulse combinations are supplied to the trackway according to code I contacts 20—19 and 24—23 are periodically closed as hereinbefore described so that relay F is periodically supplied with current of such polarity as to swing contact 65 to the left. Due to the slow acting characteristic of this relay front contact 64 remains closed during the time interval between successive energizations of the relay and lamp J_I is therefore energized continuously, relay B being de-energized.

When contacts 20—19 and 21—19 controlled by disk D and contacts 25—23 and 24—23 controlled by disk E are periodically closed, as when the trackway is being supplied with code impulse combination according to code II, relay F is periodically supplied with surges of current which maintain contact 65 in its left hand position and front contact 64 closed, and relay B is also periodically energized to keep its front contact 66 closed. Lamp J_{II}, is under these conditions, continuously lighted.

Similarly, when code V is supplied to the trackway, contacts 22—19 and 26—23 are periodically closed, relay F is periodically supplied with surges of current of such polarity as to swing contact 65 to the right and the relay of course maintains its front contact closed during the time interval between successive surges of energy. Relay B is de-energized and lamp J_V is lighted. If, however, relay B is also periodically supplied with energy, as when the trackway is being supplied with code impulse combinations according to code IV, lamp J_{IV} is continuously lighted as will be readily understood without further explanation. Should relays F and B become continuously de-energized, as by the continuous supply of alternating current to the track rails or by the complete interruption of such current, lamp J_{VI} would be continuously lighted.

Referring now to Fig. 2, in the modified form of transmitting apparatus here shown the shaft 4 is provided with only three code wheels S_I, S_{VII}, S_{VIII}, each provided with conducting segments 5 and insulated segments 6 alternately spaced about the periphery of the wheel. The operation of the apparatus will be readily understood from the description of Fig. 1. Assuming that the parts are so arranged that shaft 4 makes one revolution in 6 seconds, the characteristics of the impulse combinations supplied to the trackway for the various codes are as set forth in the table accompanying the drawing.

The transmitting apparatus illustrated in Fig. 2 is suitable for controlling the simplified form of train controlling apparatus shown in Fig. 5. In Fig. 5 the shaft 18 is controlled by a motor device G and a damping means Q in the manner already described in connection with Fig. 3. In place of the two contact disks D and E, however, shaft 18 in the form here shown carries a single contact disk H provided at its periphery with two spaced contact members 55 and 56 arranged to co-operate with a fixed contact member 54. When motor device G is de-energized, weight 68 holds the shaft 18 in its initial position in which the vane 48 abuts against fixed stop 52. When motor device G is energized for one second the shaft 18 is rotated in a clockwise direction until vane 48 engages fixed stop 53. When motor device G subsequently becomes de-energized the vane 48 is sufficiently retarded by the damping device Q to require one second to return to its initial position. When shaft 18 occupies its initial position contacts 55—54 and 56—54 are both open, but as the shaft rotates due to actuation of motor device G contact 55—54 is first closed for a brief interval, contact 56—54 is subsequently closed for a brief interval, and when the shaft occupies its final position, that is, when the vane 48 is arrested by stop 53, contacts 55—54 and 56—54 are both open. The contact disk H controls two slow releasing relays A and B. The circuit for relay A passes from battery 27, through wires 57 and 58, contact 54—55, wire 59, winding of relay A and wires 60 and 61 back to battery 27. The circuit for relay B is traced from battery 27, through wires 57 and 58, contact 54—56, wire 62, winding of relay B, and wires 63 and 61 back to battery 27.

When relays A and B are both de-energized, as when the trackway is being supplied continuously with alternating current or when this supply is completely discontinued, lamp J_{VI} is energized. If the trackway is being supplied with impulse code combination according to code I, each impulse closes contact 54—55 and completes the circuit for relay A so that this relay receives a surge of energy. Relay A, being slow acting, retains its front contact closed as long as this periodical energization continues and since relay B is de-energized, lamp J_I is continuously lighted. Similarly, if the impulse combinations supplied to the trackway are controlled by code wheel S_{VII}, relays A and B are each periodically energized and the front contact of each of these relays is maintained in its closed position so that lamp J_{VII} is continuously lighted. In similar manner if contact 7—10 of circuit controller K is closed code impulse combinations are supplied to the trackway according to code VIII and relay B is periodically supplied with surges of energy but relay A is not supplied with such energy. Relay B is therefore maintained in its energized condition and relay A is de-energized so that lamp J_{VIII} is continuously lighted.

It should be pointed out that with railway traffic controlling apparatus embodying my invention the train carried governing means comprises contacts which are selectively responsive to the actual length of each impulse in such combination and also to the proportion of a given interval of time that such impulses are supplied. To state the matter in another way, the portion of the stroke of shaft 18 through which the shaft is caused to oscillate for any given code depends not only upon the absolute length of the impulse or the absolute length of the time interval between the impulses but also on the ratio between these portions of each code impulse combinations, that is, upon their relative lengths. One advantage of my invention is that slight variations in the timing of the code impulse combination by the transmitter will not affect the accuracy of the selector device on the train. Another advantage of my invention is that none of the parts need be delicately constructed or finely adjusted.

Although I have herein shown and described only a few forms of railway traffic controlling apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a member biased to one position, a motor device for moving said member from said position, damping means for retarding motion of said member, means for supplying said motor device with different code impulse combinations comprising impulses of energy separated by time intervals whereby said member occupies different other positions depending on the proportion of a given interval of time that said motor device is energized, and contacts controlled by said member.

2. In combination, a rotatable shaft biased to one position, a motor device for rotating said shaft away from said position, means for supplying said motor device with code impulse combinations comprising successive impulses of energy separated by time intervals whereby said shaft occupies different other positions depending on the proportion of a given interval of time that said motor device is energized, a vane attached to said shaft, a damping magnet for retarding motion of said vane, and contacts controlled by said shaft.

3. In combination, a source of different code impulse combinations each comprising an impulse and a time interval, a member biased to an initial position, a motor device receiving energy from said source for causing said member to oscillate through different positions depending upon the proportion between the length of each impulse to the total length of the combination in the code impulse combinations supplied to the motor device, and contacts controlled by said member.

4. In combination, a member biased to one position, a motor device for moving said member from said position, means for supplying said motor device with different code impulse combinations comprising impulses of energy separated by time intervals whereby said member occupies different other positions depending on the proportion of a given interval of time that said motor device is energized, contacts controlled by said member, a polarized relay controlled by said contacts, and signaling means controlled by said polarized relay.

5. In combination, a member biased to one position, a motor device for moving said member from said position, means for supplying said motor device with different code impulse combinations comprising impulses of energy separated by time intervals whereby said member occupies different other positions depending on the proportion of a given interval of time that said motor device is energized, contacts controlled by said member, two relays selectively controlled by said contacts, and signaling means controlled by said relays.

6. In combination, a member biased to an initial position, a motor arranged when energized to move said member to a second position, damping means for retarding the motion of said member, two contacts arranged to be open when said member occupies its initial position and also when it occupies its second position but to be successively closed as the member moves from said initial position toward said second position, and means for supplying said motor with code impulse combinations each comprising a comparatively long impulse and a comparatively short time interval for closing one only of said contacts, and for supplying said motor with code impulse combinations each comprising a comparatively short impulse and a comparatively long time interval for closing only the remaining contact.

7. In combination, a member biased to one position, a motor device for moving said

member from said position, means for supplying said motor device with different code impulse combinations comprising impulses of energy separated by time intervals whereby said member occupies different other positions depending on the length of each such impulse of energy and also upon the proportion of a given interval of time that said motor device is energized, and contacts controlled by said member.

8. In combination, a member biased to one position, a motor device for moving said member from said position, means for causing periodic operation of said motor device for different proportions of a given interval of time whereby said member occupies different other positions depending upon the proportion of said given interval of time that said motor device is operated and upon the duration of each such periodic operation of the motor device, and contacts controlled by said member.

9. In combination, a member biased to one position, a motor device for moving said member from said position, means for causing periodic operation of said motor device for different proportions of a given interval of time whereby said member is constrained to oscillate through a selected portion of its stroke depending on the duration of each such periodic operation of the motor device and on the proportion of said given interval of time that said motor device is energized, and contacts responsive to the position of said member.

10. In combination, a member biased to one position, a motor device for moving said member from said position, means for supplying said motor device with different code impulse combinations comprising impulses of energy separated by time intervals whereby said member occupies different other positions depending on the length of each such time interval and also upon the proportion of a given interval of time that said device is de-energized, and contacts controlled by said member.

11. In combination, a member biased to one position, a motor device for moving said member from said position, means for supplying said motor device with different code impulse combinations comprising impulses of energy separated by time intervals whereby said member occupies different other positions depending upon the absolute and relative values of the lengths of said impulses and said time intervals, and contacts controlled by said member.

12. In combination, a member biased to one position, a motor device for moving said member from said position, means for supplying said motor device with different code impulse combinations comprising impulses of energy separated by time intervals whereby said member is constrained to oscillate through a selected portion of the stroke of the member depending upon the absolute and relative values of the lengths of said impulses and said time intervals, and a plurality of contacts each corresponding to a different position of said member and arranged to be operated when the member occupies such position.

13. In combination, a member biased to one position, a motor device for moving said member from said position, means for supplying said motor device with different code impulse combinations comprising impulses of energy separated by time intervals whereby said member is constrained to oscillate through a selected portion of the stroke of the member depending upon the absolute and relative values of the lengths of said impulses and said time intervals, and contacts controlled by said member.

In testimony whereof I affix my signature.

ANDREW J. SORENSEN.