Oct. 11, 1927. 1,644,843

A. J. MARSHALL

ELECTRIC SHOT FIRING DEVICE

Filed March 8, 1926 2 Sheets-Sheet 1

Fig. 1.

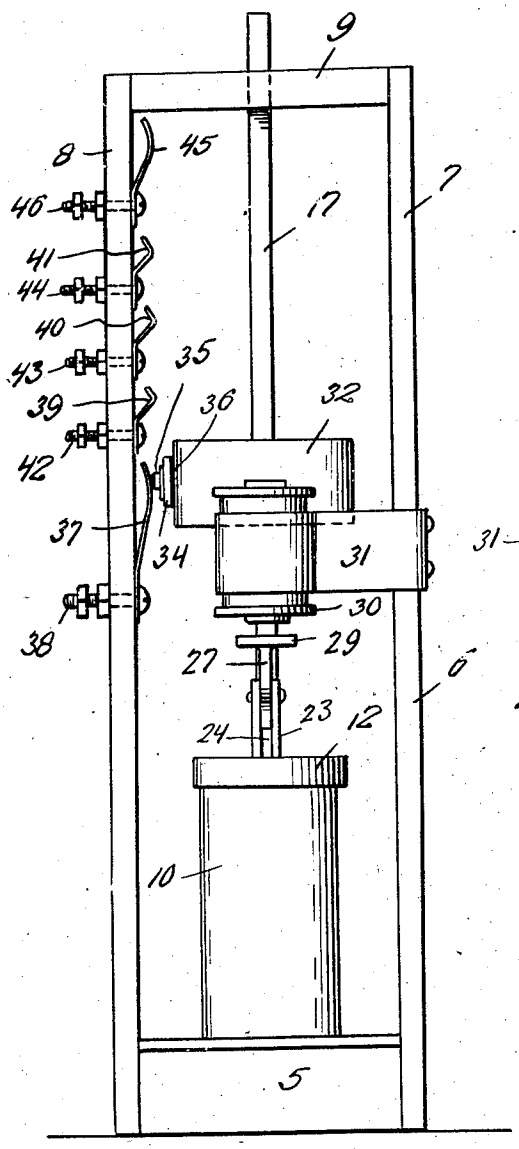
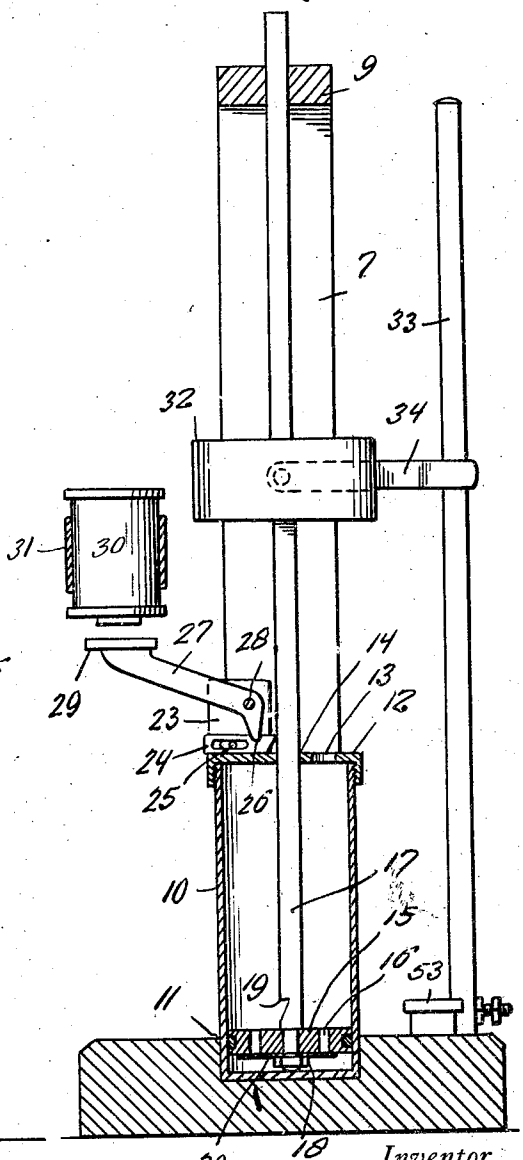


Fig. 2.



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Fig. 4.

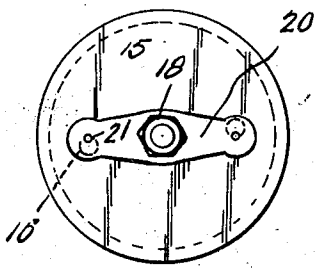


Fig. 3.

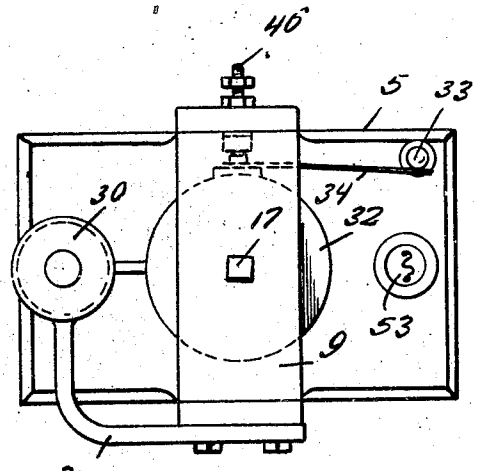
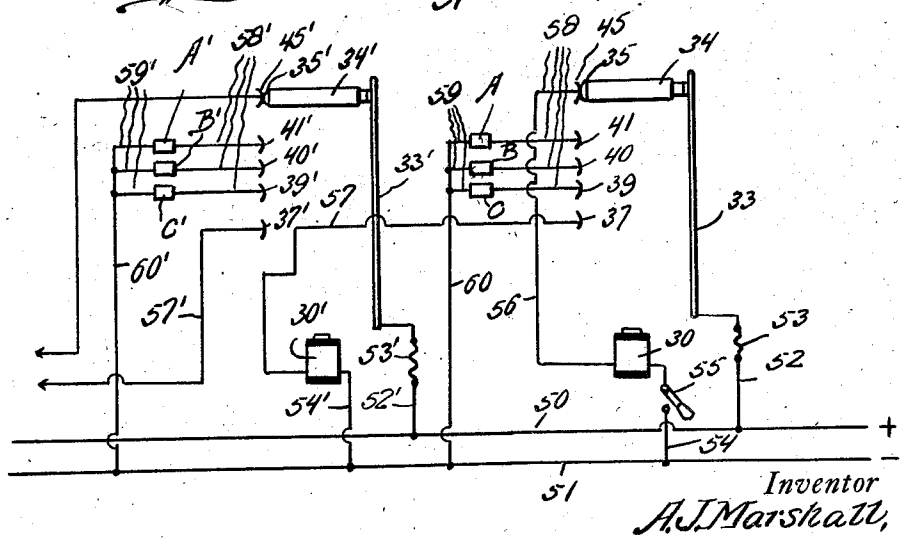


Fig. 5.



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UNITED STATES PATENT OFFICE.

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ELECTRIC SHOT-FIRING DEVICE.

Application filed March 8, 1926. Serial No. 93,284.

The present invention relates to an electric shot firing device designed for use in firing shots in mines. The device is exceedingly simple in its construction, efficient and reliable in its operation, durable, not likely to easily become out of order, and otherwise well adapted to the purpose for which it is designed.

There have been electric shot firing machines designed by others, but in all of them with which I am familiar, there is required an excessive amount of wires to operate them, whereas in the machines described in this application, only two wires are necessary and as many machines may be placed in the line as desired.

With a mine equipped with these machines, any number of shots in any number of rooms can be fired from the surface with only two wires leading to the first machine, and with only two wires from that machine to the others in series. With these machines, the shots are fired at intervals, and the intervals between the shots can be regulated as desired.

With the above and numerous other objects in view as will appear as the description proceeds, the invention resides in certain novel features of construction, and in the combination and arrangement of parts as will be hereinafter more fully described and claimed.

In the drawing:—

Figure 1 is an elevation of one of the machines embodying the features of my invention,

Fig. 2 is a vertical section taken thereon,

Fig. 3 is a top plan view thereof,

Fig. 4 is a bottom plan view of the plunger in the dash pot, and

Fig. 5 is a diagrammatic view showing two of the machines wired in series.

Referring to the construction of one of the machines, in detail, it will be seen that 5 designates a base having the rectangular frame 6 rising therefrom, including two vertical side rails 7 and 8, and a cross horizontal rail 9. A dash pot is seated on the base 5 and includes a cylinder 10, the bottom end of which is closed and counter-sunk in the recess 11 of the base 5. The upper end of the cylinder 10 is open and provided with external threads for detachably receiving a cap 12 having the off center vent opening 13 and the center opening 14. This dash pot cylinder 10 is filled with oil as usual.

A plunger 15 is movable in the cylinder 10 and provided with a pair of openings 16. A plunger rod 17 is slidable through the opening 14 of the cap 12, and has its lower end reduced to pierce the center of the plunger 15 and is held in engagement therewith by a nut 18 or in any other suitable manner. Adjacent the plunger 15, the rod 17 is provided with a notch 19. A plate 20 is held assembled in abutment with the bottom surface of the plunger 15 by means of the reduced end of the rod 17 and the nut 18. This plate is provided with openings 21 registrable with the openings 16 of the plunger 15. Obviously by shifting the openings 21 in respect to the openings 16 to vary the amount of registration thereof, the speed of the plunger through the oil in the dash pot cylinder 10 may be regulated.

A bracket 23 is mounted on the cap 12 and has slidably mounted therein a catch 24 which is limited in its movement by a pin and slot connection 25 with the bracket 23. This catch has a notch 26 which is engageable by the nose end of a bell crank lever 27 pivoted as at 28 to the bracket 23. An armature 29 is provided on the other end of the bell crank lever for being attracted by an electro-magnet 30 mounted in a bracket 31 projecting inwardly from an intermediate portion of the side vertical rail 7, said bracket being substantially L-shaped as is indicated to advantage in Fig. 3.

A weight element 32 is fixed to the intermediate portion of the plunger rod 17. An electricity conducting standard 33 rises from the base 5 at one corner thereof. A brush 34 slidably engages the standard 33. A contact 35 is disposed on the weight element 32 and is electrically engaged with the other end of the brush 34. Both the brush 34 and the contact 35 are insulated from the weight element 32 as at 36 in any suitable manner.

A stationary spring bottom contact 37 is mounted on the side vertical rail 8 by a binding post 38. A plurality of intermediate vertically alined and spaced spring contacts 39, 40 and 41 are mounted on the rail 8 above the contact 37 by means of a plurality of binding posts 42, 43 and 44 respectively. A top spring contact 45 is mounted on the rail 8 above the spring contact 41 by means of a binding post 46. These contacts 37, 39, 40,

41 and 45 are disposed in the path of movement of the contact 35.

The upper end of the plunger rod 17 pierces the center of the cross rail 9 to be guided thereby. To set the machine, the weight 32 is lifted to its uppermost position at which time the contact 35 engages the contact 45 and the catch 24 engages the notch 19. The electro-magnet 30 is then energized, attracting the armature 29, rocking the bell crank lever 27, sliding the catch 24 to disengage the notch 19, so that the weight element 32, rod 17 and plunger 15 slowly gravitate downwardly, the dash pot controlling the speed which may be adjusted as heretofore indicated by the plate 20.

As the weight 32 moves downwardly, the contact 35 engages successively the spring contact 41, 40, 39, and finally 37, and remains in engagement with contact 37 until lifted as heretofore indicated.

To appreciate the utility of this machine, it is necessary to consider several of them in circuit, and for this purpose, I have illustrated a diagram in Fig. 5. The numeral 50 denotes the positive line and the numeral 51 the negative line. These power lines may be connected with any suitable source of electrical energy and sufficient voltage may be obtained for the shot firing from a plurality of dry cells if preferred. A plurality of wires 52 and 52′ lead from the line 50 thru fuses 53 and 53′ to standards 33 and 33′ of two different machines in the present illustration. The wiring of two machines will be sufficient to give a clear understanding as to the wiring of any number of machines. A wire 54 leads from the line 51 to the electro-magnet 30 and has a switch 55 therein. A wire 54′ leads from the line 51 to the electro-magnet 30′.

A wire 56 connects the contact 45 with the electro-magnet 30. A wire 57 connects the contact 37 with the electro-magnet 30′. A wire 57′ connects the contact 37′ with the electro-magnet of the next machine, not shown. The contacts 41, 40, 39 are connected respectively to cartridges, A, B and C, by suitable wires 58, while contacts 41′, 40′, and 39′ are connected to cartridges A′, B′ and C′ in another room of the mine by suitable wires 58′. Wires 59 and 60 lead from the cartridges A, B and C to the negative line 51, while wires 59′ and 60′ lead from the cartridges A′, B′ and C′, to the negative line 51.

When the two machines are wired as detailed above, it will be seen that at the end of the day after the miners have left the mine, the weights carrying the brush 34 and 34′ and the contacts 35 and 35′ will be lifted as heretofore indicated. After all the miners have left the mine, the switch 55 is closed, so that the current will flow from the line 50 through wire 52, fuse 53, standard 33, brush 34, contact 35, contact 45, and wire 56 through electro-magnet 30, through switch 55, and wire 54 to the line 51. This causes the energization of magnet 30, so as to release the plunger rod as heretofore indicated, thereby causing the contact 35 and brush 34 to move downwardly until the contact 41 is engaged, causing the current from the standard 33 to flow through the cartridge A exploding the same. Then in like manner, as the contact 35 engages contacts 40 and 39 successively, cartridges B and C will be fired. When the contact 35 reaches the contact 37, the current flows through the wire 57 for energizing the electro-magnet 30′ for releasing the weight of this machine to allow the contact 35′ and 34′ to move downwardly, and engage successively the contacts 41′, 40′, 39′, for energizing and exploding successively cartridges A′, B′ and C′. Thus any number of the machines may be wired in series, it being only necessary to use two power lines 50 and 51. No two cartridges will be exploded at the same time, and no two rooms will have cartridges exploding at the same time.

It is preferable that the plate 20 may be made of spring metal or other resilient material so that it will be capable of flexing away from the plunger 15 on the upward stroke thereof so that the oil may rush freely through the openings 16 which are relatively large in comparison to the opening 21. This feature is provided for the obvious purpose of quickly setting the machine.

It is thought that the construction, operation, and advantages of this invention will now be clearly understood without a more detailed description thereof. The present embodiment of the invention has been disclosed in detail, since in actual practice it attains the features of advantage enumerated as desirable in the statement of the invention and the above description. It is apparent that numerous changes in the details of construction, in the materials, and in the combination and arrangement of parts may be resorted to without departing from the spirit or scope of the invention as hereinafter claimed, or sacrificing any of its advantages.

Having thus described my invention, what I claim as new is:—

1. A device of the class described including in combination, a base, a pair of vertical rails rising from the base in spaced relation, a cross rail connecting the upper ends of the vertical rails, a plurality of spring contacts on one of the vertical rails, a conductor standard rising from the base, a dash pot cylinder on the base, a plunger in the dash pot cylinder having an opening, a plunger rod piercing the plunger and rising therefrom and piercing the cross rail, a spring plate pierced by the plunger rod, and

having an opening registrable with the opening in the plunger, means for holding the rod in engagement with the plunger, and the plate adjusted as to the amount of registration of the two openings, a weight element on the rod, a contact on the weight element engageable with the spring contacts, a brush engageable with the contact on the weight element and slidably engaged with the standard, a bracket projecting from the other vertical rail, an electro-magnet mounted in the bracket, a bell crank pivoted on the dash pot cylinder and having an armature at one end associated with the electromagnet, and a catch slidable on the cylinder, and engageable with a notch provided in the rod adjacent the plunger.

2. A device of the class described including, in combination, a base, a frame rising from the base, a plurality of spring contacts arranged on the frame in spaced relation to one another, a conductor standard rising from the base, a dash pot cylinder on the base, a plunger in the dash pot cylinder, means associated with the plunger for regulating the speed thereof in the cylinder, a plunger rod engaged with the plunger and rising therefrom, a weight element on the rod, a contact on the weight element engageable successively with the spring contact, a brush engaged with the contact on the weight element and slidably engaged with the standard, an electro-magnet, an armature associated with said electro-magnet, a catch engageable with a notch provided in the rod for holding the plunger raised in the dash pot cylinder, and means associated with the catch and armature whereby when said armature is attracted by the electro-magnet, said catch is released from the notch of said rod to allow the weight element to move downwardly for successively engaging the contact thereon with the spring contact.

3. A device of the class described, including, in combination, a frame, a plurality of spring contacts arranged on the frame in vertical spaced relation, a dash pot cylinder mounted in the frame, a plunger in the dash pot cylinder, a rod rising from the plunger, a weight element on the plunger, a contact on the weight element successively engageable with the spring contact, a conductor standard, a brush engaged with the contact on the weight element and slidably engaged with the standard, means for normally holding the weight element and rod and plunger in a raised position, and an electro-magnet and armature for releasing said means.

4. A device of the class described including, in combination, a frame, a plurality of spring contacts arranged in vertical spaced alinement on the frame, a conductor standard rising alongside of the frame, a dash pot cylinder in the frame, a plunger in the dash pot cylinder, a plunger rod engageable with the plunger and rising therefrom in the frame, a weight element on the rod, a contact on the weight element engageable successively and selectively with the spring contacts, a brush engaged with the contact of the weight element and slidably engaged with the standard, a bracket on the dash pot, a catch slidable in the bracket and engageable with a notch provided in the rod for holding said rod in a raised position, means for limiting the movement of the catch, a bell crank pivotally mounted in the bracket and engaged at one end with the catch for imparting sliding movement thereto, an armature at the other end of the bell crank, and an electro-magnet associated with the armature so that when energized, the armature will be moved to rock the bell crank and to release the catch from the notch of the rod.

5. A device of the class described including in combination, a frame, a plurality of spring contacts arranged in vertical spaced alinement on the frame, a conductor standard rising alongside of the frame, a dash pot cylinder in the frame, a plunger in the dash pot cylinder, a plunger rod engageable with the plunger and rising therefrom, in the frame. a weight element on the rod, a contact on the weight element engageable successively and selectively with the spring contacts, a brush engaged with the contact of the weight element and slidably engaged with the standard, a bracket on the dash pot, a catch slidable in the bracket and engageable with a notch provided in the rod for holding said rod in a raised position, means for limiting the movement of the catch, a bell crank pivotally mounted in the bracket and engaged at one end with the catch for imparting sliding movement thereto, an armature at the other end of the bell crank, an electro-magnet associated with the armature so that when energized, the armature will be moved to rock the bell crank and to release the catch from the notch of the rod, the plunger being provided with an opening, a spring plate on the bottom of the plunger having an opening registrable with the opening of the plunger, means for adjusting the plate to regulate the amount of registration of the two openings, said plate being adapted to flex away from the plunger when said plunger is moved upwardly in the dash pot cylinder.

6. A device of the class described including, in combination, a base, a pair of vertical rails rising from the base in spaced parallel relation, a cross rail horizontally disposed and connecting the upper ends of the vertical rails and provided with an opening, a plurality of spring contacts on one of the vertical rails, a conductor standard rising from the base in spaced parallel relation to

the vertical rails, a dash pot cylinder rising from the base having its upper end open and externally threaded, a cap threadedly engaged on the upper end of the dash pot cylinder, and having a central opening and an off center vent opening, a plunger in the dash pot cylinder, having a pair of openings off center thereof and an opening in the center thereof, a plunger rod piercing the center opening of the plunger and rising therefrom, piercing the center opening of the cap and the opening of the cross rail, a spring plate having a central opening pierced by the plunger rod, said spring plate being held in abutment with the lower surface of the plunger, said spring plate provided with openings at its ends registerable with the off center openings in the plunger, a nut on the end of the plunger rod for holding the plunger rod assembled with the plate and the plunger, and to allow adjustment of the plate in respect to the plunger, a weight element on the rod above the dash pot, a contact on the weight element engageable selectively and successively with the spring contacts, a brush engaged with the contacts on the weight element and slidably engaged with the standard, a bracket projecting from the other vertical rail, an electro-magnet mounted on the bracket, a bracket on the top of the dash pot cylinder, a bell crank pivoted in the last mentioned bracket, a catch slidable in the last mentioned bracket and having a notch engaged by one end of the bell crank, means for limiting the movement of the catch, said rod provided with a notch adjacent the plunger adapted to be engaged by said catch for holding said plunger in a raised position in the dash pot cylinder, an armature at the other end of the bell crank associated with the electro-magnet.

In testimony whereof I affix my signature.

ANDREW J. MARSHALL.