Sept. 19, 1939. W. P. EADS 2,173,777

CIRCUIT CLOSING DEVICE

Filed Aug. 25, 1938 3 Sheets-Sheet 1

Fig. 1.

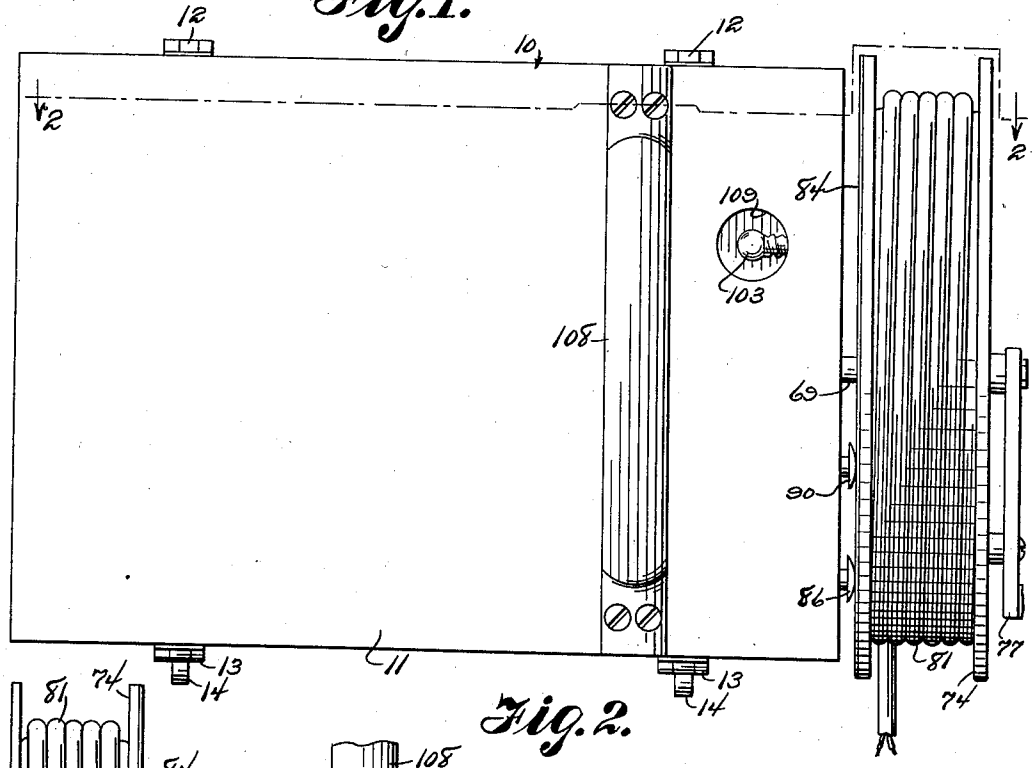
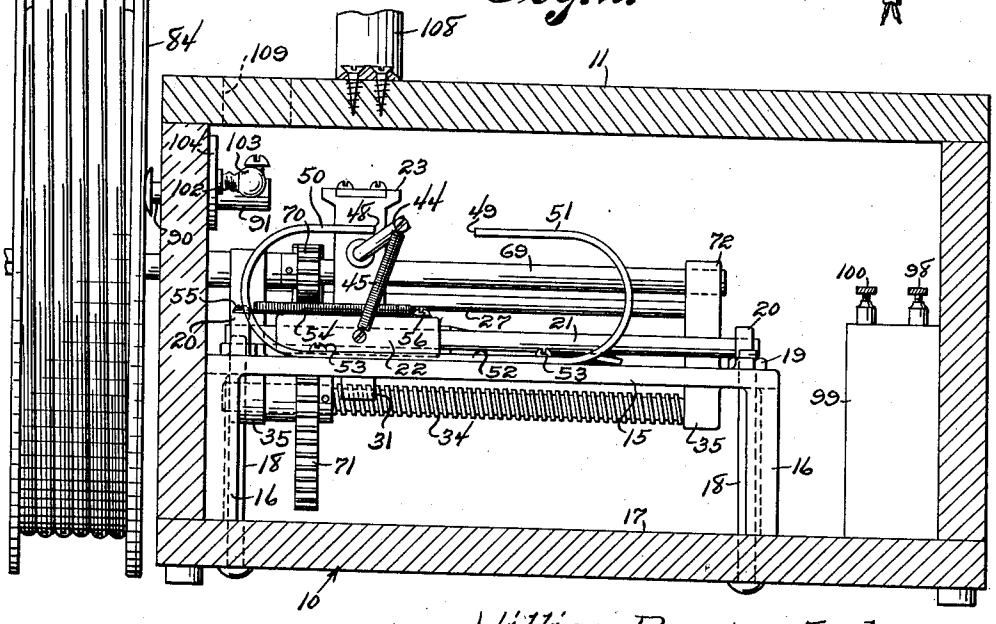


Fig. 2.



William Preston Eads INVENTOR

BY Victor J. Evans & Co.

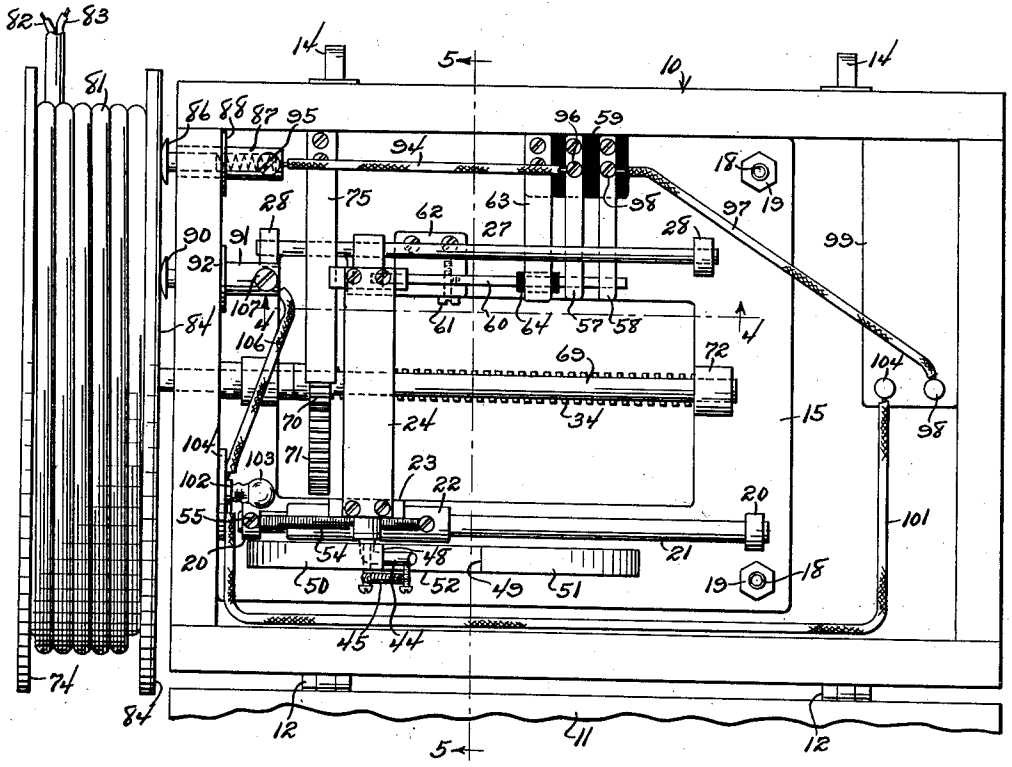
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CIRCUIT CLOSING DEVICE

Filed Aug. 25, 1938 3 Sheets-Sheet 2

Fig. 3.



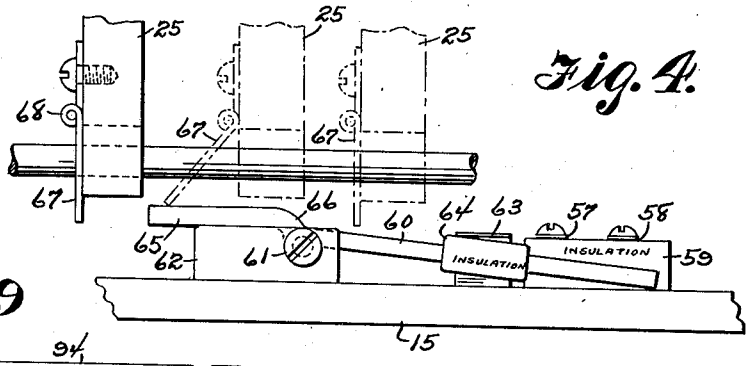
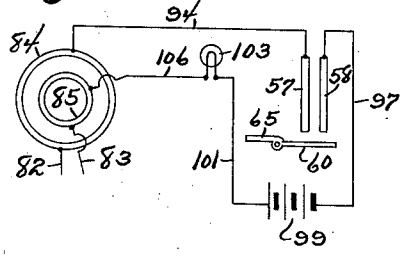


Fig. 4.

Fig. 9



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Sept. 19, 1939. W. P. EADS 2,173,777

CIRCUIT CLOSING DEVICE

Filed Aug. 25, 1938 3 Sheets-Sheet 3

Fig. 5.

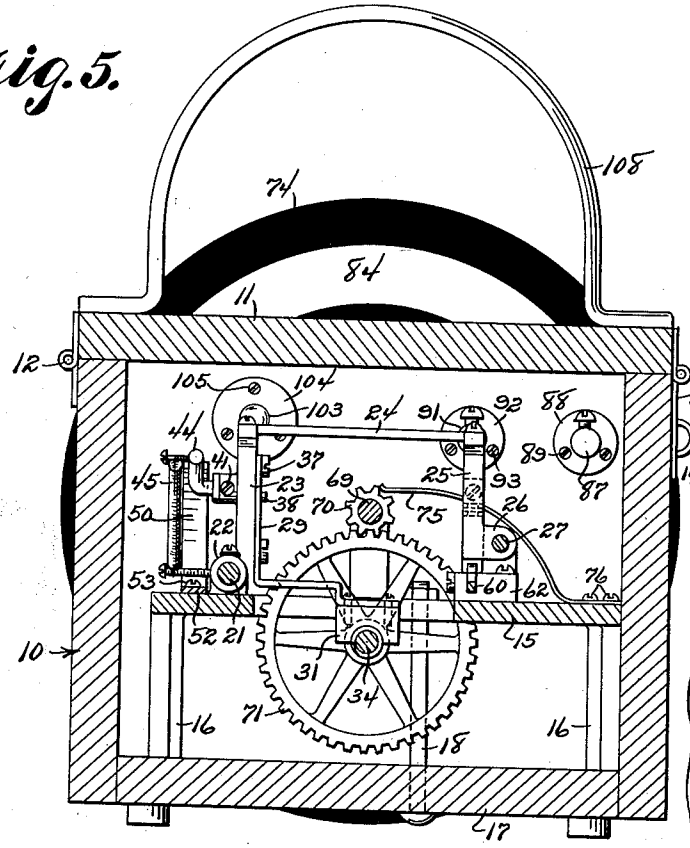


Fig. 8.

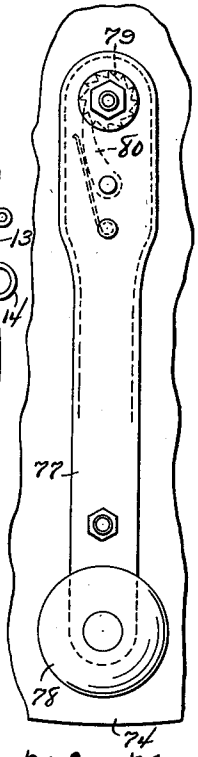
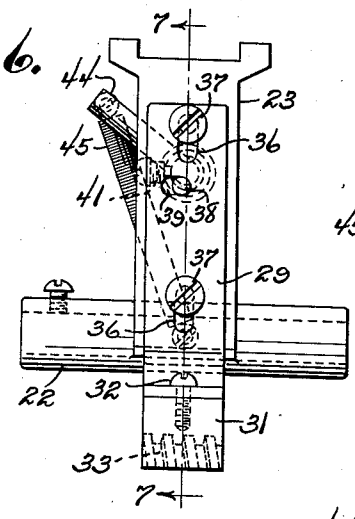


Fig. 6.



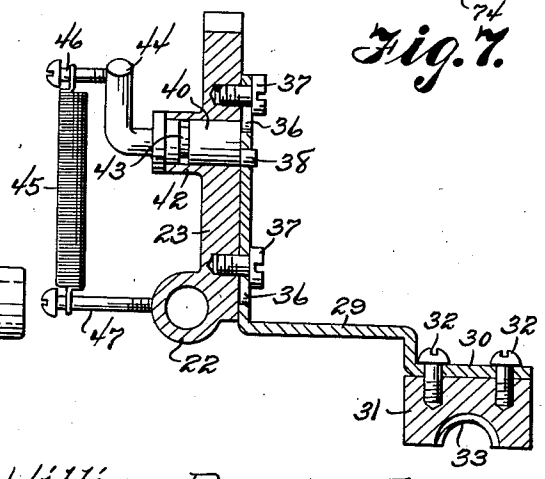


Fig. 7.

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Patented Sept. 19, 1939 2,173,777

UNITED STATES PATENT OFFICE

2,173,777

CIRCUIT CLOSING DEVICE

William Preston Eads, Kincaid, W. Va.

Application August 25, 1938, Serial No. 226,834

4 Claims. (Cl. 200—153)

This invention relates to circuit closing devices, and more particularly to an apparatus or device designed primarily for use in firing blasting charges in mining, quarrying, and other operations requiring the use of explosives.

As a measure of safety it has long been the established practice by those experienced in blasting operations, and in fact in accordance with statutory law, to provide means for effecting the firing of the charge from a remote place, to which end various devices have been produced and used with more or less success.

The prime object of the present invention is to improve generally upon apparatus or devices of this character by simplification in construction and operation while adding to the safety thereof.

A particular object is to provide a practical and efficient device which is conveniently carried by the operator, including an automatically operating circuit controlling device and extensible circuit cable, with provision for letting out the cable as the operator travels away from the place where the charge is set, thereby actuating the circuit controlling device which closes the circuit after a definite length of the cable has been paid out.

A further object is to provide means for automatically resetting the circuit controlling device after each circuit closing operation thereof.

With the foregoing and other objects and advantages to be obtained, as will hereinafter more fully appear, the invention consists in the novel general structure and particular combination and arrangement of parts thereof as hereinafter described and set forth in the appended claims, reference being had to the accompanying illustrations and practical adaptation of the invention and in which—

Figure 1 is a top plan view of the casing of the device and cable reel located externally thereon;

Figure 2 is a sectional view taken on or about the line 2—2 of Figure 1;

Figure 3 is a top plan view with the lid of the casing opened;

Figure 4 is a fragmentary detail view on an enlarged scale, illustrating the correlation of the switch element and tripping means therefor;

Figure 5 is a sectional view taken on or about the line 5—5 of Figure 3;

Figure 6 is a detail view of the reversing element of the reciprocatory carriage for the switch controlling element;

Figure 7 is a sectional view taken on the line 7—7 of Figure 6;

Figure 8 is a view illustrating the handle attachment for the circuit cable reel and the ratchet driving means between the reel and driving shaft for the reciprocatory carriage, and,

Figure 9 is a diagram of the electrical circuit and controlling device therefor.

Referring now to the drawings, the numeral 10 designates a casing of rectangular form and having a lid 11 hinged thereto, as at 12, along one longitudinal side and provided on its opposite longitudinal side with latches or hasps 13 cooperating with lugs 14 on the casing whereby the lid is releasably locked in closed position.

Within the casing 10 is a rectangular frame 15 which is supported at its four corners on legs 16, resting on the bottom 17 of the casing and being secured in place by tie-bolts 18 which are preferably inserted upwardly through openings provided therefor in the bottom 17 and having retaining nuts 19 on their upper ends which are tightened against the upper face of the frame. Mounted on upstanding lugs 20 near one side of the frame 15 and paralleling the frame in close relation thereto is a guide bar 21 on which a carriage member 22 is slidably sleeved. Said carriage 22 is provided with an upward extension 23 which is connected by a cross member 24 to an opposed carriage member 25 which is provided at its lower end with a lateral lug 26 sleeved slidably on a guide bar 27 supported at its opposite ends on lugs 28 extending upwardly from the frame 15, at the side of the frame opposite that where the bar 21 is located, said bar 27 being in a plane slightly higher than that of the bar 21.

Mounted to slide vertically on the upright extension 23 of the carriage member 22 is an angular bracket 29, the horizontal end portion 30 of which is offset downwardly and has a follower block 31 attached thereto by screws 32 or other suitable securing means. Said follower block 31 has an arcuate recess in its under side which is screw threaded to engage a worm-screw 34 which is journalled at its ends in bearing lugs 35 depending from the under side of the frame 15, said worm screw being rotated in a manner to be hereinafter more fully described and said follower block 31, when in engagement with said worm-screw, moving lengthwise thereof in either direction according to the direction in which said worm-screw is rotated.

The slidable mounting of the bracket 29 is effected by slotting the vertical leg of the bracket, as at 36, and inserting retaining screws 37 through said slots into screw threaded openings provided therefor in the vertical extension 23 of the recip-

rocatory carriage member 22. Obviously the retaining screws 37 are not tightened sufficiently to bind the bracket 29 to the carriage member 23 but merely to hold the vertical leg of said bracket member in close relation to the carriage member 23 while permitting reciprocatory movement of said bracket 29 which is effected by the operation of a crank pin 38 in a transverse slot 39 provided in the vertical leg of the bracket 29 as more clearly shown in Figures 6 and 7. The crank pin 38 is formed on a cylindrical member 40 which is fitted rotatably in a bearing provided therefor in vertical carriage member 22, said cylindrical member 40 being held against endwise movement by key-screw 41 which is inserted through a boss 42 formed on said carriage member 23, the end of said key-screw being reduced and received in an annular groove 43 formed in said cylindrical member 40. At the end of the cylindrical member 40 opposite to that on which the crank pin 38 is formed is a crank arm 44 by which said member 40 is rotated in a manner to be presently described whereby to raise and lower the bracket 29. The reciprocatory movement of the bracket 29 is limited by the length of the lower slot 36 in the vertical leg of the bracket engaging the screw 37 and at either limit of the bracket movement the crank arm 44 is in an inclined position past dead centre and is yieldably held in either position by spring 45 which is stretched between stud or screw 46 at the end of the arm and an opposed stud or screw 47 projecting laterally from the carriage member 22.

During the travel of the reciprocatory carriage crank arm 44 travels between two opposed reversing abutments 48 and 49, said abutments being located a predetermined distance apart and causing a reverse rocking movement of the arm 44 past dead centre when engaged thereby and said spring 45 snapping the arm to the limit of its movement and causing the raising or lowering of the follower block 31, as the case may be, the abutment 48 being the one to effect the lowering of the block 31 and the abutment 49, of course, effecting the raising of the block. As shown, the abutments 48 and 49 are provided by re-bending the end portions 50 and 51 of a flat bar 52, the intermediate portion of which is fastened to the top of the frame 15 by screws 53.

For yieldably holding the reciprocatory carriage in normal position and returning it to such position after each operation a spring 54 is provided, said spring being attached at one end to the adjacent lug 20 which supports the end of the guide bar 21, as at 55, the opposite end of the spring being attached to the carriage member 22, as at 56, the spring being constantly under tension and extended during the travel of the carriage from normal position and reacting to return the carriage to normal position after the crank arm 45 has engaged the abutment 49 and is thereby reversed to lift the follower block from the worm screw 34. During the return movement of the reciprocatory carriage to normal position, a normally open switch is momentarily closed to close an electric circuit which will be hereinafter more fully described. This switch, as shown, includes a pair of contact tongues 57 and 58 which are spaced apart and insulated from each other on a block of insulation material 59 located on top of the frame 15. The switch further comprises a rocking member 60 which is pivotally mounted, as at 61, in the slotted block 62 secured on top of the frame 15, one end portion at least of said member 60 being of electrical conductivity so as to close the circuit when engaging and cross-connecting said tongues 57 and 58, said member 60 being normally depressed out of engagement with said tongues 57 and 58 by a leaf spring 63 mounted on the insulation block 59 and bearing at its free end on an interposed piece of insulation material 64 provided on the underlying portion of said member 60. For actuating the rocking member 60 its end portion at the side of the pivot 61 opposite to that which contacts the tongues 57 and 58 is offset upwardly, as at 65, producing a cam shoulder 66 which is engaged by a tripping element 67 pivotally mounted, as at 68, on the carriage member 25 which rides on the guide bar 27. This pivoted tripping element 67 during the travel of the carriage from normal position rides freely across the offset portion 65 of said rocking member 60 without actuating the latter, that is to say, without raising its tongue-contacting end portion against the tension of the spring 63, but during the return movement of the carriage under the reaction of the spring element 54 after the follower block 31 is released from the worm-screw 34, said tripping element 67 being in the dotted-line position at the right of Figure 4 and supported firmly by its flatwise engagement with the adjacent portion of the carriage member 25, presses against the shoulder portion 66 of the member 60 and rocks said member on its pivot 61 so that the contact end portion of the member is lifted into engagement with said tongues 57 and 58, which engagement is maintained throughout an interval of time while the tripping member 67 in its vertical position on the carriage member 25 is riding over the end portion 65 depressed thereby.

In accordance with the present invention, the worm-screw 34 is rotated by means of a driving shaft 69 with a ratio gearing therebetween which is proportioned with relation to the pitch of the threads on said worm-screw 34 whereby to attain a travel of the reciprocatory carriage proportionate to the length of a charge-firing cable which is paid-out as will be presently described. The ratio gearing, as shown, includes a pinion 70 fixed on the shaft 69 in mesh with a large gear 71 fixed on the worm-screw 34.

The inner end of the shaft 69 is journalled in a standard 72 extending up from the adjacent end portion of the frame 15, said shaft extending through a bearing 73 on a standard at the opposite end of the frame 15 and through an opening in the end wall of the casing 10 to the outside, where a reel 74 is mounted on the shaft with a ratchet connection therebetween so that the reel may be rotated with the shaft in one direction but independently of the shaft in the opposite direction. Preferably, the ratchet arrangement is such that the joint rotation of the reel and shaft occurs when the reel is rotated in a clockwise direction, and for holding said shaft 69 against rotation when the reel is rotated counter-clockwise a leaf spring 75 is secured at one end on the frame 15, as at 76, the free end of the spring engaging the pinion 70 on said shaft 69. While any suitable ratchet means may be provided between the reel and shaft, it is preferably provided in the end portion of a handle 77, which, as shown more clearly in Figure 8, is secured on the outer end face of the reel and provided with a knob 78 for rotating the reel. The inner end portion of this handle member 77 is

made hollow to house the ratchet means, the ratchet means, as shown, comprising a ratchet wheel 79 fixed on the outer end portion of the shaft 69 which extends through central openings in the opposite side discs of the reel with freedom for independent rotation of the reel and shaft except when said ratchet wheel 79 is engaged by a spring-pressed pawl 80 carried by the handle member 77, during which engagement clockwise rotation of the reel effects a corresponding rotation of the shaft as hereinabove described and the reel is permitted to rotate counter-clockwise independently of the shaft, which latter is held against such movement by the ratchet spring 75, also hereinabove described.

On the reel 74 is wound a length of twin-wire charge-firing cable 81, the outer ends of the wires 82 and 83 of which, in use, are respectively connected to the local charge-firing means. The inner ends of said cable wires are respectively attached to some portion of the reel adjacent the hub which is of electrical conductivity and in contact with a suitable circuit terminal element. For this purpose the inner disc of the reel 74 may be provided on its outer face with a pair of concentric contact rings 84 and 85 which are out of engagement with each other or are suitably insulated, the outer ring 84 being shown in edge view in Figures 1, 2 and 3, and a portion thereof in face view in Figure 5, but both rings 84 and 85 being indicated in diagram in Figure 9.

The outer contact 84 is constantly engaged by a spring-pressed contact plunger 86 having a rounded shoe portion at its outer end and a shank which is fitted slidably in a bushing 87 inserted in an opening provided therefor in the adjacent end wall of the casing 10, the bushing 87, as shown, being provided with an annular flange 88 which is screwed to the inner face of the casing wall, as at 89, and thereby held in place. The inner contact ring 86 is similarly engaged by contact plunger 90 working in a bushing 91 flanged, as at 92, and secured to the casing wall by screws 93.

Attached to the bushing 87 which of itself is of electrical conductivity but suitably insulated from the casing 10, is a circuit wire 94 which is attached at one end to the bushing by a binding screw 95 and at its opposite end to the contact tongue 57 of the hereinbefore described circuit switch, as at 96. The opposite contact tongue 58 of the switch has one end of the circuit wire 97 attached thereto, as at 98, the opposite end of said wire 97 being attached, as at 98, to one pole of a battery 99. The other pole 100 of the battery 99 is connected by a wire 101 to one side of a light socket 102 having a signal bulb 103 fitted therein, said socket being flanged, as at 104, and screwed to the inner face of the end wall of the casing 10, as at 105. From the opposite side of the socket 102 wire 106 leads to a binding screw 107 on the bushing 91 in which the contact plunger 90 works, thus completing the circuit which includes the two wires in the charge-firing cable 81, the circuit being normally broken and so maintained until the rocking switch member 60 is moved into circuit-closing engagement with the two contact tongues 57 and 58.

In the use of the device of the present invention, the twin wire charge-firing cable, somewhat in excess of a given length, for example, over 100 feet, which is the usual minimum distance the operator is required by law to be away from the place where the explosive charge is located, is wound upon the reel 74, the winding being accomplished by turning the reel in a counter-clockwise direction by means of the knobbed handle member 77, during which operation the carriage driving shaft 69 is held against rotation by the ratchet spring 75 being in engagement with the pinion 70 on the shaft and at which time, of course, the reciprocatory carriage is in its normal position with the follower block 31 in threaded engagement with the worm-screw 34.

With the said length of charge-firing cable 81 thus wound on the reel 74 and the respective wires 82 and 83 of the cable having been duly connected with the local charge-firing means, the operator carries the casing 10 away from the charge-location thereby causing the cable to be unwound from the reel, which effects a clockwise rotation of the reel, and due to the hereinbefore described ratchet connection between the reel and the carriage driving shaft 69 the shaft is rotated with the reel. As the shaft 69 thus rotates the worm-screw 34 is rotated in the opposite direction at a regulated slower speed due to the ratio gearing therebetween. At the same time the follower block 31, due to its threaded engagement with the worm screw 34, is moved longitudinally on the screw and effects a corresponding endwise movement of the carriage comprising the members 22 and 25 which are joined by the cross-member 24 and ride respectively on said guide bars 21 and 27.

The ratio of the driving gears 70 and 71 together with the relative pitch of the threads of the worm-screw 34 in proportion to the length of the cable 81 and the diameter of the cable as coiled on the reel is such that the crank arm 44 which effects the actuation of the follower block 31 does not move into engagement with the opposed reversing abutment 49 until the predetermined length of charge-firing cable, say 100 feet, or other prescribed minimum thereof, has been unwound from the reel.

After the crank arm 44 comes in contact with the abutment 49 a slight continued travel of the carriage in the same direction causes the arm to swing reversely from the normal position shown in Figure 2 and thereby lift follower block 31 clear of the worm-screw 34, whereupon the spring 54 which has become extended during the travel of the carriage from normal position, reacts to restore the carriage to normal position and brings the arm 45 into engagement with abutment 48 which thereby effects the actuation of the arm past dead centre and the spring element 45 functions to continue the movement of the arm and pull the follower block 31 into engagement with the worm-screw 34 with snap effect.

During the actuation of the reciprocatory carriage from normal position the hereinabove described tripping element 67 which is pivoted on the carriage member 25 rides freely over the upwardly offset portion 65 of the rocking switch member 60 without causing any actuation of said switch member which is normally held with its contact end portion depressed by the spring 63, but during the return stroke of the carriage after the predetermined amount of charge-firing cable has been unreeled, said tripping member 67 engages the offset portion 65 of said switch member 60, thereby rocking the member into circuit closing engagement with tongue members 57 and 58, holding the member 60 in contact with the tongues throughout an interval of time ample for the operation of the electrical device which the closed circuit controls.

From the foregoing it is seen that a simple yet practical and safe charge-firing device is produced for use in mining, quarrying and other blasting operations, and it is here noted that any convenient carrying handle 108 may be provided on the lid 11 of the casing, said lid, in practice, being preferably locked in closed position to prevent unauthorized access to the interior of the case and tampering with the contents thereof. The handle, as shown, spans the lid transversely thereof and is located near the end of the case on which the reel 74 is mounted so as to distribute the weight equally on either side of the handle. So, too, a sight opening 109 is provided in the lid 11 in the region of the signal bulb 103, which latter being in the controlling circuit, as it is, indicates to the operator whether or not the switch elements have functioned to close the circuit as they should at the proper time during the operation of the device.

While the structure herein shown illustrates a practical adaptation of the invention, it is obvious that considerable modification may be made therein within the spirit of the invention as defined by the appended claims. The invention therefore is not limited to the specific construction shown and described in the accompanying drawings.

What is claimed is:

1. In a charge-firing apparatus, a casing having a reel thereon, a length of twin wire cable wound on said reel, the outer ends of the respective wires for connection to a blasting charge to be fired, a normally open circuit controlling switch in said casing, said switch having circuit connections with the inner ends of the cable wires on the reel, a reciprocatory carriage having operating means for moving it in one direction, said operating means being actuated by the rotation of the reel in the unwinding of the cable therefrom, means for limiting the operating movement of the carriage in said direction proportionate to the length of cable unwound from the reel, means for restoring the carriage to normal position after such operation, and means actuated by said carriage for closing the circuit controlling switch through an interval of time during the movement of the carriage to normal position.

2. In a charge-firing device, a casing, a normally open circuit controlling switch in said casing, a drive shaft in said casing, said shaft extending to the outside of the casing, a reel on said shaft extension, a ratchet connection between the reel and shaft whereby the two are rotated together in one direction but independently of each other in the opposite direction, separate ratchet means for holding the shaft against rotation during the rotation of the reel independently on the shaft but permitting rotation of the shaft in the opposite direction, a worm-screw, a ratio driving gear between said shaft and worm-screw, a reciprocatory carriage mounted to travel in parallel relation to said worm-screw, a spring element yieldably holding said carriage in normal position and reacting to restore the carriage to said position, a follower movable on said carriage into and out of engagement with said worm-screw, means operable upon the movement of the carriage into normal position for automatically moving said follower into engagement with said worm-screw, means for limiting the movement of the carriage from normal position and simultaneously reversing the actuating means for the follower whereby to move the follower out of engagement with said worm-screw, means on the carriage for closing said circuit controlling switch through an interval of time during the return movement of the carriage to normal position, a twin-wire firing cable wound on said reel for connection with a local charge-firing means, the inner end of the cable being in circuit with the controlling switch within the casing by electrical connections through the reel, the length of the cable and its diameter as coiled on the reel being proportioned with respect to the ratio gear between the driving shaft and the worm-screw, and the pitch of the screw threads, whereby the reciprocatory carriage reaches the limit of its movement from normal to such position when a predetermined length of the charge-firing cable is unwound from the reel and accordingly effects rotation of the driving shaft.

3. In a charge-firing device, a casing having a normally open circuit controlling switch therein, a reciprocatory carriage in said casing, operating means for moving said carriage from normal position, means for limiting the travel of said carriage from normal position, means for yieldably holding the carriage in normal position and reacting to restore it to such position, means on said carriage for closing said circuit-controlling switch through an interval during the return movement of the carriage to normal position, a reel on said casing adapted to actuate the carriage operating means during rotation of the reel in one direction, the reel rotating in the opposite direction free of said carriage operating means, and a twin-wire charge-firing cable wound on said reel to be connected at its outer end with the local charge-firing means, the inner end of the cable having a circuit connection through the reel with said circuit-controlling switch in the casing, the relative diameter of the cable as wound on the reel being proportionate to the range of the carriage operating means whereby the carriage reaches the limit of its travel from normal position and is consequently restored to normal position when a predetermined length of the charge-firing cable is unwound and accordingly rotates the reel to actuate the carriage operating means.

4. In a charge-firing device, a casing having a normally open circuit-controlling switch therein, said switch comprising a pair of contact tongues and a rocking member having a circuit closing portion normally spring-pressed out of engagement with said tongues, said rocking member having an offset cam portion, a reciprocatory carriage member having a tripping element pivoted thereon to swing out of actuating relation to said rocking member when the carriage is moved from normal position but engaging the cam portion of said rocking member whereby to actuate said rocking member into circuit closing engagement with said contact tongues during part of the return movement of the carriage to normal position, operating means for moving said carriage from normal position, means for limiting the movement of the carriage from normal position and automatically restoring it to normal position after it reaches such limit of movement, a reel on said casing having provision for actuating said carriage operating means when the reel is rotated in one direction, the reel being rotatable in the opposite direction independently of said carriage operating means, and a twin-wire charge-firing cable wound on said reel for

connection at its outer end with a local charge-firing means, the inner end of said cable being in circuit connection with said circuit-controlling switch in the casing, the relative diameter of the cable as wound on the reel and the ratio of the carriage driving means being such that the carriage moves to the limit of its travel from normal position when a predetermined length of the cable is unwound from the reel and accordingly rotates the reel to effect the actuation of the carriage operating means.

WILLIAM PRESTON EADS.