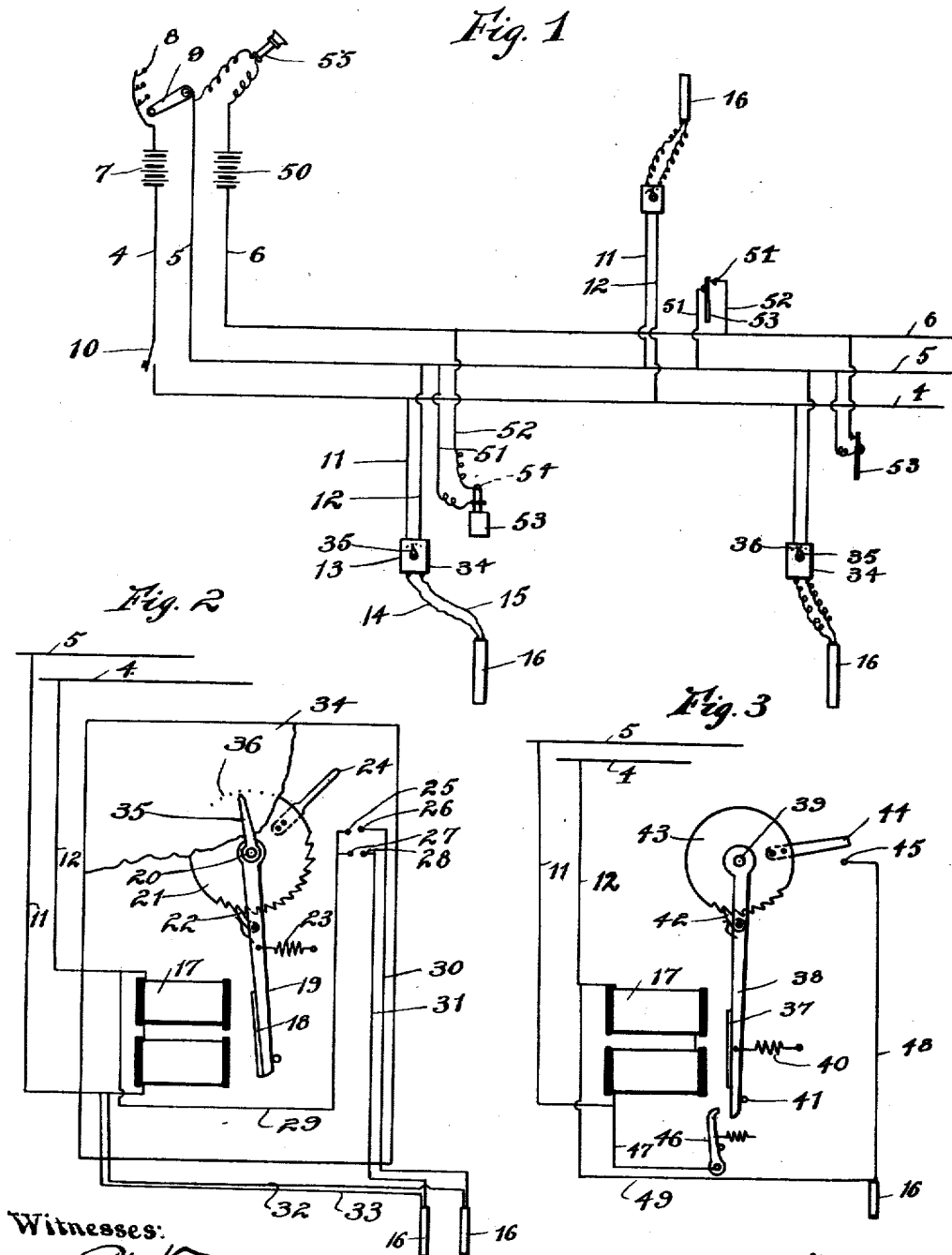


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ELECTRIC SYSTEM FOR DISCHARGING EXPLOSIVES.
APPLICATION FILED MAR. 22, 1909.

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UNITED STATES PATENT OFFICE.

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ELECTRIC SYSTEM FOR DISCHARGING EXPLOSIVES.

1,012,146.

Specification of Letters Patent.

Patented Dec. 19, 1911.

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To all whom it may concern:

Be it known that I, RALPH E. NOBLE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Systems for Discharging Explosives, of which the following is a specification.

This invention relates to means or systems for discharging explosives by electricity and is particularly adapted for use in cases where it is desired to explode one or more charges or shots from a distance and to determine or record the explosion. It is especially adapted for use in connection with mines, and provides means whereby an operator, for instance, on the ground at the mouth of the shaft may discharge one or more shots successively and may note when the explosion occurs and if, for any reason, any of the shots fail to explode.

Among the objects of the present invention are to provide means for accomplishing the results suggested, by means of a minimum amount of wiring and comparatively small, although efficient, devices.

I accomplish the desired results by means of the apparatus or system shown diagrammatically in the accompanying drawings, in which—

Figure 1 is a view illustrating the method of wiring, as for instance in a mine; Fig. 2 shows one form of selective device; and Fig. 3 a modified form of selective device.

As shown in these drawings, 4, 5 and 6 represent the main wires or conductors leading from the operator's switch and signaling devices, throughout the mines or other places where the explosives are to be discharged. The conductors 4 and 5 are used principally for carrying the current for discharging the explosives, although the conductor 5 is also used in connection with the wire 6 to operate the signaling apparatus. For convenience, the discharging apparatus will first be described, as it may be used in certain instances without the signaling apparatus.

Any source of electricity, for instance a battery 7, is connected in circuit with the wire 4 which is provided with a plurality of terminals 8—8 which are adapted to make contact with a switch lever 9 for closing the circuit through said wires. This switch is preferably located, for instance at

the top of the shaft, with the wires leading down through the shaft, and then out through the main entries to the rooms or cross-cuts where the shots are to be fired. I also prefer to provide a safety switch 10, preferably located at the bottom of the shaft, which must be closed by the operator as he leaves the mine before he can operate the switch 9. Branch wires or conductors 11 and 12 lead from the wires 4 and 5, respectively, to selective devices indicated at 13, and wires or conductors 14 and 15 lead from the selective devices to the shots or explosives indicated at 16. By the term selective devices, I intend to include any convenient form of device or apparatus which is adapted to be operated by successive electrical impulses, as for instance by opening and closing the switch 9, so that said switch may be operated one or more times before the current is allowed to pass through the wires leading from the selective devices to the explosive in order to discharge the latter.

One convenient form of such selective device is illustrated in Fig. 2, in which an electromagnet 17 is shown with its terminals connected to the wires 11 and 12. The armature 18 is mounted on the lower end of a lever 19 which is loosely pivoted to a shaft 20 mounted in any convenient form of support. The ratchet wheel 21 is mounted on the shaft 20 and is adapted to be turned by means of a pawl 22 on the arm or lever 19. The arm is preferably held in retracted position by means of a spring 23. The ratchet wheel 21 is provided with a wiper or contact member 24 which is adapted to close the circuit, at the desired time, between contacts 25 and 26 or contacts 27 and 28. The wiper 24 is preferably made of such dimensions and arranged on the wheel in such position that it will pass entirely across and clear any pair of contacts when the wiper is at a point adjacent to any such pair and the ratchet wheel is moved one step by the action of the arm 19 and pawl 22. A wire or conductor 29 leads from the wire 12 and makes connection with the terminals 25 and 27. A wire 30 leads from the contact or terminal 26 to one of the explosives or shots 16. A second wire 31 leads from the terminal or contact 28 to a second shot or explosive 16. Wires 32 and 33 lead from the conductor 11, or from a suitable connec-

tion therewith, to the second terminals, respectively, of the two shots or explosives 16—16, these explosives of course being provided with resistance wires or other ordinary devices whereby they will be exploded by means of an electric current. The magnet and ratchet wheel are preferably mounted in a box or casing indicated at 34, and the shaft or pivot 20 is provided with an indicator or finger 35 rigidly secured thereto outside of the box, whereby said shaft, with its attached ratchet wheel, may be turned. A scale or dial 36 on the box may be used to indicate the position of the wiper 24.

The selective device as thus described is adapted to discharge one or more explosive charges in succession, its operation being as follows: When the charges have been placed and the connections made, the operator on leaving the mine closes the switch 10, and then when he reaches the top of the shaft or other place where the switch 9 may be located, he swings the switch lever to the first contact 8. This will close the circuit from the source of electricity 7, through the wires 4 and 11, magnet 17 and wires 12 and 5, thereby giving an electric impulse to the magnet 17, causing the armature 18 to be attracted. This will cause the lever 19 to swing, which in turn moves the ratchet wheel through the action of the pawl 22, thereby swinging the wiper 24 forward one step. If desired, two of the contacts, such as 25 and 26, may be arranged so that this first impulse will cause a circuit to be closed momentarily through said contacts, or, as indicated, several impulses may be necessary to swing the lever and ratchet wheel before the wiper reaches such contacts. When the wiper 24 passes over the contacts 25 and 26, a circuit is momentarily closed from the wire 12, through the wire 29, contact 25, wiper 24, contact 26, wire 30, exploder device of the explosive 16, and wire 32 to wire 11, whereby the current will pass through the exploding device and cause the charge or shot 16 to be fired. After this shot has been fired, the operator then moves the switch lever 9 forward over a sufficient number of contacts 8, so that the impulses given to the magnet 17 will operate the arm and ratchet wheel a sufficient number of times to pass over the next succeeding pair of contacts, for instance 27 and 28, when the next shot or explosive 16 will be fired. In this way, any successive number of shots may be fired with one selective device operating by means of only two main wires.

In the device just described, the circuit through the explosive device is only closed for a predetermined time, depending upon the movement of the wiper 24; but in some instances it may be desirable to have the contact closed for a more or less continued

length of time, so that the device used for exploding the charge, for instance a fine platinum wire, such as is commonly used, may have sufficient time to become heated even if the current should be somewhat weak. This and other advantages are accomplished by means of the modified form of device shown in Fig. 3, in which the magnet 17 is shown as connected to the main lines by means of wires 11 and 12, as above described. In this instance, the armature 37 is secured to a swinging arm or lever 38 loosely mounted on a shaft or pivot 39. The lever may be arranged so that it will fall back to normal position under the influence of gravity; but in order to insure its positive operation, I prefer to provide the same with a spring 40 which also tends to hold the lever against the stop 41. The lever or arm 38 is provided with a pawl 42 adapted to engage with the teeth of a ratchet wheel 43 bearing a wiper or contact finger 44. One or more contacts 45 are arranged within the path of the wiper 44. A contact finger or similar member 46 is arranged adjacent to the lower end of the arm 38, so that when the arm is swung, as for instance under the action of the magnet 17, a circuit will be closed between said contact member and said arm. A wire 47 leads from the wire 11, or a terminal thereof, and is connected to the contact member 46. Another wire 48 leads from the contact 45 to one of the terminals of the exploding device of the charge 16. A third wire 49 leads from the wire 12, or a terminal thereof, to the other terminal of the exploding device. When the operator closes the current through the main line by means of the switch 9, one or more impulses may be given to the magnet 17, thereby swinging the arm and turning the ratchet wheel until the wiper 44 rests on the contact 45 and remains there until the operator moves the switch 9 from the corresponding contact 8. When the lever 38 is attracted by the magnet and the wiper 44 is on the terminal 45, a circuit will be closed from wire 11, through wire 47, contact device 46, arm 38, ratchet wheel 43, wiper 44, contact 45, wire 48, exploding device of the explosive 16, wire 49 and wire 12. From this it will be seen that the current will pass through the exploding device as long as the switch 9 remains closed, and when the charge explodes the circuit between the wires 48 and 49 will ordinarily be broken. However, should coal or rock fall on these wires so that they would still remain in contact, this short-circuiting of the magnet would cause its field to be weakened and the arm 38 would return to normal position. This would cause the circuit to be broken at the contact device 46, thereby opening the short-circuit. Then, the next time the circuit is closed through the main

line, the magnet 17 will cause the arm 38 to vibrate again and the wiper 44 will pass on from the contact 45, thereby permanently breaking such circuit through the wires 48 and 49.

Where there are a number of shots or explosives to be fired or discharged, for instance in a coal mine, the operator, after all of the connections have been made, sets the ratchet wheels in a predetermined order by means of the pointers 35 or other similar devices, so that each time the circuit is closed through the main line, each of the wipers will be advanced one point. Then, by properly arranging the wipers in a predetermined order, he will know which one will be advanced to make contact each time the circuit is closed through the main line. Then the operator goes to the top of the mine and moves the switch 9, for instance to the first contact 8; then, if one of the wipers has been set so that it moves forward to close the circuit through the explosive, this particular shot will be fired; then he moves the switch to the next contact 8, when the wiper, which is arranged to make contact with two movements of the ratchet wheel, will cause the next shot to be fired, and so on until all of the shots or explosives have been discharged. The position of the switch 9 on the series of contacts 8 will then indicate how many of the explosives or charges have been discharged. After all of the shots have been fired, the selective devices are again connected up for the next operation.

Of course, it is desirable for the operator to know whether, when the current has been directed through one of the explosives, said explosive has actually been fired, or for any reason has failed to be discharged. In order to notify the operator of each explosion, I have arranged a signaling apparatus adapted to be used in connection with the firing apparatus. To this end, a third wire 6 is arranged adjacent to the wires 4 and 5, as indicated in Fig. 1, and is connected with a source of electric supply, as for instance a battery 50. Adjacent to each of the selective devices, for instance in the entrance to the room in which the explosives are to be discharged, I arrange a transmitter or contact closing member which is adapted to be actuated by the vibrations of the air caused by the explosions. As illustrating such a device, I have shown wires 51 and 52 leading from the main wires 5 and 6. The wire 51 is connected to a pendulum or similar vibratory member 53, such member being hung so that it will be swung or vibrated by the action of the air currents or vibrations when the explosion occurs. When this member vibrates, its opposite end makes contact with a terminal 54 at the end of the wire 52. Adjacent to the operator's switch 9 is arranged a receiver 55, or other

indicator, which is adapted to indicate the passage of a current therethrough, for instance a lamp or recording apparatus might be introduced in the place of such receiver. This receiver is connected, by means of suitable wires, with the main wires 5 and 6. The operation of such signaling or notifying apparatus will be readily understood. When an explosion occurs adjacent to one of the transmitters or vibratory devices 53, it will cause the device to be vibrated, thereby making contact with the terminal 54. When such contact is made, a circuit is closed from the battery 50, through the wire 6, wire 52, contact 54, transmitter 53, wire 51, wire 5, receiver or signaling device 55 and back to the battery. Thus, when the operator closes the switch 9 and holds the receiver to his ear, or observes the corresponding signaling device, he will know when each shot has been fired as the switch closes the several circuits.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A selective device for the purpose set forth, comprising an electromagnet, wires leading to said magnet from a source of electric supply, a swinging arm actuated by said magnet, a ratchet wheel actuated by said arm, a wiper on said wheel, a contact with which said wiper makes contact, a contact device arranged adjacent to the lower end of said arm for making contact therewith when the arm is attracted by the magnet, a wire leading from one of said first mentioned wires to said contact device, a wire leading from the other of said first mentioned wires to the shot or explosive to be fired, and a wire leading from the contact in the path of said wiper to said shot, the arrangement being such that when said arm has been actuated by the magnet a predetermined number of times, said wiper will rest on the contact within its path and said arm will make contact with the contact device, thereby closing the circuit through the explosive discharging means, said circuit remaining closed until the explosive is discharged or said arm moves back to its normal position.

2. In an electric apparatus for discharging explosives in coal mines, the combination with sources of electricity, of three wires leading from said sources, a recording switch for making and breaking the circuit from two of said wires through one of said sources, a plurality of circuit closing devices connected with said last named wires, wires leading from said circuit closing devices to the explosives to be discharged, said circuit closing devices being adapted to be adjusted so that circuits from said source of supply to said explosives may be closed successively by the making and breaking of the circuit

by means of said switch, transmitters or
circuit closing devices arranged adjacent to
said explosives and adapted to be operated
by the movement of the air caused by the
explosion, said devices being connected with
the third wire and one of said pair of wires,
and a receiver or indicator in circuit with
said second named source of supply and

with said transmitters, whereby the closing
of the circuit by said transmitters may be
noted by the operator. 10

RALPH E. NOBLE.

Witnesses:

A. W. FENSTEMAKER,
LOUIS H. GEIER.

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Washington, D. C."