RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed April 13, 1931 2 Sheets-Sheet 1

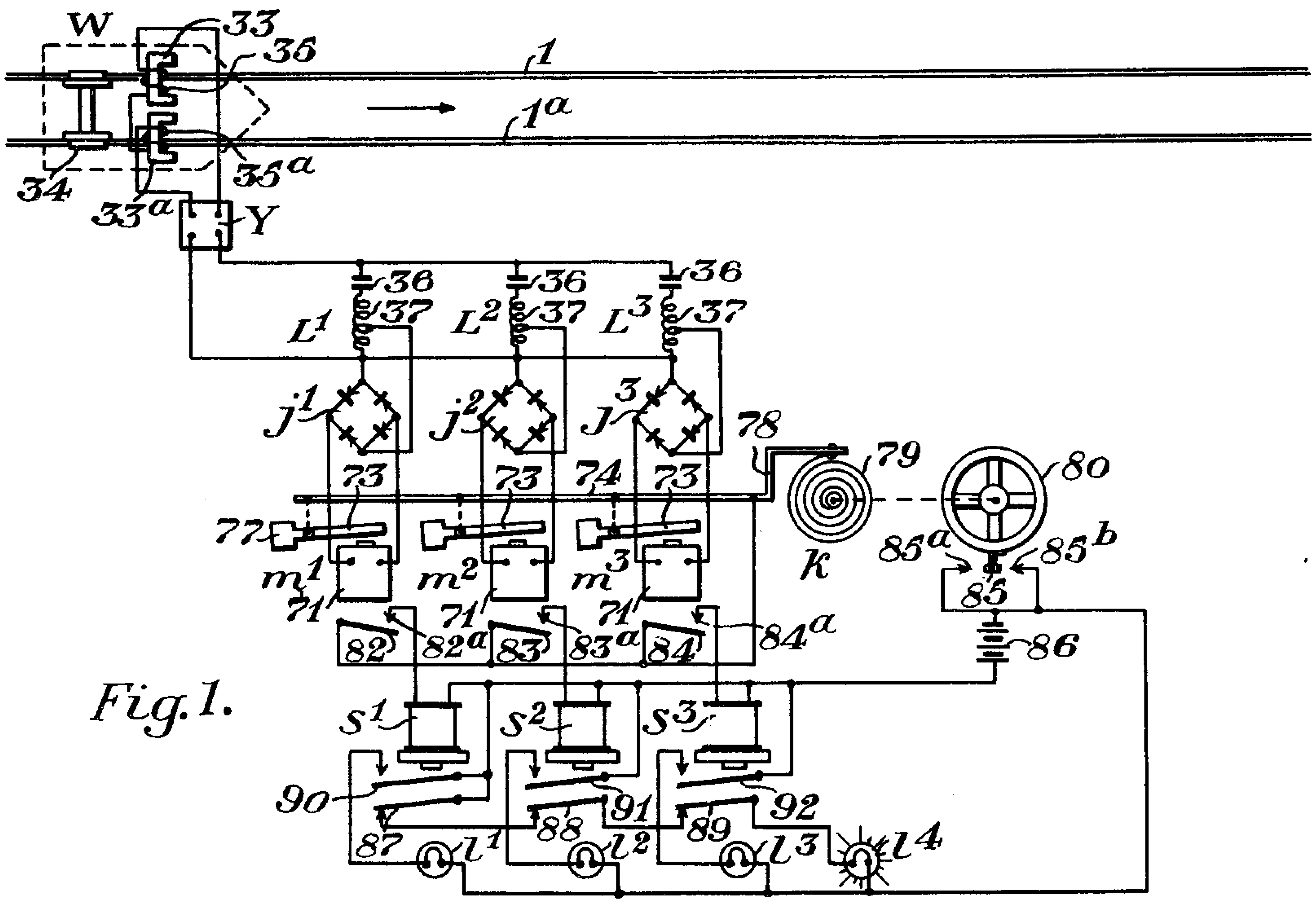

Fig. 1.

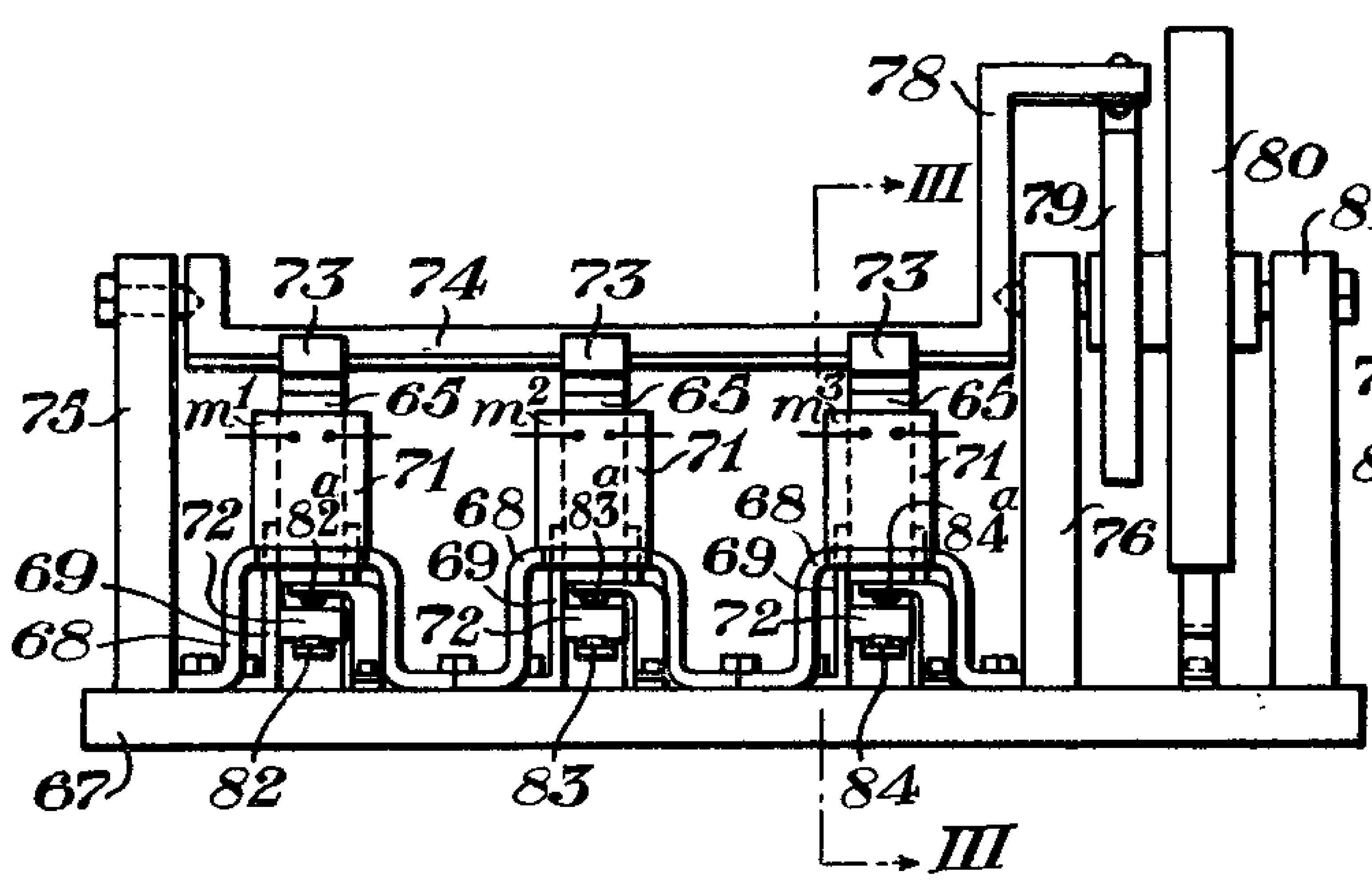

Fig. 2.

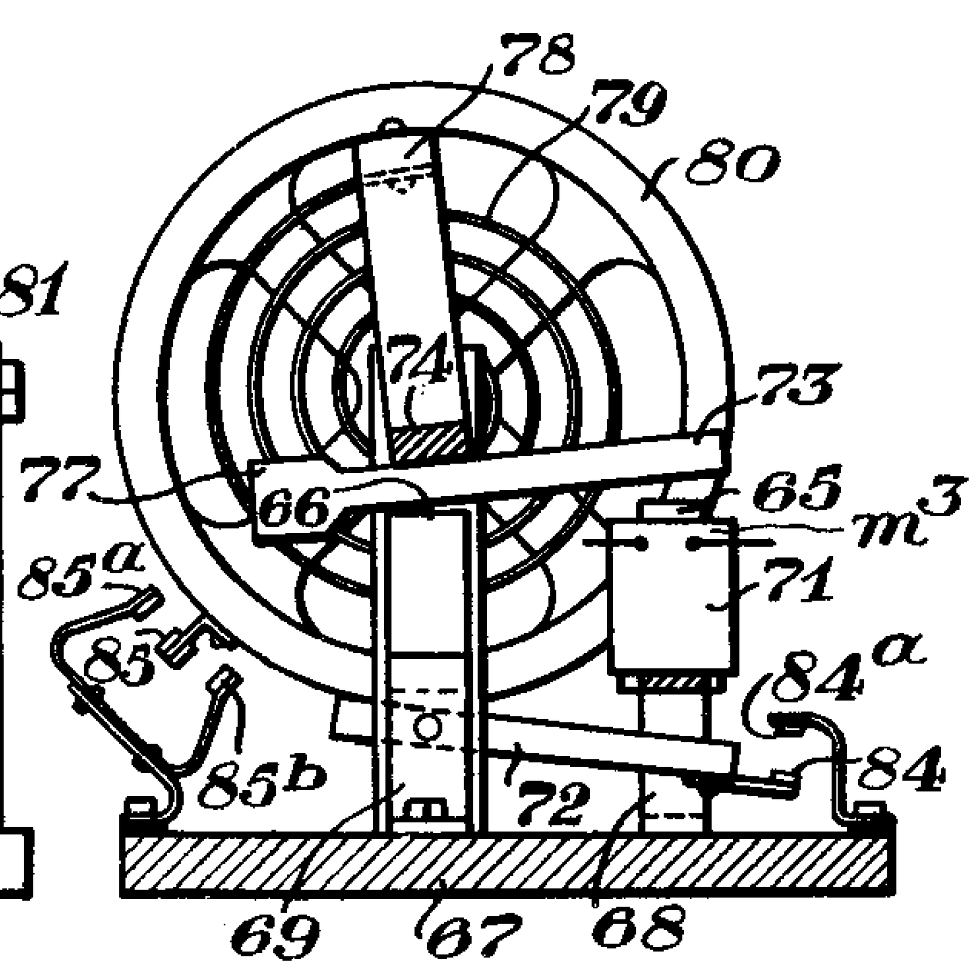

Fig. 3.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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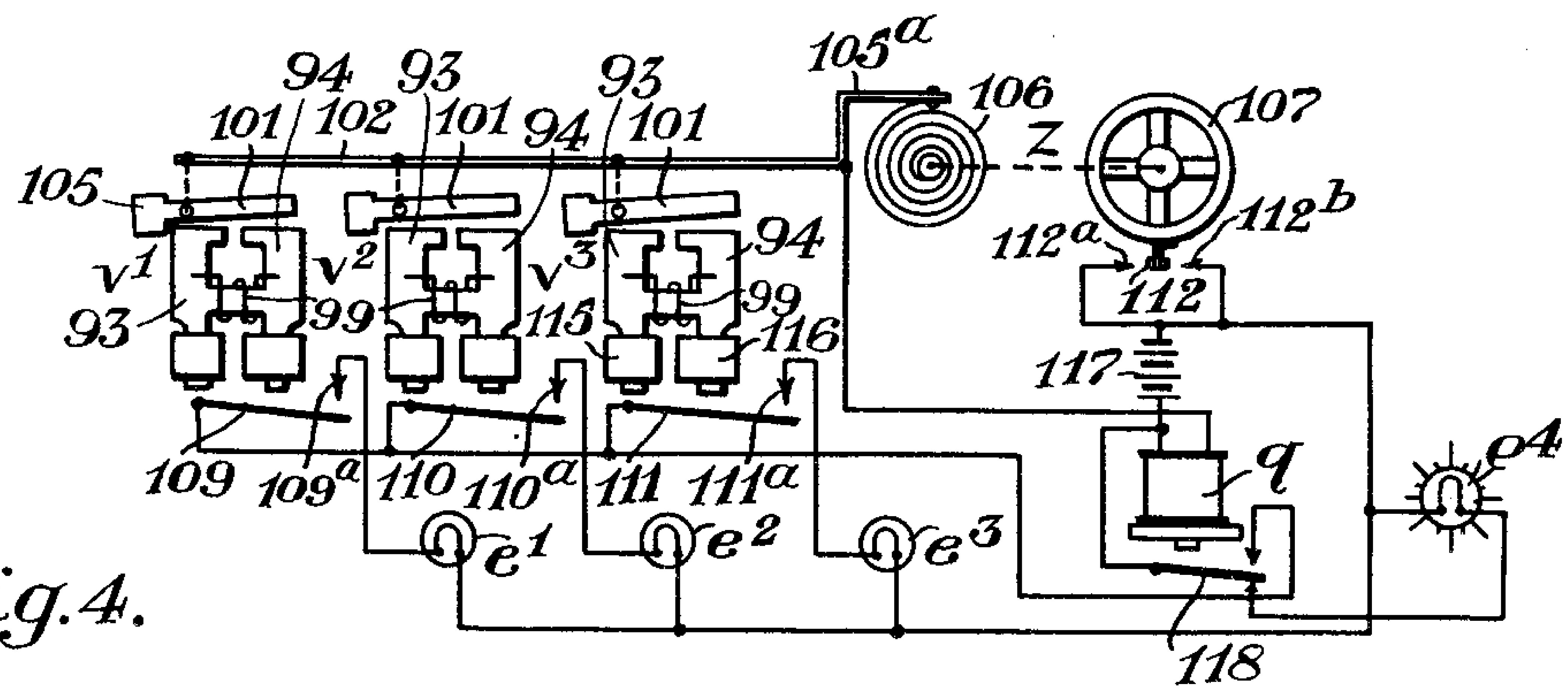


Fig. 4.

Fig. 5.

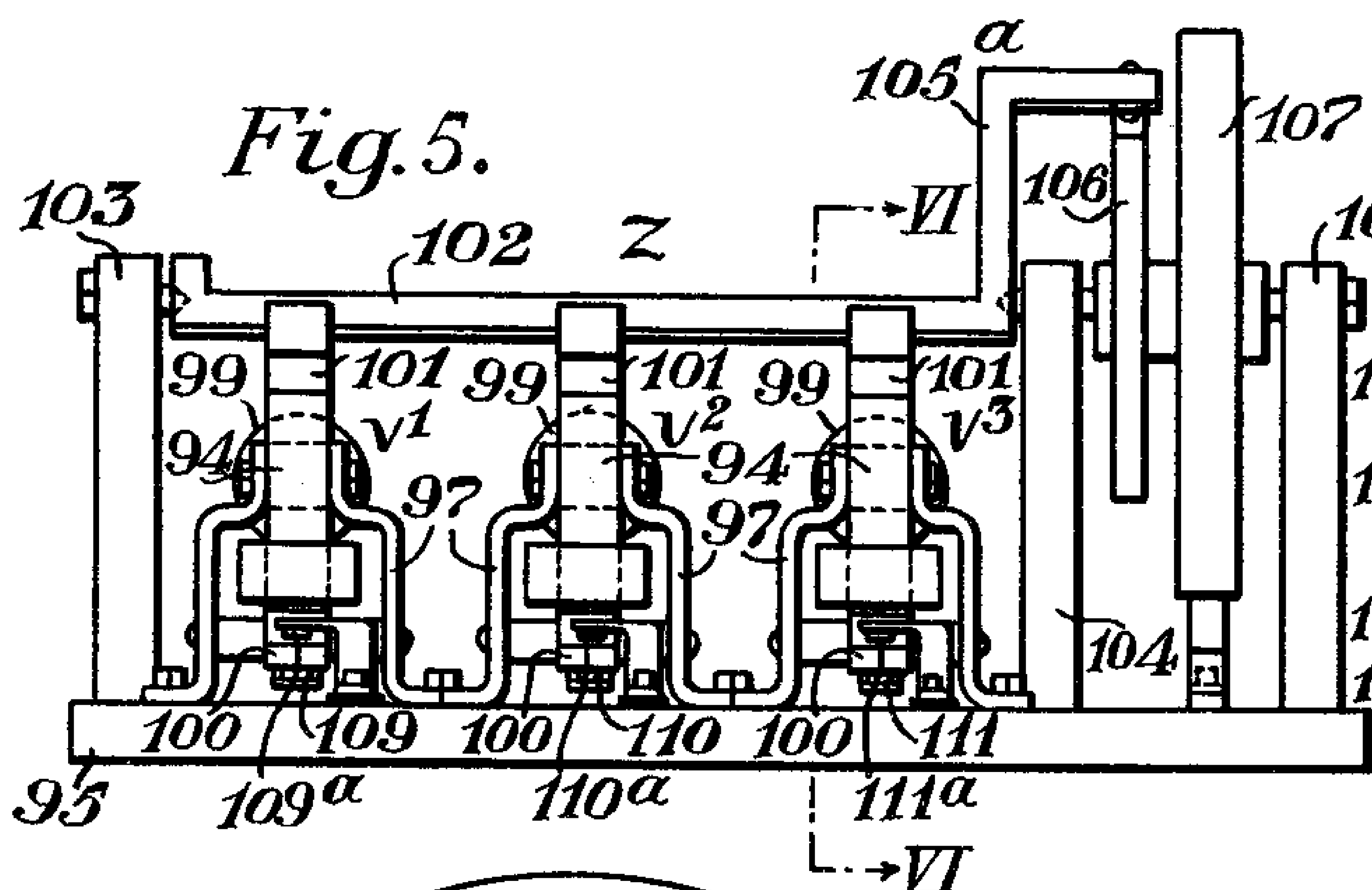
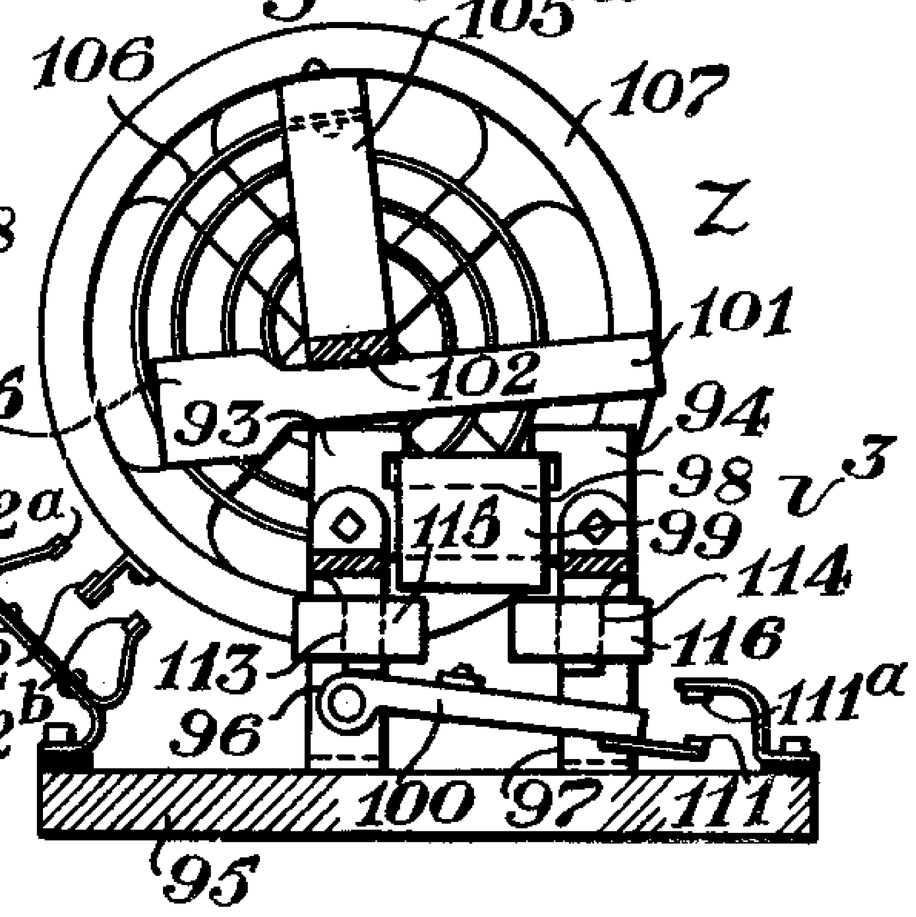


Fig. 6.



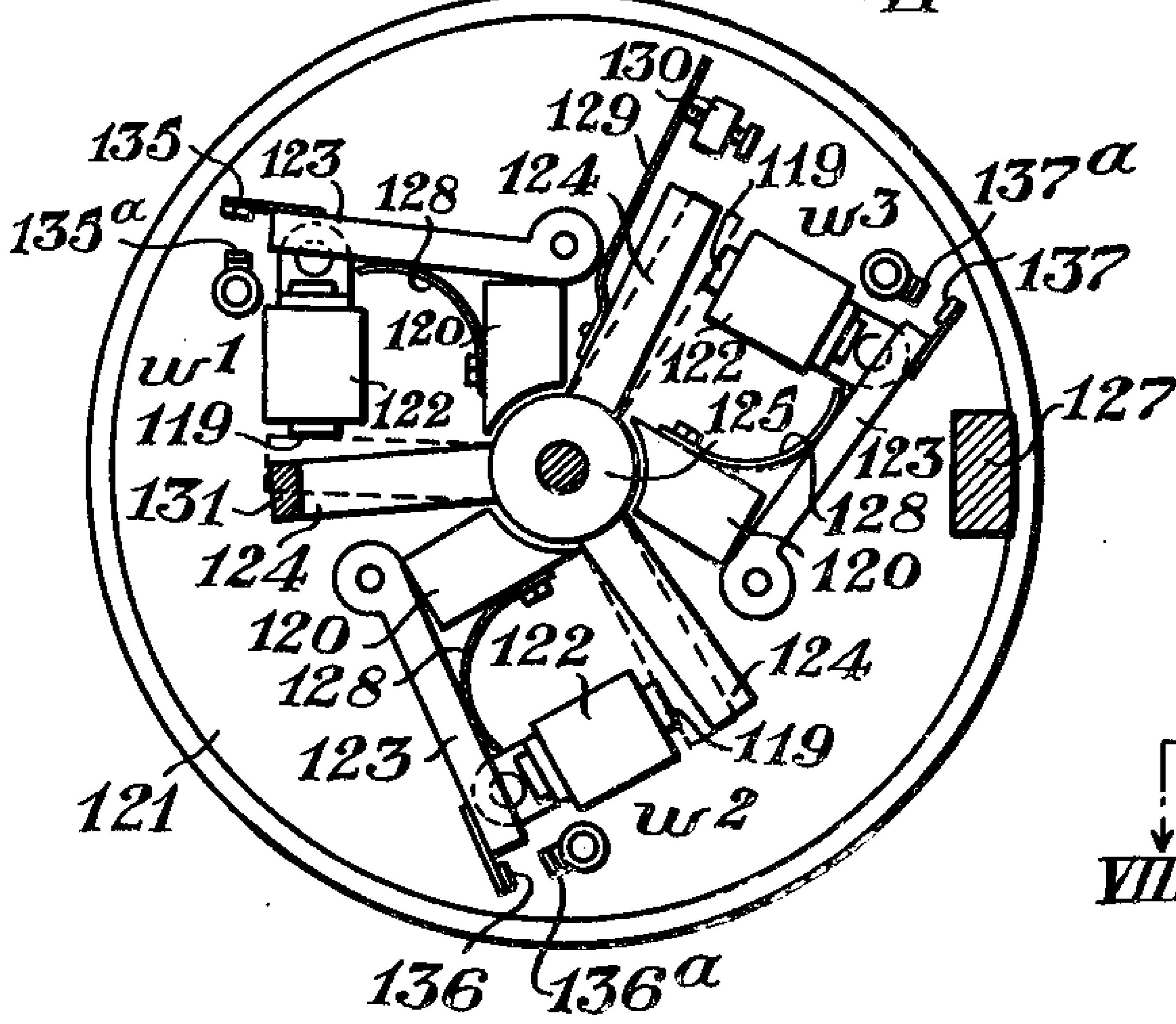


Fig. 8.

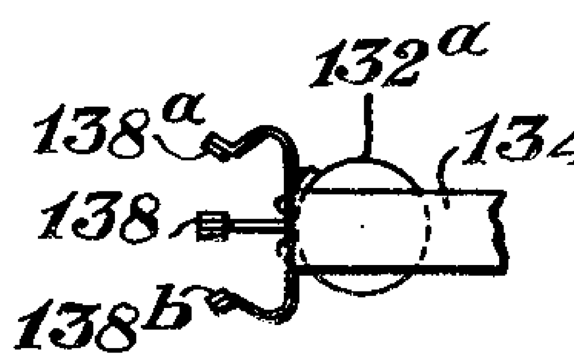


Fig. 9.

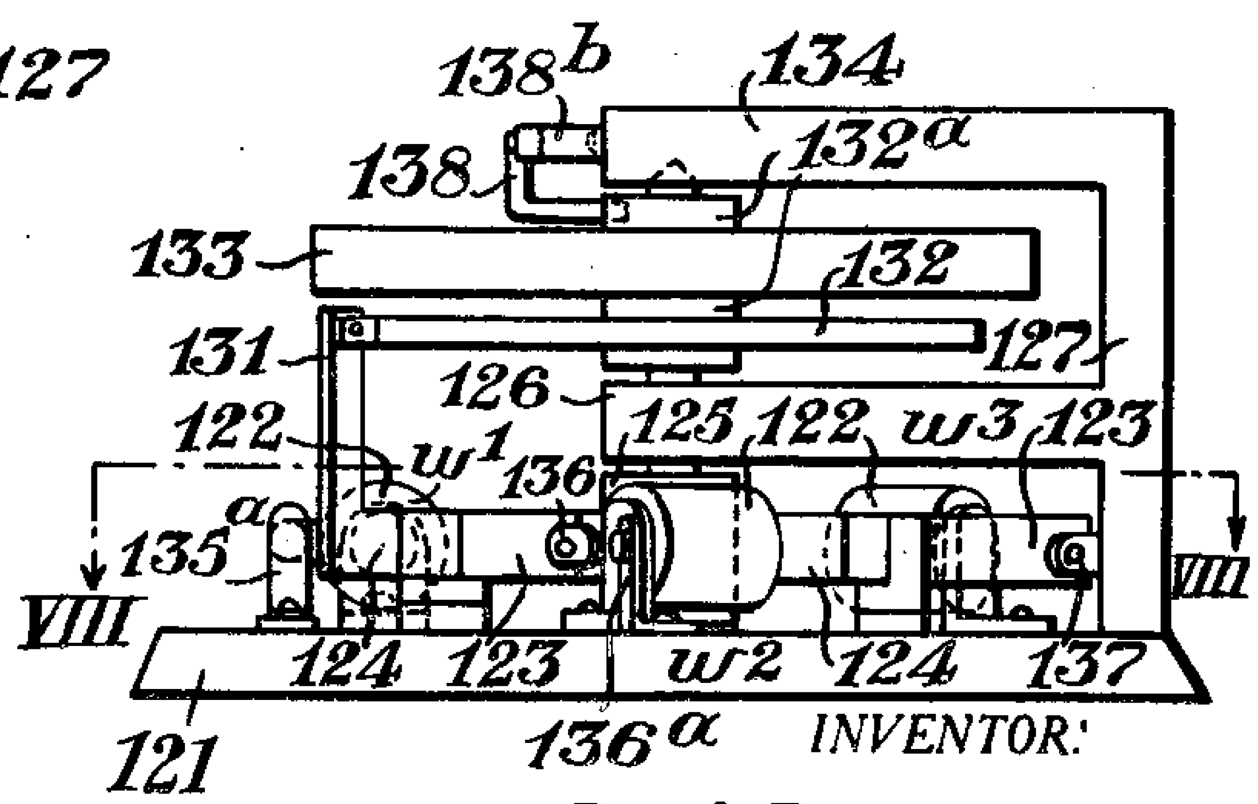


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Fig. 7. by A. L. Vencill

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Patented May 9, 1933 1,907,722

UNITED STATES PATENT OFFICE

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Application filed April 13, 1931. Serial No. 529,646.

My invention relates to railway traffic controlling apparatus, and has for an object the provision of novel and improved train-carried receiving means for use in connection with a train control system of the type disclosed and claimed in an application for Letters Patent of the United States filed by L. O. Grondahl on the thirteenth day of April, 1931, Serial No. 529,723, Patent No. 1,869,847 dated Aug. 2, 1932.

In the aforesaid application by Grondahl, means are provided for supplying the track rails with alternating carrier currents of different frequencies periodically interrupted or coded at one and the same frequency, together with train-carried receiving apparatus selectively responsive to the coded carrier currents. One feature of the present application is the provision of improved train-carried receiving means for use in connection with a system of this character.

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

In the accompanying drawings, Fig. 1 is a diagrammatic view showing one form of receiving apparatus embodying my invention. Fig. 2 is a view showing in side elevation the oscillator illustrated in Fig. 1. Fig. 3 is a vertical sectional view taken on the line III—III of Fig. 2. Fig. 4 is a fragmentary diagrammatic view showing another form of receiving apparatus embodying my invention. Fig. 5 is a side view of the oscillator shown in Fig. 4. Fig. 6 is a vertical sectional view on the line VI—VI of Fig. 5. Fig. 7 is a side view of a modified form of oscillator also embodying my invention. Fig. 8 is a horizontal sectional view taken on the line VIII—VIII of Fig. 7. Fig. 9 is a fragmental view showing a contact mechanism forming part of the oscillator illustrated in Figs. 7 and 8.

Similar reference characters refer to similar parts in each of the views.

Referring first to Fig. 1, a train-carried apparatus in the form here shown, comprises two magnetizable cores 33 and 33^a, mounted in front of the forward axle and disposed above the two track rails 1 and 1^a, respectively. These cores carry windings 35 and 35^a, which are connected in series in such manner that the alternating currents induced therein by an alternating current flowing in opposite directions in the two track rails 1 and 1^a at any given instant, are additive. This circuit constitutes the input circuit for an amplifier Y, the output circuit of which is provided with three multiple branches L^1, L^2 and L^3. Each branch includes a reactor 37 and a condenser 36, and these elements are so adjusted that the three branches L^1, L^2 and L^3 are tuned respectively at 60 cycles, 80 cycles and 130 cycles per second.

In this embodiment of my invention, shown in Figs. 1, 2 and 3, I employ a mechanical oscillator, designated as an entirety by the reference character *k*, which is selectively responsive to the coded currents transmitted over the track rails for controlling the several indicating devices located on a train. This oscillator includes three electromagnets m^1, m^2 and m^3, which are respectively energized by direct current supplied by rectifiers j^1, j^2 and j^3, which are connected across portions of the circuits L^1, L^2 and L^3, respectively. The magnets *m* each comprise two core members 65 and 66,—shown in Figs. 2 and 3,—which are mounted on a base 67 in spaced relation therewith and with each other by means of brackets 68 and 69, respectively. The core member 65 is provided with a winding 71 which is adapted to be energized when the circuit L, with which the electromagnet *m* is associated, is energized by an alternating current having a frequency at which such circuit is tuned to resonance. Associated with the core members 65 and 66 is a lower armature 72, which is pivotally mounted on the bracket 69, and an upper armature 73 which is fixed intermediate of its ends to a bar 74. This bar extends longitudinally above the core members 66 and is pivotally mounted at its ends upon pedestals 75 and 76 carried by the base 67. The upper armature 73 is normally biased toward an open position by a counterweight 77 but the lower armature 72 gravitates to an open position through its own weight when the electromagnet with which it is associated is deenergized. By reason of the fact that the lower armatures 72 are mounted for mutually independent movement, only one of these armatures will respond when the winding 71 associated with such armature is energized, the armatures 72 of the other electromagnets remaining open, but inasmuch as all of the upper armatures 73 are fixed to the bar 74, all of these armatures will close when any one of the windings 71 is energized.

The bar 74 is provided at one end with an upwardly extending crank arm 78 which is fixed to one end of a spiral spring 79. The other end of the spring 79 is fixed to the hub of a balance wheel 80 which is mounted for oscillatory movement upon the adjacent pedestal 76 and a similar pedestal 81 also carried by the base 67.

The lower armatures 72 of the electromagnets m^1, m^2 and m^3 are provided with contact arms 82, 83 and 84, respectively, for engagement with fixed contact element 82^a, 83^a and 84^a carried by, but insulated from, the base 67, when the electromagnets are energized. A contact arm 85 is also provided on the balance wheel 80 which is adapted to alternately engage fixed contact elements 85^a and 85^b carried by the base 67 when the magnets m are energized periodically by coded current, as will hereinafter be described.

The balance wheel 80 is mechanically tuned to oscillate at a natural frequency equal to that of the code impressed upon the current energizing the electromagnets m. This is accomplished by so proportioning the torsion exerted by the spiral spring 79 and the weight of the balance wheel 80 that they oscillate in resonance at the frequency of the code interruptions of the magnet energizing current, which as previously stated, may be at a rate of two interruptions per second. As a result, when any one of the electromagnets m is energized by current interrupted twice a second, the balance wheel 80 will oscillate through an amplitude sufficient to alternately close the contacts 85—85^a and 85—85^b, but if the current energizing the electromagnets m is interrupted at any other frequency, the balance wheel 80 will not oscillate through an amplitude sufficient to close these contacts although it may respond to a slight degree.

The electromagnets m^1, m^2 and m^3 control slow-releasing relays s^1, s^2 and s^3, respectively, which in turn control the circuits for a plurality of lamps l^1, l^2, l^3 and l^4, which are located in the cab and which, when illuminated, indicate "high speed", "medium speed", "low speed", and "stop", respectively. When there is no coded current flowing in the track circuit, the electromagnets m and the slow-releasing relays s controlled thereby are all deenergized. In this case the lamp l^4 indicating "stop" will be illuminated by virtue of a circuit passing from battery 86, through back contacts 87, 88 and 89 of slow-releasing relays s^1, s^2 and s^3, respectively, in series, and lamp l^4, back to battery 86.

If a 60-cycle current coded at the proper frequency is supplied to the track circuit, the winding 71 of the electromagnet m^1 will be energized periodically by direct current supplied by the rectifier j^1. The energization of electromagnet m^1 at code frequency causes it to attract and release the lower and upper armatures 72 and 73 at code frequency. The movement of the armature 73 causes the bar 74 to oscillate about its pivots at code frequency and this movement is transmitted through the spiral spring 79 to the balance wheel 80. Inasmuch as the balance wheel 80 is mechanically tuned to oscillate at code frequency, its oscillatory movement will build up until it reaches its maximum amplitude, at which point it will alternately open and close the contacts 85—85^a and 85—85^b. Also, the movement of the lower armature 72 will periodically open and close contact 82—82^a at code frequency. By reason of the resilient connection between the upper armature 73 and the balance wheel provided by the spiral spring 79, there will necessarily be a time lag between the closing of the contact 82—82^a and the closing of the contacts 85—85^a and 85—85^b. The construction of the parts is such that contact 82—82^a is closed approximately half the time contact arm 85 connects alternately with elements 85^a and 85^b within each cycle whereas arm 82 connects once with element 82^a within the same cycle. Therefore, there will be a time within each cycle when both the contacts 82—82^a and the contact 85—85^a, or both the contact 82—82^a and the contact 85—85^b, are closed. At such time, a circuit is established for the slow-releasing relay s^1 which passes from battery 86, through either contact 85—85^a or contact 85—85^b, balance wheel 80, spiral spring 79, crank arm 78, bar 74, front contact 82—82^a of electromagnet m^1, and winding of slow-releasing relay s^1, back to battery 86. The energization of slow-releasing relay s^1 opens back contact 87 and closes a front contact 90 thereof, thereby interrupting the circuit previously traced for lamp l^4, and establishing a circuit for the high speed control lamp l^1, passing from battery 86, through front contact 90 of slow-releasing relay s^1, and lamp l^1 back to battery 86. The slow-releasing character of relay s^1 maintains the back contact 87 open and the front contact 90 thereof closed during the interruption between code impulses as long as the coded 60-cycle current is flowing in the track circuit.

The operation of the apparatus in response to the medium speed and low speed control currents is substantially the same as that above described in connection with the high speed control current, in that when a coded

80-cycle current is supplied to the track circuit, the lamp l^2 indicating "medium speed" is illuminated by virtue of a circuit controlled by a front contact 91 of slow-releasing relay s^2, and when a coded 130 cycle current is supplied to the track circuit, the lamp l^3 indicating "low speed" is illuminated by virtue of a circuit controlled by a front contact 92 of slow-releasing relay s^3.

In Figs. 4, 5 and 6, I have shown another form of train carried apparatus selectively responsive to the coded carrier currents transmitted by the track circuits. This apparatus includes a mechanical oscillator z which comprises three electromagnets v^1, v^2 and v^3 which are energized independently when alternating currents of 60, 80 and 130-cycle frequencies, respectively, are supplied to the track circuits as hereinbefore described in connection with Figs. 1, 2 and 3.

Each of the electromagnets v comprises core members 93 and 94, shown in Figs. 5 and 6, which are mounted on a base 95 by means of brackets 96 and 97, respectively, and which are connected intermediate their ends by a horizontally extending portion 98. A winding 99 is mounted on the intermediate portion 98 and is energized by virtue of the circuit L with which it is associated.

Associated with the core members 93 and 94 is a lower armature 100 which is pivotally mounted at one end on the bracket 96, and an upper armature 101 which is fixed intermediate of its ends to a bar 102. This bar extends longitudinally above the core member 93 and is pivotally mounted at its ends upon pedestals 103 and 104 carried by the base 95. The upper armature 101 is biased toward an open position by a counterweight 105 but the lower armature 100 gravitates to an open position through its own weight when the associated winding 99 is deenergized. As in the structure disclosed in Figs. 1, 2 and 3, the lower armatures 100 are mounted for independent pivotal movement and consequently only one of these armatures will respond when the electromagnet v that is associated with such armature is energized, the armatures of the other electromagnets remaining open, but inasmuch as all of the upper armatures 101 are fixed to the bar 102, all of these armatures will close when any one of the electromagnets v is energized.

The bar 102 is also provided at one end with an upwardly extending crank arm 105^a which is fixed to one end of a spiral spring 106. The other end of this spring is fixed to the hub of a balance wheel 107 which is mounted for oscillatory movement upon the adjacent pedestal 104 and a similar pedestal 108 also carried by the base 95.

The lower armatures 100 of the electromagnets v^1, v^2 and v^3 are provided with contacts having movable members 109, 110 and 111, respectively, which are adapted to engage fixed members 109^a, 110^a and 111^a, carried by but insulated from the base 95, when the electromagnets are energized. A contact member 112 is also provided on the balance wheel 107 which is adapted to alternately engage fixed contact members 112^a and 112^b, carried by the base 95, when the magnets v are energized periodically by coded current, as will hereinafter be described.

The balance wheel 107 is mechanically tuned to oscillate at a natural frequency equal to that of the code impressed upon the current energizing the electromagnets v. As a result, when any one of the electromagnets v is energized by current interrupted at code frequency, the balance wheel 107 will oscillate through an amplitude sufficient to alternately close the contacts 112—112^a and 112—112^b, but if the current energizing the electromagnets v is interrupted at any other frequency, the balance wheel 107 will not oscillate through an amplitude sufficient to close these contacts although it may respond to a slight degree.

The electromagnets v^1, v^2 and v^3 and a slow releasing relay q control the circuits for a plurality of lamps e^1, e^2, e^3 and e^4 which are located in the cab and which, when illuminated, indicate "high speed", "medium speed", "low speed", and "stop", respectively. When there is no coded current flowing in the track circuit, the electromagnets v and relay q are all deenergized.

If a coded 60-cycle current is supplied to the track circuit, the winding 99 of the electromagnet v^1 will be energized at code frequency and cause it to attract and release the upper armature 101 at the same frequency. The movement of the armature 101 causes the bar 102 to oscillate about its pivots also at code frequency and this movement is transmitted through the sprial spring 106 to the balance wheel 107. Inasmuch as the balance wheel 107 is mechanically tuned to oscillate at code frequency, its oscillatory movement will build up until it reaches its maximum amplitude at which point it alternately opens and closes the contacts 112—112^a and 112—112^b.

The lower armautre 100, however, remains closed, during the energization of electromagnet v^1 at code frequency, by reason of the fact that this armature is slow-releasing. This is accomplished by providing the cores 93 and 94 of the electromagnets v with lower portions 113 and 114 of reduced cross-sectional area and by encircling these portions by copper collars 115 and 116. As a result, the contact 109—109^a remains closed during the coded interruptions.

When the contacts 112—112^a and 112—112^b are opened and closed as hereinbefore described, a circuit is established for relay q passing from battery 117, through one or the other of these contacts, balance wheel 107, spring 106, crank arm 105^a and winding of slow-releasing relay q back to battery 117. The energization of slow-releasing relay q because of coded 60-cycle current in the track rails establishes a circuit passing from battery 117, through a front contact 118 of relay q, front contact 109—109ᵃ of electromagnet v^1 and lamp e^1 back to battery 117. This causes the illumination of lamp e^1, which indicates "high speed" to the engineman. The slow-releasing character of relay q maintains the front contact 118 thereof closed, during the coded interruptions, as long as the coded 60-cycle current is flowing in the track circuit.

The operation of the apparatus in response to the medium speed and low speed control currents is substantially the same as that above described in connection with the high speed control current in that when coded 80-cycle current is supplied to the track circuit, the lamp e^2 indicating "medium speed" is illuminated by virtue of a circuit controlled by front contact 110—110ᵃ of electromagnet v^2 and the front contact 118 of relay q, and when a coded 130-cycle current is supplied to the track circuit, the lamp e^3 indicating "low speed" is illuminated by virtue of a circuit controlled by a front contact 111—111ᵃ of electromagnet v^3 and the front contact 118 of relay q. When none of the control currents is present in the track rails, relay q will be deenergized, thus causing lamp e^4 to be lighted by a circuit including battery 117 and the back point of contact 118 of relay q. The illumination of lamp e^4 indicates "stop".

In Figs. 7, 8 and 9, I have shown another form of oscillator adapted to be employed in the circuit shown in Fig. 1. This oscillator embodies three electromagnets w^1, w^2 and w^3 each of which comprises two core members 119 and 120 which are mounted on a base 121. The core member 119 of each of the electromagnets w is provided with a winding 122 which is adapted to be energized when the circuit L, with which the electromagnet w is associated, is supplied with alternating current having a frequency at which such circuit is tuned to resonance. Associated with the core members 119 and 120 is an armature 123 which is pivotally mounted on the base 121 for horizontal movement, and an armature 124 which is fixed to a hub 125 for pivotal movement about a central vertical axis. The hub 125 is mounted for oscillatory movement between the base 121 and a bracket 126 extending horizontally from a pedestal 127 carried by the base 121. The armatures 123 are each independently biased toward an open position by a leaf spring 128 which is secured at one end to the associated core member 120, but the armatures 124 are collectively biased toward an open position by a single leaf spring 129 which is secured to one of the armatures 124 for engagement with an adjustable screw 130 carried by the base 121. As in the structures hereinbefore described, the independent mounting of the armatures 123 permits only one of these armatures to respond when the electromagnet w with which it is associated is energized but by reason of the fact that all of the armatures 124 are fixed to the hub 125, all of these armatures will close when any one of the electromagnets w is energized.

One of the armatures 124 is provided with a vertically extending arm 131 which is secured to one end of a spiral spring 132. The other end of the spring 132 is fixed to the hub 132ᵃ of a balance wheel 133 which is mounted for oscillatory movement about a vertical axis between the bracket 126 and a similar bracket 134 also carried by the pedestal 127.

The armatures 123 of the electromagnets w^1, w^2 and w^3 are provided with contact elements 135, 136 and 137, respectively, for engagement with fixed contact elements 135ᵃ, 136ᵃ and 137ᵃ, carried by but insulated from the base 121, when the electromagnets w are energized. A contact element 138 is also provided in the hub 132ᵃ of the balance wheel 133 for alternate engagement with fixed contact elements 138ᵃ and 138ᵇ carried by the bracket 134 (Figs. 7 and 9), when the magnets w are energized periodically by coded current. This contact device in all three forms of apparatus shown should be resilient enough not to seriously interfere with the free swing of the balance wheel.

The balance wheel 133 is mechanically tuned to oscillate at a natural frequency equal to that of the code impressed upon the current energizing the electromagnets w. As a result, when any one of the electromagnets w is energized by current interrupted at code frequency, the balance wheel 133 will oscillate through an amplitude sufficient to alternately close the contacts 138—138ᵃ and 138—138ᵇ, but if the current energizing the electromagnets w is interrupted at any other frequency, the balance wheel 133 will not close these contacts.

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. A circuit controller comprising a plurality of electromagnets, a circuit for controlling each of said electromagnets each electrically tuned to resonance at a different frequency, a member associated with said electromagnets and mechanically tuned to oscillate at the frequency of coded interruptions in said circuits, contact mechanism closed by said member once during each oscillation thereof, a contact device controlled by each

of said electromagnets and periodically closed for a time interval equal to at least one-half of the time period of each cycle of oscillatory movement of said member, and a plurality of circuits each controlled jointly by said contact mechanism and by one of said contact devices.

2. Apparatus selectively responsive to alternating currents of different frequencies periodically interrupted at one and the same frequency, comprising a plurality of electromagnets each controlled by one of said currents, an oscillating mechanism controlled jointly by said electromagnets and mechanically tuned to oscillate at the frequency of the interruptions in said currents, a circuit controller controlled by said oscillating mechanism, a contact device controlled by each of said electromagnets, and a plurality of signals each controlled jointly by one of said contact devices and by said circuit controller.

3. Apparatus selectively responsive to alternating currents of different frequencies periodically interrupted at one and the same frequency, comprising a plurality of electromagnets, a circuit for controlling each of said electromagnets electrically tuned to resonance at the frequency of one of said currents and controlled by the same current, an oscillating mechanism operated by all of said electromagnets and mechanically tuned to oscillate at the frequency of the interruptions in said currents, contact mechanism controlled by said oscillating mechanism, a contact device controlled by each of said electromagnets, a plurality of relays each controlled jointly by one of said contact devices and by said contact mechanism, and a plurality of signals each controlled by one of said relays.

4. Apparatus selectively responsive to alternating currents of different frequencies periodically interrupted at one and the same frequency, comprising a plurality of electromagnets, a circuit for controlling each of said electromagnets electrically tuned to resonance at the frequency of one of said currents and controlled by the same current, an oscillating mechanism controlled jointly by said electromagnets and mechanically tuned to oscillate at the frequency of the interruptions in said currents, contact mechanism controlled by said oscillating mechanism, a contact device controlled by each of said electromagnets, a slow-releasing relay controlled by said contact mechanism, and a plurality of signals each controlled by one of said contact devices and by said slow-releasing relay.

5. Apparatus selectively responsive to alternating currents of different frequencies periodically interrupted at one and the same frequency, comprising a plurality of electromagnets, a circuit for controlling each of said electromagnets electrically tuned to resonance at the frequency of one of said currents and controlled by the same current, an oscillating mechanism controlled jointly by said electromagnets and mechanically tuned to oscillate at the frequency of the interruptions in said currents, a contact mechanism controlled by said oscillating mechanism, a slow-releasing contact device controlled by each of said electromagnets, a slow-releasing relay controlled by said contact mechanism, and a plurality of signals each controlled by one of said slow-releasing contact devices and by said slow-releasing relay.

6. Apparatus selectively responsive to alternating currents of different frequencies periodically interrupted at one and the same frequency, comprising a plurality of electromagnets, a circuit for controlling each of said electromagnets electrically tuned to resonance at the frequency of one of said currents and controlled by the same current, a contact device controlled by each of said electromagnets, a plurality of armatures one for each of said electromagnets mounted to move in unison when any one of said electromagnets becomes energized, an oscillating mechanism actuated by said armatures and mechanically tuned to respond at the frequency of the interruptions in said currents, a circuit controller controlled by said oscillating mechanism, and a plurality of signals each controlled jointly by one of said contact devices and by said circuit controller.

7. Apparatus selectively responsive to alternating currents of different frequencies periodically interrupted at one and the same frequency, comprising a plurality of electromagnets, a circuit for controlling each of said electromagnets electrically tuned to resonance at the frequency of one of said currents and controlled by the same current, a contact device controlled by each of said electromagnets, a plurality of radially extending armatures one for each of said electromagnets mounted to move in unison about a vertically extending axis when any one of said electromagnets becomes energized, a balance wheel mounted to oscillate about an axis coincident with that of said armatures, yieldable means connecting said armatures and said balance wheel, said balance wheel having a moment of inertia such as will cause it to oscillate at the frequency of the interruptions in said currents when one of said electromagnets becomes energized, a circuit controller controlled by said oscillating mechanism, and a plurality of signals each controlled jointly by one of said contact devices and by said circuit controller.

8. Apparatus selectively responsive to alternating currents of different frequencies periodically interrupted at one and the same frequency, comprising an oscillating member mechanically tuned to oscillate at the frequency of the interruptions in said currents, a contact operated by said oscillating member

and adapted to become closed upon the oscillatory movement thereof in each direction, a plurality of electromagnets for oscillating said member independently of one another, a circuit for controlling each of said electromagnets each electrically tuned to resonance at the frequency of one of said currents and responsive to said current interruptions, a contact controlled by each of said electromagnets and adapted to be closed for successive time periods each equal to at least one-half of the time period of oscillatory movement of said oscillating member, and a plurality of signals each controlled jointly by said first-mentioned contact and by one of said second-mentioned contacts.

In testimony whereof I affix my signature.

PAUL N. BOSSART.