No. 615,762. Patented Dec. 13, 1898.

J. D. TAYLOR.

RAILWAY CROSSING SIGNAL.

(Application filed Jan. 12, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig 1

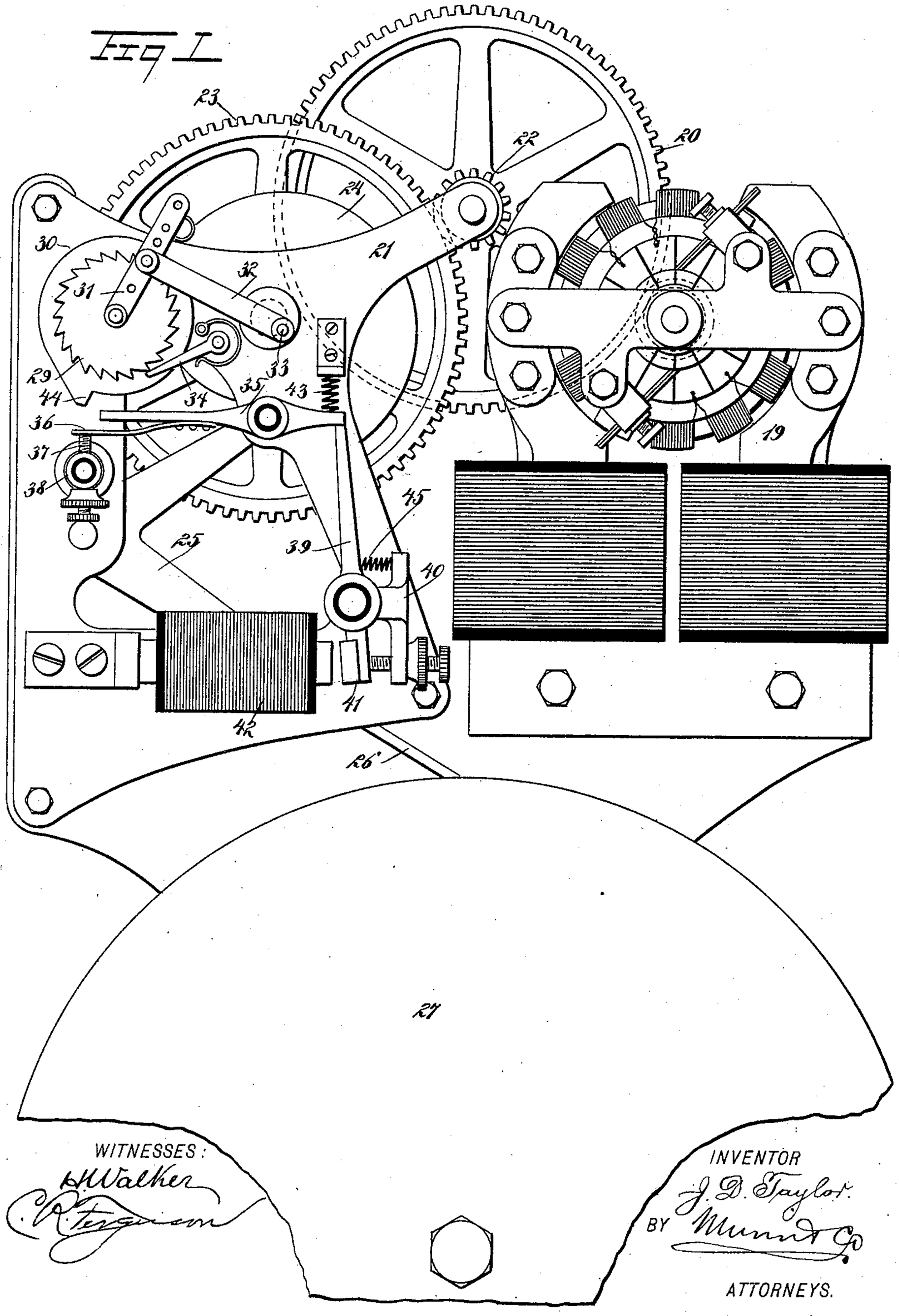

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Fig 2

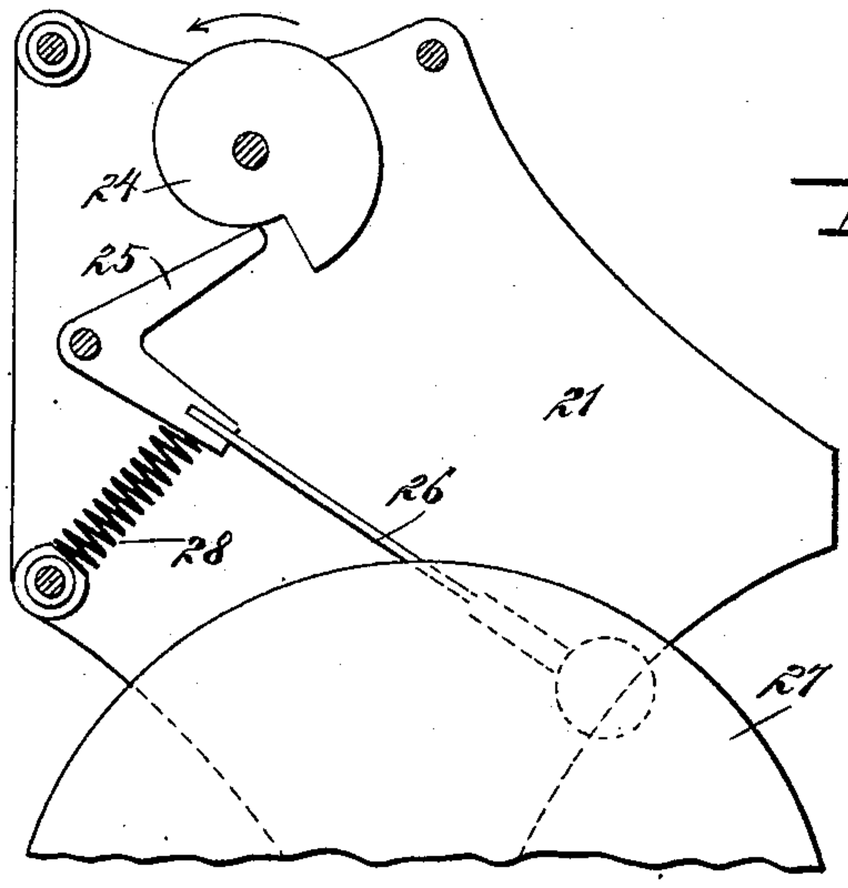
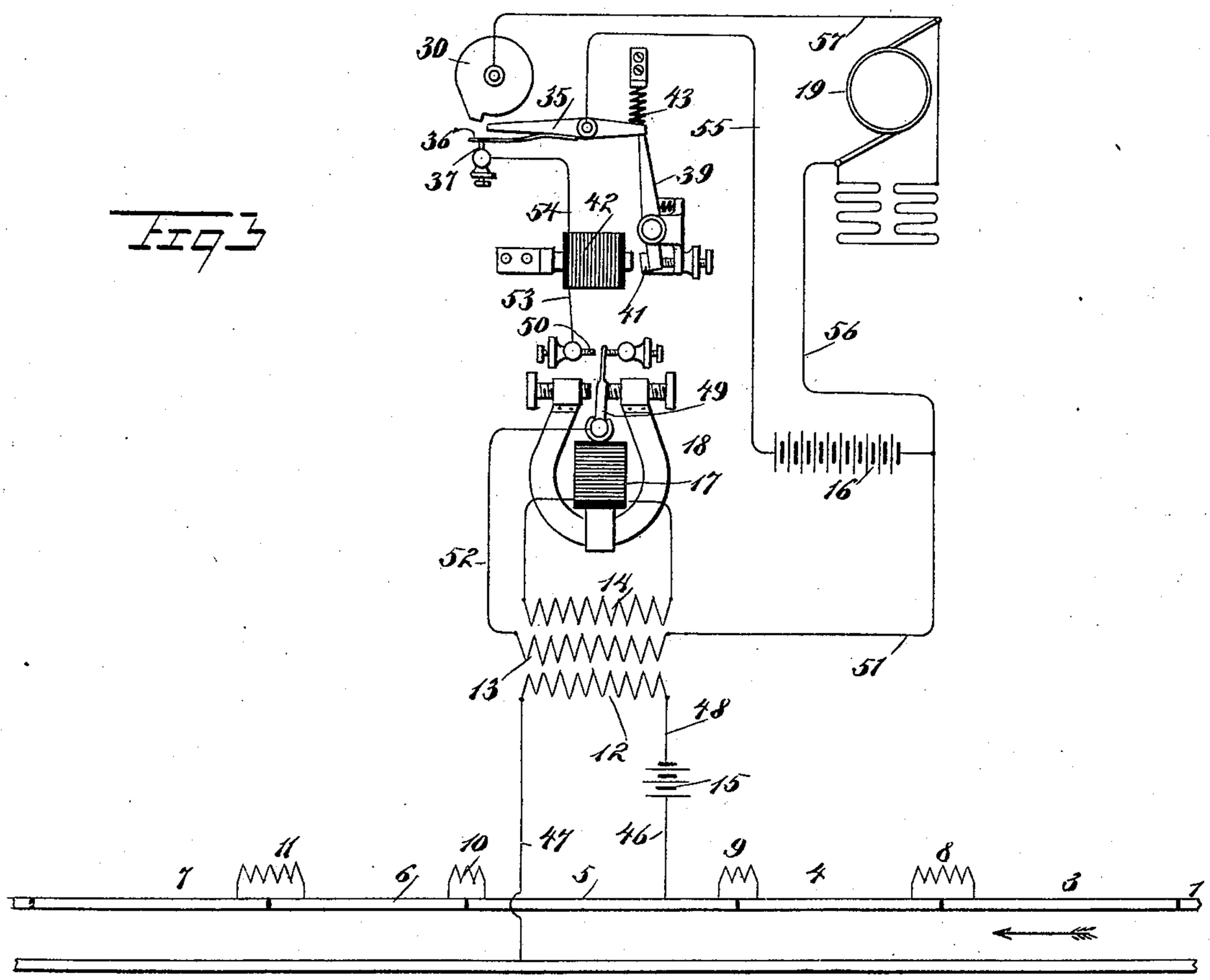


Fig 3



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RAILWAY-CROSSING SIGNAL.

SPECIFICATION forming part of Letters Patent No. 615,762, dated December 13, 1898.

Application filed January 12, 1898. Serial No. 666,434. (No model.)

To all whom it may concern:

Be it known that I, JOHN D. TAYLOR, of Chillicothe, in the county of Ross and State of Ohio, have invented a new and Improved Railway-Crossing Signal, of which the following is a full, clear, and exact description.

This invention relates to railway-crossing signals; and the object of the invention is, first, to provide an automatic alarm-signal to be placed at the crossing of the street or other highway with a railroad which will sound an alarm when a train is approaching the crossing, but only when the train is actually approaching and not when it is standing or receding from the crossing, and, second, to provide an alarm which can be heard above the noise of traffic on the street or highway. It is very important to attain both these objects—so much so that if they are not attained the signal as a warning of danger is practically useless. These alarm-signals are most needed at points where switching is done, because switch-yards are needed most at the centers of population. At these points trains very frequently approach a street-crossing, pass the apparatus by which it sets the alarm, and then stop and stand for a considerable length of time, and then very likely back off without reaching the street at all. An alarm which sounds during the time the train is standing on the starting apparatus or between it and the crossing or while the train is moving away from the crossing is of little value, because people become accustomed to its false alarms and soon learn to disregard it altogether. The systems controlled directly by the ordinary track-circuit, either normally closed or open, have this defect. An attempt has been made to remedy this by constructing the apparatus so that the train starts the bell ringing by operating the circuit-closer placed at a distance from the crossing and so that the bell will cut itself out of the circuit after ringing a certain length of time, providing the train passes over the circuit-closer in the meantime; but the defect is only partially remedied, while a worse one is introduced, because the train, if it passes the crossing, will operate the circuit-closer on the other side of the crossing and again set the bell ringing.

I will now describe a crossing alarm-signal embodying my invention, and then point out the novel features in the appended claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a side elevation of a signal mechanism employed. Fig. 2 is a front elevation with part of the mechanism removed in order to show the construction of other parts, and Fig. 3 is a diagrammatic view of the system.

Referring to the diagrammatic view, 1 2 designate the rails of a track, one rail, 1, being divided into sections 3, 4, 5, 6, and 7. These sections are separated electrically from each other and from contiguous portions of the track by insulating material in the ordinary manner. The sections 3 4, however, are connected electrically through a resistance 8. The sections 4 and 5 are connected together through a reduced resistance 9. The sections 5 and 6 are connected through a resistance 10 equal to the resistance 9, and the sections 6 and 7 are connected through a resistance 11 equal to the resistance 8. The resistances 8 and 9 are on one side of the crossing and the resistances 10 and 11 are on the other side.

12, 13, and 14 represent coils of insulating-wire wrapped on an iron core and forming an induction-coil of the usual construction, excepting that it has two primary coils, one, 12, being connected to one pole of a battery 15 and the other, 13, being connected to one pole of a battery 16. The terminals of the secondary coil 14 are connected to the magnet 17 of the polarized relay 18.

Referring now to Fig. 1, 19 indicates a small electric motor, which may be of any of the well-known types. On the armature-shaft of the motor is a pinion meshing with a gear-wheel 20, having its journal-bearings in a frame 21, and on the journal of this gear-wheel 20 is a pinion 22, meshing with a gear-wheel 23, also having its shaft-bearings in the frame 21, and on the shaft of this gear-wheel 23 is a spiral cam 24. One arm of an angle-lever 25 engages with the periphery of the cam 24, and to the other arm of this angle-lever is attached a hammer-lever 26 for sounding the alarm-bell 27. A spring 28 presses the lever 26 yieldingly against the cam 24. As the cam turns the hammer is

pushed away from the bell 27, and when the offset in the cam 24 passes the end of the lever 25 the hammer is driven against the bell 27 by means of the spring 28. Thus there will be one stroke on the bell for each revolution of the cam. While with this apparatus, as it is arranged to give only about one stroke per second, the strokes are fewer than with the ordinary vibrating bell, yet each stroke gives a very much louder sound than is possible to obtain with the common vibrating bell on account of the very low efficiency of the latter and the limit which it is necessary to put on the amount of current supplied to it to avoid rapid deterioration of the contacts.

A ratchet-wheel 29 and a cam 30 are rigidly attached together and rotate on a stud projected from the frame 21. The ratchet 29 and the cam 30 are made to rotate by a pawl pivoted on an arm 31, mounted on the stud upon which the cam and ratchet are mounted. This pawl-carrying arm 31 is made to oscillate by its link connection 32 with a crank-pin 33 on the end of the shaft which carries the spiral cam 24. As this shaft revolves the ratchet 29 is moved forward step by step, and a spring-pressed retaining-pawl 34, engaging with the ratchet-wheel, prevents any backward movement. The arm 31 is provided with a series of lugs, with either one of which the link 32 may be engaged when it is desired to regulate or change the distance of movement of the ratchet-wheel.

As will be hereinafter explained, the length of time of ringing the bell depends on the time required for the cam 30 to make one revolution. The time during which the bell will ring can be changed to suit the circumstances and requirements of the places by changing the connections between the link 33 and the arm 31.

A lever 35 is pivoted between its ends on a stud attached to the frame 21; but is insulated therefrom, and the lever is so placed that it is possible for it to touch the cam 30 throughout an entire revolution of said cam. The lever 35 carries a contact-spring 36, adapted to engage with a contact-screw 37 in a post 38, mounted on but insulated from the frame 21. The contact-spring 36 is normally held in engagement with the contact 37 by means of an armature-lever 39, pivoted to a bracket 40 on the frame 21. The armature-lever, however, is insulated from said bracket. The upper end of this armature-lever 39 normally engages under the end of the lever 35 opposite that on which the spring-contact 36 is mounted.

The lever 39 carries at its lower end an armature 41 for coacting with an electromagnet 42. When a current is sent through this electromagnet 42, the armature 41 will be attracted and the upper end of the lever 39 will be drawn away from the lever 35, so that a spring 43, bearing upon this end of the lever, will move the opposite end of the lever 35 upward to engage it with the cam 30 and at the same time separate the contact 36 from the contact 37. The cam 30 is circular, excepting that it has a lug 44 at one side. Therefore no change in the position of the lever will be made during the revolution of the cam until the lug 44 is brought into a position to depress the end of the lever 35, when the lever 39 will be forced by a spring 45 again underneath the end of the lever 35 and the contact 36 against the contact 37. At this time the electromagnet 42 will of course not be energized.

To describe the operation of the mechanism and circuits, a train may be supposed to be approaching and moving in the direction indicated by the arrow between the tracks in Fig. 3. When the first wheel of a train touches the rail 3, the circuit of the battery 15 is closed, so that the current flows from said battery through the wire 46, connecting with the rail-section 5, thence through the rail-section 5, resistance 9, rail 4, resistance 8, rail 3, then through the wheels and axle of a car or engine to the rail 2, thence through a wire 47, leading from said rail 2 to the primary induction-coil 12, and then by a wire 48 back to the battery 15. The starting of this current in the primary coil 12 induces a momentary current in the secondary coil 14, which flows through the coils of the polarized relay 18 in such direction as to cause the lever 49 to be drawn against a contact-point 50. The lever 49 is placed centrally between the poles of the permanent magnet—that is, so that when at the middle point of its motion it is midway between the poles and when thrown to one side by a current of one sign it will not return to the other side until a current of opposite sign is sent through the coils of the electromagnet 17.

For brevity I will call the current induced in the secondary coil 14 by increasing current in either of the primaries 12 or 13 a "positive" current and that induced by a decreasing current in the primaries a "negative" current. Of course to do this the primaries themselves must be connected to their respective batteries in such a way that increasing currents in one will induce currents of the same direction in the secondary coil as will be induced by the increasing current in the other primary coil. Under these conditions, then, the current above mentioned induced in the secondary is a positive current, and, as stated, it causes the lever 49 to be thrown against the contact-point 50. This closes a circuit of the battery 16, so that a current flows through the wire 51, primary coil 13, the wire 52, the lever 49, the contact-point 50, wire 53, the electromagnet 42, the wire 54, the contact 37, contact-spring 36, the lever 35, and wire 55 back to the battery 16. The effect of starting this current through the primary coil 13 is to induce a positive current in the secondary coil 14, which flows through the coil of the polarized relay 18.

This induced current tends to throw the lever 49 against the contact 50, or, in other words, to press the lever more firmly against said contact. A current from the battery 16 also flows through the electromagnet 42, causing it to draw the armature 41 and move the lever 39 out of engagement with the lever 35, which under the influence of the spring 43 is moved into contact with the cam 30 and at the same time separates the contacts 36 and 37. This breaks the circuit of the battery 16 through the magnet 42 and the primary 13. The effect on the induction-coil is that of a decreasing current in the primary, and a negative current is induced in the secondary coil 14 and sent through the coils of the relay 18. This causes the lever 49 to be drawn away from the contact-point 50, thus breaking the circuit through the battery 16 in a second place.

As a result of the action of the current before named the lever 35, as stated, has been brought into contact with the cam 30. This closes another circuit of the battery 16, so that the current flows through a wire 56, motor 19, wire 57, cam 30, lever 35, and wire 55 back to the battery 16. This causes the motor 19 to rotate, and through the train of gearing before described the cams 24 and 30 will be rotated. The rotation of the cam 24 rings the bell, as before mentioned. As this rotation continues the lever 35 maintains connection with the cam 30 until the lug 44 on said cam leaves the end of said lever 35. Before leaving the lever, however, the lug will have pressed the end of the lever down, so that the armature-lever 39 may be moved in position to support said lever 35. This of course brings the spring-contact 36 into engagement with the contact 37, and the whole apparatus is placed in its normal position.

The proportions and adjustments shown in the drawings would require ten revolutions of the cam 24 to one of the cam 30. The bell would therefore make ten strokes and would ring about ten seconds as the result of one positive impulse through the polar relay. When the train above mentioned proceeds toward the crossing far enough to cause one of its wheels to touch the rail 4, then the resistance 8 is cut out of the circuit of the battery 15 and the current flows through the wire 46, rail 5, resistance 9, rail 4, the wheels and axle of the train to the rail 2, thence through the wire 47, primary coil 12, and wire 48 back to the battery 15. This current, owing to the difference in resistance, is stronger than the one before named through the coil 12, and of course at the instant of cutting out the resistance 8 the current through the coil 12 is increasing and a positive current will be induced in the secondary coil 14 and sent through the coil of the polar relay. This will cause the operation before mentioned to be repeated and the bell will ring for another period of ten seconds. When the train passes the resistance 9 and cuts it out of circuit, the current through the primary 12 will again be increased and the operation will be repeated.

Now when the wheels and axle bridge the space between the rails 5 and 2 the current through the primary 12 is at the maximum. Supposing the train to proceed in the same direction and to recede from the crossing when the last pair of wheels passes the resistance 10, this will be added to the circuit of the battery 15 and the current through the coil 12 will be thereby reduced. This will induce a negative current in the secondary coil 14, which will have no effect on the bell. The current through the coil 12 will again be reduced when the last wheels pass the resistance 11 and it is thus added to the circuit. When the last wheel leaves the rail 7, the circuit of the battery 15 will be opened, which of course induces a negative current in the coil 14.

From the above it will be seen that as a train approaches a crossing the circuit of the battery 15 through the coil 12 is first closed through resistance and then successive portions of the resistance are cut out of circuit until no external resistance is left in the circuit. When the train is receding from the crossing, successive portions of the resistance are added to the circuit and finally the circuit is entirely opened.

Increments of current in the coil 12 have the effect of ringing the bell, while decrements of current have no effect. Consequently a train approaching the crossing will ring the bell, but a train receding from the crossing will not ring the bell.

Suppose a train to approach the crossing moving in the direction of the arrow. When the first wheel touches the rail 3, the bell will be set ringing, as before described. Now suppose the train stops in the section 3 and stands there for some time. The bell will ring ten seconds and then cut itself out of circuit, as before described. It is well known that a uniform current in the primary of an induction-coil has no effect on the secondary, so however long the train may stand in the section 3 the bell will not be kept ringing longer than the time for which it was adjusted, and this, in view of the fact that cars in switching often stand from ten minutes to half an hour on a section, is a great improvement. Suppose the train now moves again toward the crossing. When the first wheel touches the rail 4, the resistance 8 is cut out of circuit, the current through the coil 12 is increased, and the bell is set ringing for ten seconds more. If the train stops in section 4, the bell stops after the ten seconds have passed. If the train proceeds and passes the resistance 9, the bell rings again; but if it should back away from the crossing the bell is unaffected.

If a train in approaching the crossing should be running so fast as to reach the resistance 8 before the bell stops ringing as the result of the first impulse of the current produced by the train entering the section 3, the

second impulse, due to the cutting out of the resistance 8, will not be lost, because, as before stated, the lever 49 remains wherever it may be placed by a current until a reverse current changes it and this second impulse throws it in contact with the contact-point 50. When the cam 30 completes the revolution which was started by the first impulse mentioned, the lug 44 places the spring 36 in contact with the contact 37, and as the lever 49 is in contact with the point 50 the circuit of the battery 16 is closed through the primary coil 13 and the magnet 42 through the circuit above described. The magnet 42 is thus energized and the lever 39 is held away from engagement with the lever 35, so that as soon as the lug 44 passes the end of the lever 35 the spring 43 immediately places it in contact with the cam 30 and the bell continues to ring for another period, so if a train is running fast the bell will ring continuously while the train is approaching the crossing.

The track-sections should be comparatively short near the crossing, so that a train which is stopped far enough away from the crossing to again start toward it and acquire a dangerous speed before reaching the crossing will have to pass at least one of the resistance-coils. The outer sections may be considerably longer, because if a train is running very fast it will cover a considerable distance during the period that the bell is ringing, and if it is running slowly it is not necessary to give a warning so far away, and if there is a considerable period of silence while the train is passing over the outer section no harm will result. The length of the sections will of course depend to some extent on the conditions existing at the place to be protected.

The use of the coil 13 is to induce a negative current in the secondary 14, which flows through the coils of the relay and retracts the lever 49. Without the coil 13 the lever 49 would have to be retracted by a spring or by adjusting it closer to the poles of the permanent magnet on the side opposite the contact 50, either of which methods would make it require a stronger current to place the lever against the contact 50. Besides, as the currents which operate the polar relay are only momentary, the contacts secured in this way will be only momentary and might not last long enough to effect the release of the lever 35, whereas by using the coil 13 the lever is held in contact with the point 50 until the lever 35 is released. Even a positive current induced in the coil 14 by starting the current in the coil 13 is advantageous, as it makes the contact between the lever 49 and contact-point 50 firmer.

To secure the best results, the increments of magnetic induction due to closing the battery 15 through all the resistances on one side of the crossing to cutting out successive portions of resistance one at a time and to closing the battery 16 through the coil 13 should be about equal. This can be easily effected by making the coils 12 and 13, the iron core, and the resistances 8 and 9 of suitable proportions. The induction should not be carried very high, however—say about twelve thousand lines per square centimeter—so that small changes in the magnetizing force may produce a maximum change in the magnetic induction. Constructed in this way very small battery-power is sufficient for operating a coil, not more than one or two cells of low resistance being required in the battery 15.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a railway-crossing signal, a signal-sounding mechanism, an open track-circuit at one side of a crossing, a resistance connecting one portion of the track-circuit with another, the resistances diminishing as they approach the crossing, a primary coil in the track-circuit, a secondary coil operating by an induced current from the primary to operate the signal, and another primary for bringing the signal to rest, substantially as specified.

2. In a railway-crossing signal, a signal-sounding mechanism, an electric circuit comprising an induction-coil having two primaries and one secondary, an open rail-circuit having resistances for controlling one of the primary coils, and a relay operating by an induced current of the secondary coil to operate the signal mechanism, the second primary operating to restore the relay to normal, substantially as specified.

3. In a railway-crossing signal, a signal-sounding mechanism, a motor for operating the same, a track-circuit, an induction-coil comprising two primaries and one secondary, one of the primaries having connection with the track-circuit, and a relay operated by the induced current of the secondary coil to operate the signal mechanism, the other primary operating to restore the relay to normal, substantially as specified.

4. In a railway-crossing signal, a signal-sounding mechanism comprising an electric motor, an induction-coil having two primaries and one secondary, track-sections at one side of the crossing connected by resistances diminishing as they approach the crossing, connections between said track-sections and one of the primaries, a battery in said connection, a relay operated by the induced current of the secondary coil, connections between the other primary coil and the motor-battery, the said connections being controlled by the relay, and a battery in said connections, substantially as specified.

5. In a railway-crossing signal, the combination with an electric circuit comprising the railway-tracks, of a motor-circuit, a motor in the motor-circuit, a cam operated by the motor, a bell-sounding hammer operated by said cam, and another cam operated by the first-

named cam for cutting the motor out of the circuit, substantially as specified.

6. In a railway-crossing signal, a signal-sounding mechanism comprising an electric motor, an electric circuit in which the motor is arranged, a cam operated by the motor, a bell-sounding hammer operated by said cam, another cam having a step-by-step rotary movement imparted to it from the first-named cam, and means operated by the last-named cam for cutting the motor out of circuit, substantially as specified.

7. In a railway-crossing signal, a signal-sounding mechanism, comprising an electric motor, an electric circuit in which the motor is arranged, a cam operated by said motor, a bell-sounding lever operated to sound the bell upon each complete rotation of the cam, another cam having a step-by-step rotary movement, and a circuit-closing lever operated by the last-named cam, for cutting out the motor, substantially as specified.

8. A railway-crossing signal, comprising a bell, an electric motor, a motor-circuit, a track-circuit for controlling the motor-circuit, a spiral cam operated by the motor, an angle-lever, one arm of which is engaged with the periphery of said cam, a bell-sounding hammer carried by the other arm of said lever, another cam, a lever adapted to engage with said other cam, to place said lever and cam in the electric circuit of the motor, and means carried by said cam for moving said lever into engagement with another circuit, or to cut out the motor-circuit, substantially as specified.

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