(No Model.)

2 Sheets—Sheet 1.

E. FROST.

BELL.

No. 418,560. Patented Dec. 31, 1889.

Fig. 2,

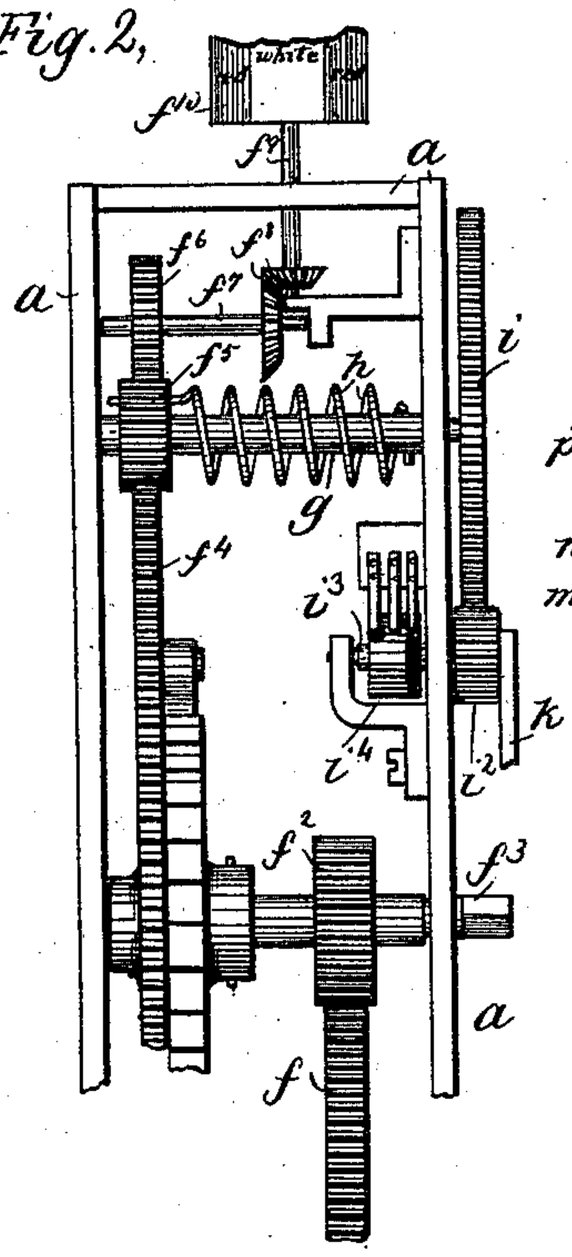


Fig. 1,

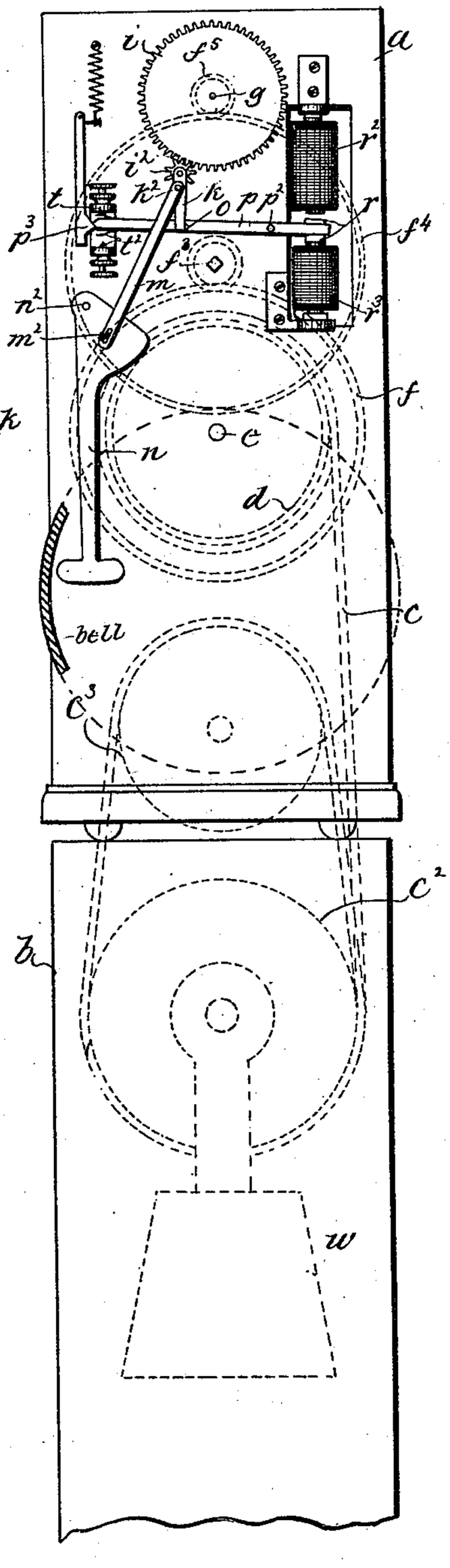


Fig. 3,

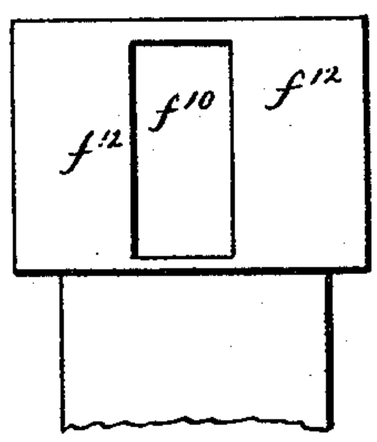
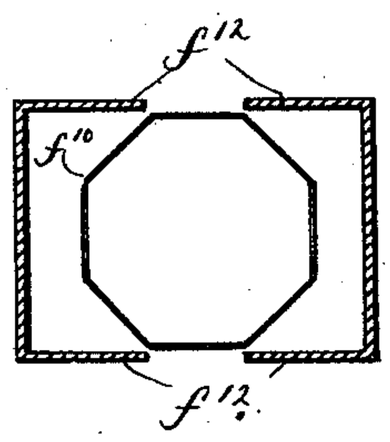


Fig. 4,



Witnesses.

Jas. J. Maloney

H. D. Hill.

Inventor,
Edward Frost,
by Jos. P. Livermore,
Att'y.

(No Model.) 2 Sheets—Sheet 2.

E. FROST.

BELL.

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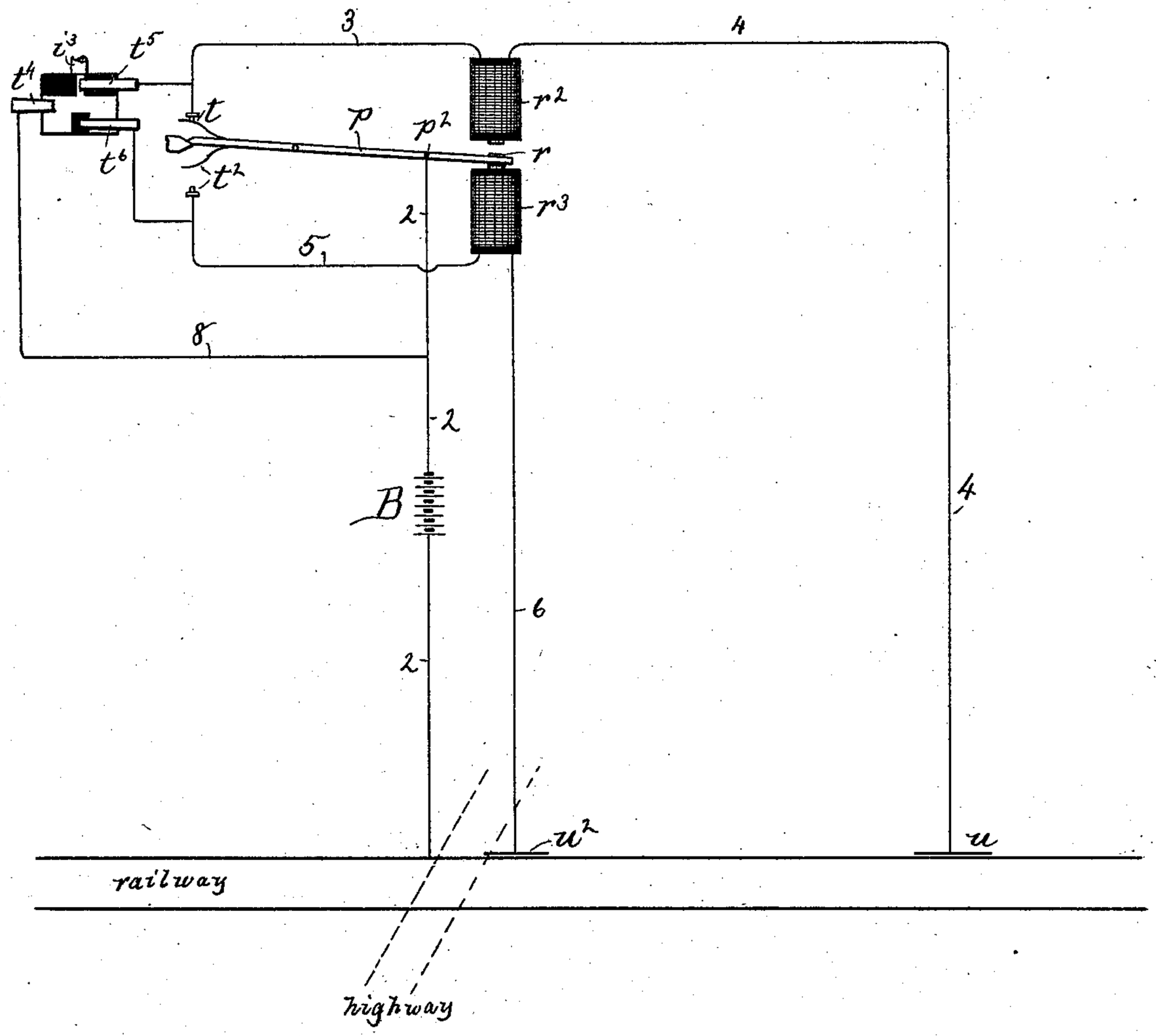
Fig. 5



Witnesses,
Jas. J. Mealoney.
M. E. Hall

Inventor,
Edward Frost,
by Jos. P. Livermore
Att'y.

UNITED STATES PATENT OFFICE.

EDWARD FROST, OF LITTLETON, MASSACHUSETTS.

BELL.

SPECIFICATION forming part of Letters Patent No. 418,560, dated December 31, 1889.

Application filed July 2, 1889. Serial No. 316,345. (No model.)

To all whom it may concern:

Be it known that I, EDWARD FROST, of Littleton, county of Middlesex, State of Massachusetts, have invented an Improvement in Bells, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

The object of my invention is to produce an alarm or mechanical bell-striker suitable for use at highway-crossings on railways to give warning of the approach of trains, the operation of the bell being controlled by a detent that can be operated at any desired point.

Considerable difficulty has been experienced in attempts to produce mechanically-operated bells for crossing-signals owing to the necessity of providing motive power sufficient for striking a very large number of blows at one winding of the actuating weight or spring, so that there will be no danger of the actuator running down and thus becoming inoperative in the intervals between the successive windings, which may be performed once a day. When a very large weight is employed in connection with a train of wheel-work, so that the weight descends very slowly and moves only a short distance for each blow of the bell-hammer, it is difficult to make the hammer give a quick sharp stroke, and when a mainspring is employed as the actuator it is practically impossible to produce a spring of sufficient length to keep the bell in operation any considerable length of time.

The object of the present invention is to overcome these objections to the actuation of a bell-hammer, either by a weight or by a spring, and to provide an actuating-motor for the bell-hammer having the advantages of each kind of actuator—that is, one capable of giving the prompt vigorous movement to the bell-hammer derived from a spring and also capable of storing power for a long period of operation by the movement of a very heavy slowly-descending weight.

The invention is embodied in an apparatus comprising a train of wheel-work, the main shaft of which is provided with a winding-drum, upon which is wound a weight-sustaining cord, preferably passed over pulleys, so that the descent of the weight through a given distance unwinds a much greater length of cord from the drum. The said main drum-shaft is connected by speed-increasing gearing with a hammer-actuating shaft; but interposed in the said train, preferably at a point near the most rapidly-moving portion, is a mainspring, one end of which connects with the train of gearing leading to the main drum-shaft, and the other end of which connects with the gearing or wheel-work leading to the hammer-actuating shaft, the result of which arrangement is that the force of the weight is applied to the spring which sustains the weight when the bell-hammer is not operating; but when the detent controlling the movement of the bell-hammer is disengaged the said bell-hammer is impelled by the said spring, which is, however, strained up again or practically rewound by the descent of the weight as fast as it is relaxed by expending its force in impelling the bell-hammer. The bell-hammer itself is supported on a pivoted arm, and normally hangs almost vertically beneath the pivot, in which position it strikes a blow upon the bell. By this arrangement the force of gravity tends to make the bell-hammer strike, and is increased or followed up, as it were, by the impulse derived from the actuating-weight and interposed spring, which have to be of sufficient power to raise the hammer or retract it, after the blow is struck, against the force of gravity.

A slotted connection or equivalent means for providing for lost motion is provided between the hammer-arm and the impelling-train of wheel-work, so that if in striking a blow the hammer-arm should acquire a velocity greater than that at which the train can follow it it will not be impeded or retarded by its connection with the train. A visual signal also operates in conjunction with the bell.

Figure 1 is a front elevation of a bell embodying this invention adapted to be used as a railway-crossing signal; Fig. 2, a sectional detail thereof; Fig. 3, a front elevation of the visual signal; Fig. 4, a horizontal section thereof, and Fig. 5 a diagram representing a circuit that may be used to control the operation of the bell.

The operative parts may be supported on

suitable plates or frame-work *a*, itself supported on a post or upright *b*, a portion only of which is shown in Fig. 1, said post containing the main actuating-weight *w*. The mechanism is actuated by the said weight *w*, which acts upon a cord *c*, wound upon a drum *d*, as shown in dotted lines, said drum being upon a main shaft *e*, provided with a gear *f*, meshing with a pinion f^2, connected with the winding shaft or arbor f^3, which is suitably squared or otherwise adapted to receive the winding-key by which the pinion f^2 and gear *f* are turned in the proper direction to rotate the shaft *e* and drum *d*, so as to wind the weight-supporting cord *c* thereon. The said cord *c* is preferably passed over one or more pulleys c^2, from the axles of which the weight *w* is suspended, and also over one or more stationary pulleys c^3, so that the movement of the drum *d* relative to the descent of the weight *w* may be multiplied as much as required, and a very heavy weight having only a comparatively short fall may turn the drum *d* with sufficient power a very large number of times. The shaft f^3 also supports a gear f^4, which may be connected with said shaft by a ratchet and pawl, as is usual in clock-work, so that the said gear is turned with the shaft f^3, as the latter moves under the descent of the weight; but it is not turned when said shaft f^3 is rotated in the opposite direction by the winding-key for the purpose of raising or winding the weight. The said gear f^4 meshes with a pinion f^5, which is loose upon the shaft *g*, the said pinion f^5 being connected with one end of a mainspring *h*, as best shown in Fig. 2, the other end of which spring is connected with the said shaft *g*, the arrangement being such that the rotation of the pinion f^5 by the main actuating-weight *w*, through the train of gearing, tends to wind up or strain the spring *h*, which in turn tends to rotate the shaft *g* in the same direction that the gear *f* is rotated or tends to rotate under the force derived from the weight *w*. The shaft *g* has fixed upon it a gear *i*, meshing with a pinion i^2, the axle or arbor of which is provided with an arm *k*, which is provided with a wrist-pin k^2, connected by a link *m* with the hammer-arm *n*, pivoted at n^2, and being vibrated on said pivot as the wrist-pin k^2 is revolved by the action of the train of wheel-work. The arm *k* forms or is provided with one member of a detent controlling the movement of the hammer-arm, the other member of which detent consists of a projection *o* upon a lever *p*, pivoted at p^2 upon the frame-work. The said detent may be controlled or operated in any suitable way, so as to release and subsequently stop the motor at the proper times. As shown, in this instance it is provided with armatures *r* for electro-magnets r^2 r^3, which may be connected in circuit in such manner that the magnet r^2 is energized upon the approach of a train, and thus moves the detent into position to permit the motor to operate and sound the alarm, while the magnet r^3 is energized when trains arrive at such position that the alarm no longer need be operated.

While it is immaterial, so far as the remainder of the apparatus is concerned, how the detent-lever may be operated, the magnets, with the circuit arrangements therefor, which will now be described, afford a very efficient and convenient means for controlling the alarm.

The circuit of magnet r^2 includes a circuit-breaker *t*, controlled by the detent or armature lever *p* in such manner that when the armature is in the retracted position with relation to the said magnet the said circuit-closer *t* is closed. The circuit of the magnet r^2 also includes the battery B, shown as placed in the wire 2, (see Fig. 5,) connecting one of the rails of the track with the detent-lever *p* and one member of the circuit-breaker *t*, from the other member of which the circuit extends, as shown at 3, to the magnet r^2, and thence, as shown at 4, to a suitable circuit-closer *u*, placed at a sufficient distance along the track from the crossing and adapted to be operated by the trains arriving at the said circuit-closer *u*, which may be merely an insulated rail or bar placed sufficiently near the rail that forms a part of the battery-circuit to be connected therewith by the treads of the wheels as the train passes by. The circuit of the magnet r^3 contains a similar circuit-closer t^2, operated by the detent-lever *p*, and so arranged as to be opened when the one *t* is closed, and the opposite. One member of the said circuit-closer t^2 is connected by wire 5 with one terminal of the magnet r^3, the other terminal of which is connected by wire 6 with a circuit-closer u^2, which may be similar to the one *u*, but placed at or near the highway-crossing, or at a point at which the alarm may cease operating upon the arrival of the train. The detent-lever *p* is acted upon by a cam or wedge p^3, which throws it in one or the other direction from an intermediate point and completes its movement in either direction after it has passed the intermediate point in the said movement, and the circuit-closers *t* t^2 are made with springs that maintain contact until just as or after the lever passes the said intermediate point. Thus the closing of the circuit-closer *u* upon the approach of the train energizes the magnet r^2, which attracts the armature, moves the detent-lever over the cam, and thereby permits the compound train of spring and wheel-work to vibrate the bell-hammer *n*. The cam p^3 completes the movement of the armature toward the magnet r^3, and in so doing breaks the circuit of the magnet r^2 at *t*, but connects the circuit of the magnet r^3 at t^2, the latter circuit being, however, normally still open at u^2. Thus only a momentary impulse of the battery is required to set the instrument in operation and leave it in operation indefinitely. If the circuit-closer u^2 of the magnet r^3 be casually closed,

an adverse effort of the magnet r^3 would result when the circuit-closer t^2 made contact, but would be inoperative for the instant required for the cam, aided by residual magnetism in r^2, to complete the release. If the circuit-closer u^2 remained continuously closed—as, for instance, by presence of a train—the detent-lever sets up a rapid oscillating movement and the bell rings continuously, maintaining the alarm by the constant recurrence of the release so long as circuit of r^2 remains closed, and ceasing when it breaks; hence a considerable length, suitable for maintenance of alarm in the contingency so arising is to be given to the circuit-closer u. When the train arrives at u^2, it is clear of circuit-closer u and closes the normally-open circuit of the magnet r^3, which moves the detent-lever in the direction to stop the train of wheel-work, the cam p^3 completing such movement, and thus opening the circuit-closer t^2 and closing the one t, so that the magnet r^2 is again put into control of the circuit-closer u.

In order to avoid a vibratory action of the armature and its lever p in case both circuit-closers u u^2 should be closed at the same time, the arbor i^3 of the pinion i may be provided with a circuit-changer or commutator device i^4, the purpose and effect of which are best understood from diagram, Fig. 5. The said commutator comprises a hub which is continuously connected, as by spring t^4, with wire 8, branching from the wire 2, between its connection with the battery B, and with the circuit-closers t t^2. A spring t^5, connected with the wire 3 between its connection with the magnet r^2 and circuit-closer t, rests upon a portion of said hub, which is of insulating material except a short space which is touched by the spring t^5 at the moment that the movement of the arbor i^3 is arrested by the detent k o. A spring t^6, connected by wire 5 between its connection with the magnet r^3 and circuit-closer t^2, rests against a portion of said hub, which is all of conducting material except a short insulating portion which is in contact with said spring t^6 when the movement of the shaft i^3 is arrested by the detent. Thus when the armature is nearest the magnet r^3 and the train of wheel-work is arrested by the detent the circuit for magnet r^2 is connected not only at t, but at t^4 t^5, by means of the commutator-hub, while the circuit of the magnet r^3 is separated not only at t^2, but also between t^4 and t^6, so that even if the circuit-closer u^2 should remain closed when the circuit-closer at u was closed the magnet r^2 would receive the entire current until the armature k had completed its movement and the train had started to move. When, however, the detent is fully released and the arbor i^3 begins to turn, the circuit of the magnet r^2 will be broken at t^4 t^5, as well as at t, while the circuit of the magnet r^3 will be closed at t^4 t^6, as well as at t^2, so that the magnet r^2 will make one complete movement of the armature to the position required for engaging the detent; but such engagement will not take place until a complete vibration of the bell-hammer has been made and a blow been struck, at the end of which time the commutator-hub will come to its original or normal position, thus opening the circuit of the magnet r^3 and closing that of the magnet r^2, which will again release the motor and cause another blow to be struck in a similar manner. By this construction, if both circuit-closers u u^2 happen to be closed at one time, the armature will merely make one vibration for each vibration of the bell-hammer, and the motor cannot be arrested until the circuit-closer u^2 is closed or remains closed after the circuit is opened at t^2.

In the operation of the apparatus it will be observed that the train of wheel-work has to first lift the bell-hammer against the force of gravity, which will require practically the full force of the spring h to be applied by the weight w. When, however, the wrist-pin k^2 passes its dead-center position and the bell-hammer begins to descend, gravity assists the force of the spring h, which by its elasticity will follow up the movement of the hammer and will impel the same throughout its downward stroke, thus giving a violent blow upon the bell. The weight w, in the meantime descending, will again be brought to bear upon the spring and strain it sufficiently to raise the hammer for the next blow, and the operation will thus continue, the blows being given practically by gravity assisted by the spring action, and the spring being rewound, so as to renew such action during each return movement of the hammer. When a vibrating device like the bell-hammer is connected by a link with a revolving crank or wrist-pin, the said crank must necessarily be at a dead-center position when the hammer is near the end of its stroke, and would thus tend to slow up the movement of the hammer just before the end of the stroke. To prevent such slowing up from interfering with the blow of the hammer against the bell, the link m is slotted, as shown at m^2, either where it engages with the hammer-arm or with the wrist-pin, and thus allows freedom of movement of the hammer with relation to the wrist-pin, so that whenever the velocity of the hammer moving toward the bell is greater than would be derived from direct positive connection with the wrist-pin the said hammer can move freely by its momentum and strike the blow without being impeded by the said wrist-pin. By these provisions very powerful blows are struck upon the bell, and the motor is capable of keeping the hammer in operation a very great length of time by one winding of the weight w, so that by winding the said weight once a day the alarm will be operated for all the trains passing the point requiring protection by such alarm during the day.

If desired, some part of the motor may be provided with a device which by its move-

ment will serve as a visual signal to accompany the audible signal produced by the bell. For example, the pinion f^5 may engage with a toothed wheel f^6 from a shaft f^7, connected by beveled gearing f^8 with a vertical shaft f^9, which may carry a lantern or drum f^{10}. (Best shown in Figs. 2 and 4.) The said lantern may be substantially octagonal in shape, having lantern-panes of different colors—as, for example, white and red, the red panes being of glass, so as to show a red light at night. The angular position and rotary movement of the lantern is such with relation to that of the detent-arm k that when the motor is arrested by said detent-arm one of the white panes will be presented to the view of a person approaching on the highway, the red panes at either side of said white pane being then preferably concealed by a stationary shield f^{12}, (see Figs. 3 and 4,) which may have suitable instructions marked upon it, the said shield having an opening through which one pane only of the lantern can be seen.

If the alarm is operating, the lantern will rotate and will thus show intermittingly the red or "danger" signal in the opening in the screen, so that a person unable to hear the alarm may still receive suitable notification of the approach of the train.

The lantern or visual signal is preferably impelled by that part of the compound train of the motor which is actuated by the weight, and thus does not interfere with the action of the spring h in making the bell-hammer vibrate promptly.

I claim—

1. The combination of the main actuating-weight and train of wheel-work with the bell-hammer operated by said train of wheel-work and a spring interposed in said train at a point between the bell-hammer and actuating-weight, as described, whereby the bell-hammer is actuated directly by the elasticity of the spring and the latter is maintained in wound-up or strained condition by the descent of the weight, substantially as and for the purpose described.

2. The combination of an actuating-train of wheel-work with a vibrating bell-hammer and connecting-link between said bell-hammer and the crank or wrist-pin operated by said train of wheel-work, said link having a loose connection whereby lost motion is provided between the hammer and wrist-pin, substantially as and for the purpose described.

3. The combination of the train of wheel-work, a detent-lever therefor, with two electro-magnets—one operating to move said detent-lever in one direction and the other in the other direction—and circuit-closers in circuit with said magnets operated by said detent-lever, which closes the circuit-closer of the magnet of which the armature is in its retracted position, and the cam by which said detent-lever is thrown from intermediate to extreme position until moved therefrom by the attraction of said armature, substantially as described.

4. The combination of the train of wheel-work having an arbor provided with a detent-arm and a detent-lever co-operating therewith, with two electro-magnets—one operating to move said detent-lever in one direction and the other in the other direction—and a commutator operated by the said arbor that carries the detent-arm, the said commutator retaining the circuit of one of said magnets open when the detent is engaged, and retaining the circuit of the other of said magnets open while the motor is moving toward the position at which it may be arrested by the detent, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWD. FROST.

Witnesses:
JOS. P. LIVERMORE,
M. E. HILL.