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CONTROL CIRCUIT FOR STEP-BY-STEP SWITCHES

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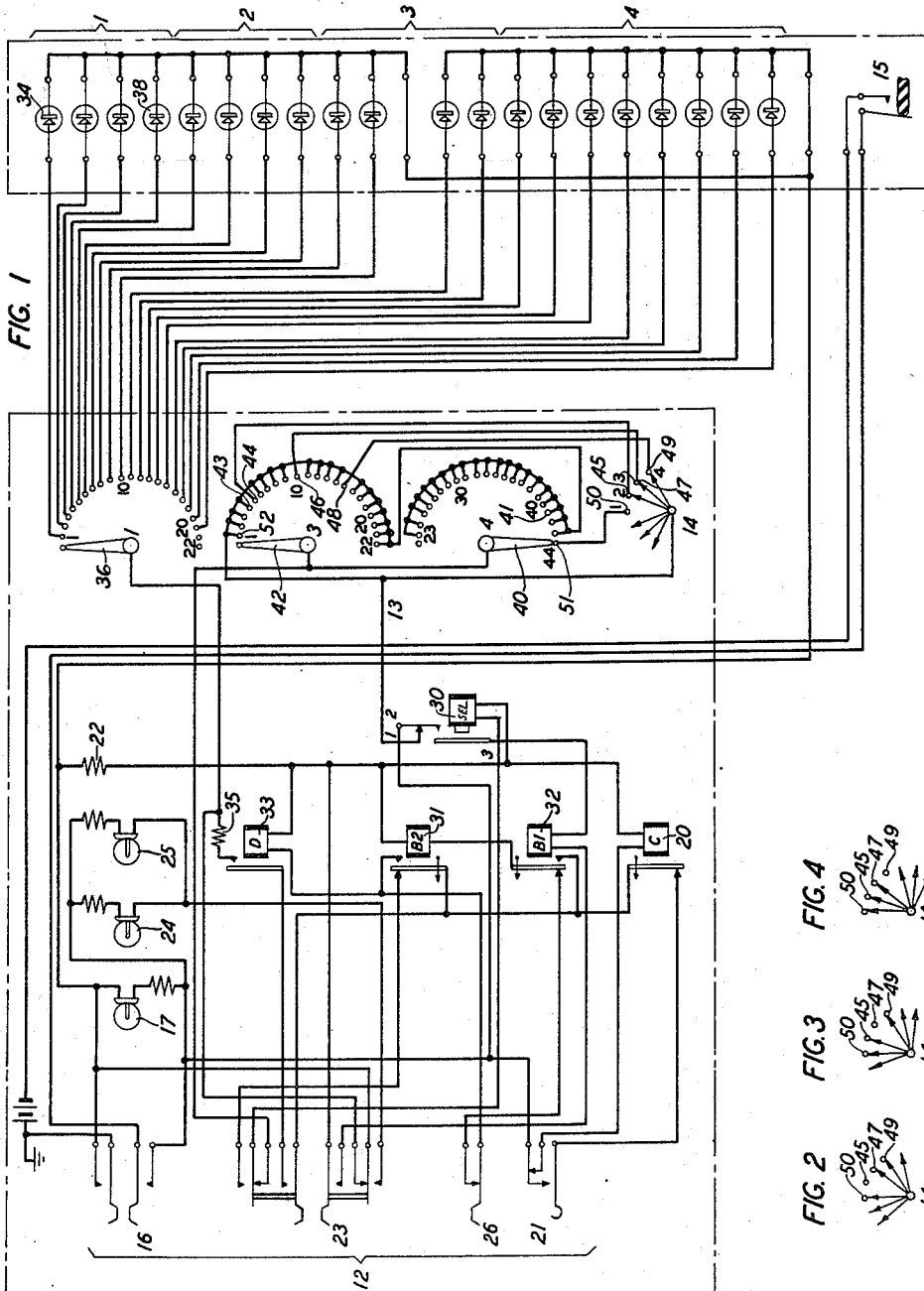
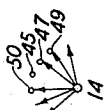


FIG. 4

FIG. 3

FIG. 2



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CONTROL CIRCUIT FOR STEP-BY-STEP SWITCHES

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4 Claims. (Cl. 175—375)

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This invention relates to firing control mechanisms and particularly to mechanisms for firing fuses employed in igniting explosive charges.

An object is to simplify the construction and operation of firing mechanisms and to improve their utility.

Heretofore different types of mechanical, chemical and electrical fuses have been employed for igniting explosive charges such as mines or such charges as are used for propelling rockets, and a number of various mechanical devices operated by hand or by relay devices have been employed for firing such fuses.

It is a feature of the present invention to provide a hand-operated mechanism for selectively firing any one or more of different series or groups of fuses in succession or for firing any one of the fuses in any one of said series for each hand operation of said mechanism.

The applicant's invention has been illustrated in the accompanying drawings in which Fig. 1 shows a typical arrangement for firing various groups of fuses and Figs. 2, 3 and 4 show various positions of a hand-operated switch employed in this system for selecting groups of fuses to be fired.

Referring now to the drawings, Fig. 1 shows four different groups of fuses, groups 1, 2 and 3, consisting of four fuses each and group 4, consisting of eight fuses, a mechanism for firing any selected group or groups. This mechanism consists generally of a group of operating keys 12, a step-by-step switch 13, a hand-operated switch 14 and circuits, control lamps and relays for effecting the various operations.

This mechanism operates as follows: If it is desired for example to start firing the first group 1, and either stop after this group is fired or continue to fire the succeeding groups 2, 3 and 4 or any number of these groups, the so-called group hand-operated switch 14 is set as shown in Fig. 1. A connection is thereafter established between contacts 15 which contacts may be closed by any suitable arrangement such as for example a door or doors (not shown) which may normally cover the fuses and the associated rockets if the fuses are used for this purpose and which may be opened when the firing begins. This arrangement of doors may be provided so that any accidental operation of the key mechanism will not set off the fuses until the mechanism is actually in readiness for functioning. Then the start key 16 is operated. This causes the establishing of a circuit for the lighting of lamp 17, from battery, contacts 15, key 16, lamp 17, key 16, to

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ground. Relay 20 is also operated over a circuit from battery, contacts 15, key 16, the firing plunger key 21, winding of relay 20, resistance 22, key 16 to ground. If the second make-ready key 23 is operated the lamps 24 and 25 are lighted over a circuit from battery, contacts 15, key 16, lamps 24 and 25, keys 23 and 16 to ground. The key 26 is then operated and the circuits are now ready for the firing of the first group 1 by the operation of firing key 21. The operation of key 21 releases relay 20 and causes the operation of select magnet 30 for the stepping of the switch 13, and the firing of the fuses. The circuit for stepping magnet 30 extends from battery, contacts 15, key 16, firing key 21, contacts of relays 20 and 31, key 23, winding of magnet 30, resistance 22, key 16 to ground. Relay 32 is then operated over a circuit from battery, contacts 15, key 16, contacts of magnet 30, winding of relay 32, contacts of key 23, resistance 22, key 16 to ground. Relay 32 in operating closes a circuit for the operation of relay 31 from battery, contacts 15, keys 16 and 21, contacts of relays 20 and 32, winding of relay 31, resistance 22, key 16 to ground. Relay 31 closes a circuit for the operation of relay 33 from battery, contacts 15, keys 16 and 21, contacts of relays 20 and 31, winding of relay 33, resistance 22, key 16 to ground. As relay 31 operates the circuit of stepping magnet 30 is opened and this stepping magnet releases causing the brushes of switch 13 to take one step to advance them to the first position. At this time, that is as soon as relay 33 operates, a first fuse 34 in group 1 is fired over a circuit from battery, contacts 15, key 16, key 21, contacts of relay 20, key 23, contacts of relay 33, resistance 35, brush 36, first terminal of the associated bank, fuse 34, key 16 to ground. Then after an interval relay 32 releases due to the release of stepping magnet 30 and this relay in releasing releases after an interval relay 31. Both these relays 31 and 32 are slow in releasing. On the release of relay 31, relay 33 is released. On the release of relay 31, the stepping magnet 30 is again operated and this cycle of operations of the relays 31, 32, 33 and stepping magnet 30 are repeated to step the brushes of the switch 13 to succeeding terminals to fire the succeeding fuses.

If now after firing of the fourth and last fuse in group 1, which is fuse 38, it is desired not to fire any more fuses, key 21 may be released. Should the operator, however, desire to fire one or more of the succeeding groups of fuses, he will maintain the firing key 21 operated for this purpose and the switch 13 will be stepped, by the operation

and release of the above-mentioned relays and the stepping magnet 30, to continue the firing until key 21 is released. In any case as soon as firing key 21 is released, the stepping mechanism may be returned to normal without firing any of the remaining fuses by the release of keys 26 and 23. On the release of key 21 the circuit for the operation of relay 20 is reestablished and the stepping magnet 30 is operated on the released key 23 from battery, contacts 15, key 16, self-interrupting contacts of stepping magnet 30, the twentieth terminal 41 of the bank associated with brush 40 and this brush if all the fuses have been fired, contacts of key 23, winding of stepping magnet 30, resistance 22, key 16 to ground. If, however, only the first group of fuses have been fired, the switch would naturally have its brush 42 on terminals 43 as it would have taken only four steps. In this case the connection from the self-interrupting contacts of the stepping magnet 30 for the operation of this magnet will extend to the fourth terminal 43 to brush 42, key 23, and through the select magnet, resistance 22, key 16 to ground. This would cause the switch to take one step and when the brush 42 lands on terminals 44, a connection is established over this terminal for the self-interrupting contacts through brush 42 contact 45 and brush of switch 14 over the same circuit to step the switch another step. After this the circuit will be established over the succeeding four terminals of the bank associated with brush 42 and as it advanced to terminal 46, the circuit is extended through switch 14 over terminal 47 then four more steps are taken over the next four terminals of the bank associated with brush 42 and when the brush lands on terminals 48 another connection is established through switch 14 over terminal 49 and then the succeeding eight steps are taken by the connections through the remaining eight terminals and brush 42 until the switches have taken half a turn and then the connections are established through brush 40 and associated bank terminals until the switches return to normal.

If it is now assumed that the operator does not want to fire the four first fuses in the first group 1, but desires to fire the four fuses of the succeeding group 2 he will set the switch 14 to the position shown in Fig. 2 of the drawing and only operate key 16. As soon as key 16 is operated the lamp 17 lights as before and stepping magnet 30 will now operate over a circuit from battery, contacts 15, key 16, self-interrupting contacts of the stepping magnets of the stepping magnets 30, the brush and first terminal 50 of switch 14, the first terminal 51 and brush 40 of the step-by-step switch 13, contacts of key 23, winding of stepping magnet 30, resistance 22, key 16 to ground. This caused the switch 13 to take one step, disconnecting the brush 40 from terminal 51 and as brush 42 lands on the first terminal 52, another circuit is closed through the self-interrupting contacts of stepping magnet 30 independent of switch 14 to cause the stepping magnet to take another step. The stepping of switch 13 is continued for another four steps past the terminal 43 and when the brush 42 lands on the terminal 44 as there is no connection for this terminal through switch 14 at this time the stepping will be discontinued and the switch stopped. As soon as the switch stopped the operator will operate the keys 23 and 26 to prepare the circuit for the firing of the succeeding groups of fuses, that is, group 2, and as soon as the firing key 21

is operated in the same manner as the fuses in group 1 were fired. The firing of the succeeding groups will be continued if the operator so desires, but he may stop the firing at any point by releasing the firing key 21 and then the switch is returned to normal on the release of key 23 in the manner as hereinbefore described.

If it is desired to omit the firing of the fuses in groups 1 and 2 and instead fire the fuses in group 3, the switch 14 may be set to the position shown in Fig. 3. In this case the switch 13 will take the first five steps as before and when the brush 42 lands on terminal 44, a connection will be established through switch 14 over the terminal 45 and thus the switch will take another step and continue another five steps until brush 42 lands on terminal 46 which has no connection through switch 14 and thus stops at this point for the firing of the remaining groups by the operation of keys 23, 26 and 21 as described. On the other hand if the last eight fuses in group 4 only are to be fired switch 14 is set as shown in Fig. 4 the switch 13 will therefore step until the brush lands on terminal 48 where there is no connection for the stepping magnet 30 which will then stop and the firing of this last group may then be started by the operation of keys 23, 26 and 21 as usual.

If it is desired to fire only one fuse for each operation of the firing key 21, the procedure would be, for example, if the first fuse in group 1 is to be fired, instead of operating key 26 with the other keys and then operating the firing key 21, this key 26 would be retained in normal position. Therefore, after the release of relay 32 when the stepping switch has taken one step, relays 31 and 33 will not release as a holding circuit will be established for these two relays in parallel from battery, contacts 15, key 16, key 21, contacts of relay 20, contacts of the operated relay 31 through the winding of relay 33, resistance 22, key 16 to ground for holding relay 33 and through contacts of relay 31, key 26, contacts of released relay 32, winding of relay 31, resistance 22, key 16 to ground. These relays will be maintained operated as long as the firing key 21 is maintained operated. When the key 21 is then released, relay 20 reoperates and relays 31 and 33 are released. If it is then desired to fire additional fuses key 21 is again operated, the switch will then take another step by the operation of the stepping magnet and relays 32, 31 and 33 as usually and relays 31 and 33 will lock up until the key 21 is again released. Thus succeeding fuses may be fired for each operation of the firing key 21. If it is decided that only one fuse is to be fired or that the firing of fuses is to be stopped after any desired number of fuses have been fired by corresponding succeeding operations of key 21, the switch 13 may be returned to normal as hereinbefore described.

What is claimed is:

1. A control mechanism for controlling electrical circuits comprising a step-by-step switch having contacts at step positions thereof, electric means for stepping said switch, relay means and a key mechanism in circuit with and operable for controlling said stepping means to step said switch normally continuously and automatically into successive engagement with each contact thereon, some contacts on said switch adapted to have circuits connected thereto to be controlled by said switch, and a settable selector, a plurality of special contacts on said switch, each special contact disposed between con-

secutive groups of said some contacts, said selector arranged to interconnect some of said special contacts with the circuit of said stepping means and arranged thereby to stop the stepping of said switch when said switch engages the first of said special contacts not interconnected by said selector with the circuit of said stepping means.

2. A control mechanism for controlling electrical circuits comprising a step-by-step switch having contacts at step positions thereof, electric means for stepping said switch, relay means and a key mechanism in circuit with and operable for controlling said stepping means to step said switch normally continuously and automatically into successive engagement with each contact thereon, some contacts on said switch adapted to have circuits connected thereto to be controlled by said switch, and a settable selector, at least two special contacts on said switch, said special contacts disposed between consecutive groups of said some contacts, said selector arranged to interconnect one of said special contacts with the circuit of said stepping means and arranged thereby to stop the stepping of said switch when said switch engages the other of said special contacts.

3. A control mechanism for controlling electrical circuits comprising a step-by-step switch having contacts at step positions thereof, electric means for stepping said switch, relay means and a key mechanism in circuit with and operable for controlling said stepping means to step said switch normally continuously and automatically into successive engagement with each contact thereon, contacts on said switch adapted to have circuits connected thereto to be controlled by said switch, and a settable selector interconnected with said switch and with the circuit of said stepping means and arranged to stop the stepping of said switch after a number of steps thereby predetermined by a setting of said selector, said key mechanism reoperable for controlling said stepping means to further step said switch under similar control of the same setting of said selector.

4. A control mechanism for controlling electrical circuits comprising a step-by-step switch

having contacts at step positions thereof, electric means for stepping said switch, relay means and a key mechanism in circuit with and operable for controlling said stepping means to step said switch normally continuously and automatically into successive engagement with each contact thereon, some contacts on said switch adapted to have circuits connected thereto to be controlled by said switch, and a settable selector, a plurality of special contacts on said switch, each special contact disposed between consecutive groups of said some contacts, said selector arranged to interconnect some of said special contacts with the circuit of said stepping means and arranged thereby to stop the stepping of said switch when said switch engages the first of said special contacts not interconnected by said selector with the circuit of said stepping means, said key mechanism reoperable for controlling said stepping means to further step said switch under similar control of the same setting of said selector.

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