

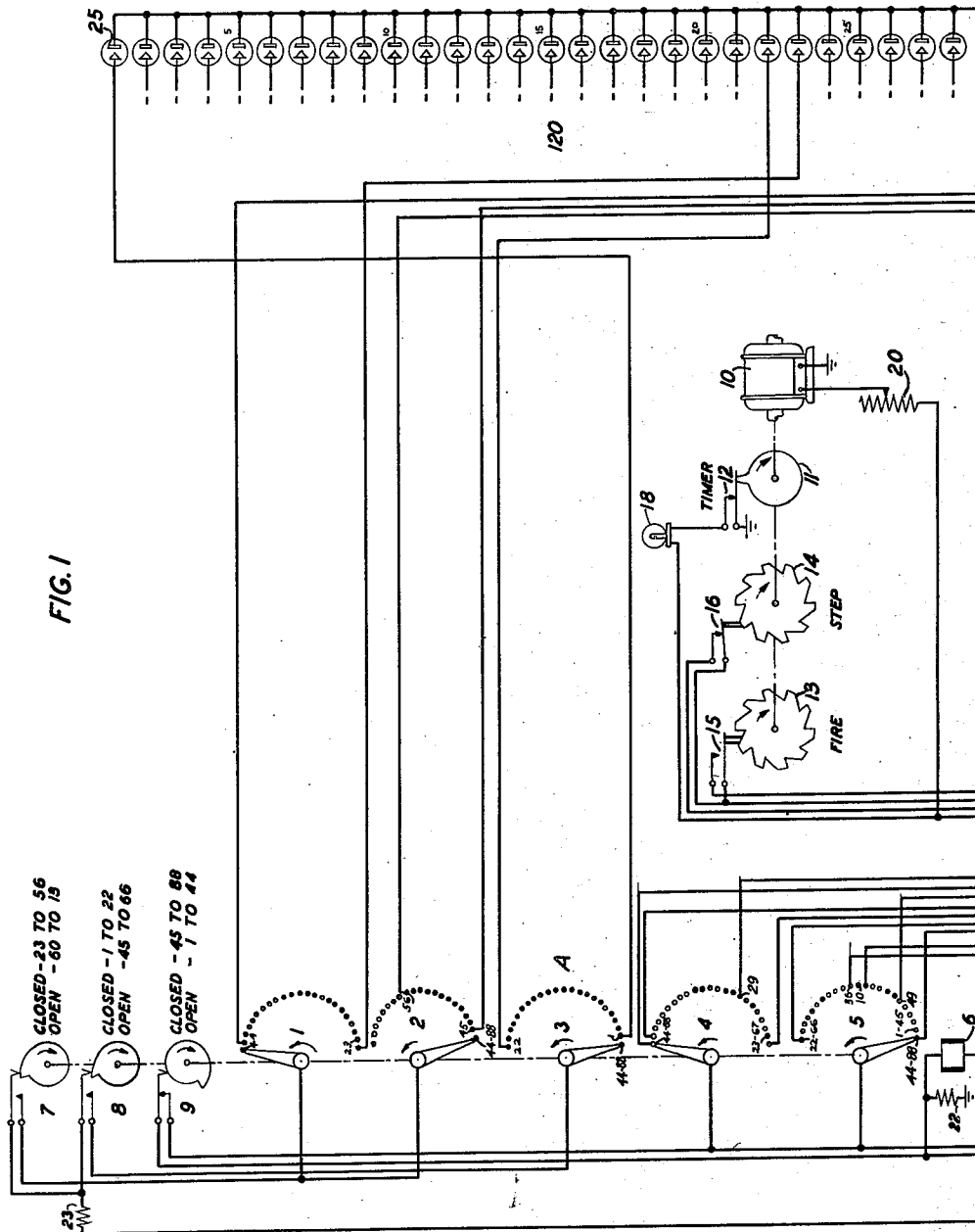
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O. H. WILLIFORD
CONTROL MECHANISM

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2 Sheets-Sheet 1



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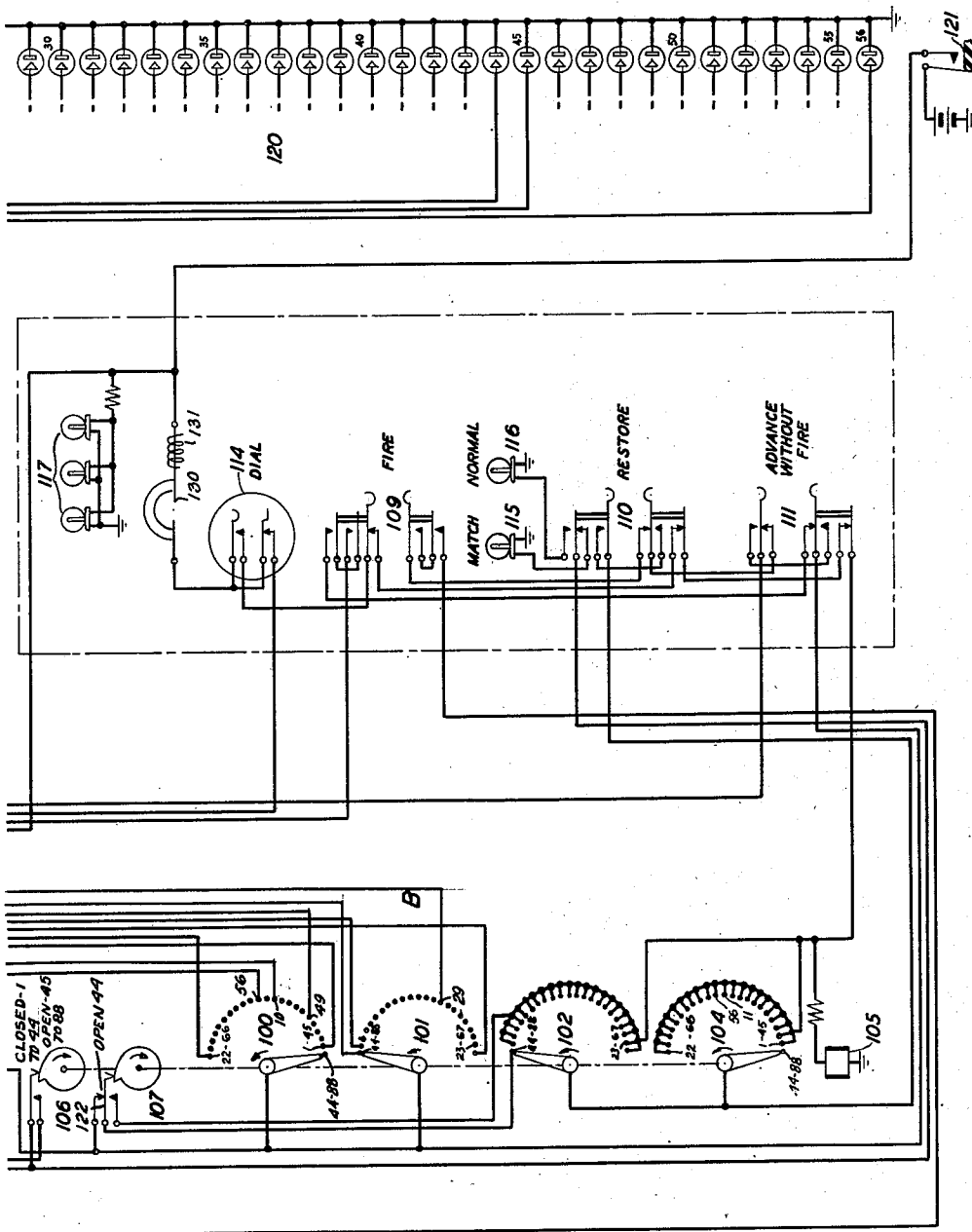


FIG. 2

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CONTROL MECHANISM

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5 Claims. (Cl. 102—70.2)

1

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 fuse firing mechanisms to increase their utility.

Heretofore different types of mechanical chemical or 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. One such device is disclosed in the copending application of H. B. Brown, Serial No. 564,139, filed November 18, 1944, and in this device a hand-operated mechanism is provided for selectively firing any one or more of different series of groups of fuses, or for firing any one of the fuses in any one of said groups for each hand operation of said mechanism.

It is a feature of the present invention to provide a mechanism for preselecting and firing any desired number of succeeding fuses among a large series of fuses regardless of the position of said succeeding fuses in said series.

The invention has been illustrated in accompanying drawings in which Figs. 1 and 2 show a mechanism in accordance with the applicant's invention as applied to a system for controlling the firing of a series of fifty-six fuses.

Referring now to the drawings, there are shown two ordinary step-by-step mechanisms A and B each having a series of banks of terminals each bank having twenty-two positions and associated brushes which step over said terminals to connect with one terminal for each step, all of the brushes being shown in their normal positions. The banks for switch A are numbered from 1 to 5 and the stepping magnet 6, while the banks for switch B have been numbered from 100 to 104 and the stepping magnet 105. Associated with each switch is a series of cams operating on contacts, for example, associated with switch A are cams 7, 8 and 9 which close and open associated contacts in various combinations as indicated in the associated tables; that is, cam 7 closes its contacts in positions 23 to 56 and opens them in positions 60 to 13; cam 8 closes its contacts in positions 1 to 22 and opens them in positions 45 to 66, while cam 9 closes its contacts in positions 45 to 88 and opens them in positions 1 to 44. These cams are so driven by the step-by-step mechanism that such closures take place at the indicated positions while the

2

switches rotate and make two complete revolutions; that it, while the switch takes 88 steps, 22 steps for each half revolution. Switch B is also provided with two cams 106 and 107 which are rotated to operate contacts as follows. Cam 106 closes its contacts in positions 1 to 44 and opens them in positions 45 to 88, while cam 107 opens its upper contact 122 in position 44 and opens its lower contact in position 88. Other apparatus in this mechanism is a motor 10 that drives a cam 11 to close contacts 12 once for each revolution, and two sprocket wheels 13 and 14 which close associated contacts 15 and 16, respectively, once for each tooth in the cam wheels which have ten teeth each. There are also provided a series of keys one marked 109 which is called the firing key, another 110 which is called the restore key and 111 which is called advance without firing key. An ordinary dial 114 is also provided in this circuit and a series of indicating lamps 115, 116, 117 and 118. At the right of these drawings, Figs. 1 and 2, are shown 56 fuses with associated wiring marked in general by the figure 120 and a safety switch 121 for closure of a circuit connection to battery which may be arranged so that it closes only when, for example, a firing door (not shown) is opened for the firing of the rockets associated with the fuses.

Referring to these apparatus as described and their circuit connections as shown, if it is desired to fire all of the 56 fuses in succession, the following operations take place.

First the fire door is opened to close the connection to battery at contacts 121 and then the dial 114 is operated to dial 56 but in groups of five zeros (the dial marking which indicates 10 pulses to be transmitted) and one digit 6 to make a total of 56 impulses. The circuit for stepping magnet 105 to operate the brushes may be traced from battery, contacts 121, dial 114, keys 109, 110 and 111, winding of magnet 105 to ground. The operation of the dial causes the switch B to take fifty-six steps, that is, it rotates the brushes one revolution taking forty-four steps to their normal positions again and twelve steps more during the second revolution. At this time the brushes of banks 100 and 104 are standing on the twelfth terminal in their respective banks. In this case the cam 106 has its contacts opened. The connection of the battery at contacts 121 also closes a circuit for the starting of the motor 10 from battery, contacts 121, a rheostat 20, which may be adjusted to cause the motor to operate at a desired definite speed, then through the motor to ground. On the closing of this con-

nection, lamp 18 is lighted and immediately extinguished the moment the motor starts but is re-lighted for each revolution thereof, to indicate motor operation and for checking the motor speed. Lamps 117 are also lighted in this circuit from battery through contacts 121 to indicate that the system is in use. The motor 10 rotates the cam wheels 13 and 14 to close contacts 15 and 16 alternately to control the firing of fuses and stepping of the switches as will be described. The firing key 109 is now operated. This causes the stepping magnet 6 for switch A to operate in steps under control of contacts 16. The circuit for this magnet may be traced from battery, contacts 121, contacts of dial 114, contacts 16, contacts of keys 109 and 111, winding of stepping magnet 6, resistance 22 to ground. The magnet 6 in stepping causes circuits for firing of succeeding fuses to begin starting with fuse 1 through the brush of bank 3 as follows, battery, contacts 121, dial 114, contact 15, contacts of keys 111, 110 and 109, resistance 23, contacts of cam 8, brush of bank 3 and the first terminal and first fuse 25 to the common ground for all the fuses. On the next 22 steps of the stepping magnet 6, the next 21 fuses are fired through the connections made at the succeeding terminals in bank 1 of the switch A. When the switch A takes the twenty-third step the firing of the next fuses 23 to 44 takes place through the brush of bank 1 of switch A over the same circuit with the exception that the circuit extends through contacts of cam 7. After the forty-fourth fuse has been fired the firing of the succeeding twelve fuses takes place through the brush of bank 2 of switch A through the contacts of cam 7. After the fifty-sixth fuse is fired the stepping magnet 6 stops operating the switch A as this magnet is now short-circuited over a circuit now established from the battery through contacts 121, dial contacts 114, 16, keys 109 and 111, brush of bank 109 and terminal 56, terminal 56 and brush of bank 5 switch B, contacts of cam 9, contacts of key 110, lamp 115 to ground. This causes lamp 115 to respond to the impulses by contacts 16 and flash accordingly, indicating that all the fuses have been fired and that the firing key should be restored and the mechanism returned to normal. When this indication is given the firing key 109 is released and the restore key 110 is operated extinguishing lamp 115. Switch B is now restored to normal over a circuit from battery, contacts 121, contacts of dial 114, contacts 15, contacts of keys 111, 110, brush and the fifty-sixth terminal and succeeding terminals for succeeding steps of banks 104 and 102 of switch B, magnet 105 to ground. That is, switch B will take 32 more steps before it gets back to normal. When the switch B has returned to normal the connection through the brush of bank 102 to the terminals of this bank is open and magnet 105 now ceases to operate and thus switch B will remain in normal position. Switch A will now be returned to normal from the fifty-sixth position by a circuit closed from battery, contacts 121, contacts of dial 114, contacts 15, contacts of keys 111, 110, brush of bank 102 in normal position, contacts 122 of cam 107, winding of stepping magnet 6, resistance 22 to ground. When the magnet 6 has returned the switch A to normal a short-circuit therefor is provided through the brush and normal terminal of bank 101 of switch B and normal terminal and brush of bank 4 of switch A, contacts of cam 9 switch A, contacts of key 110, lamp 116 to ground. This lamp now

flashes under control of contacts 15 to indicate that the both switches A and B have returned to normal. The key 110 may now be released.

If it is desired to fire only a limited number of fuses instead of the whole series the procedure is the same as described except that the dial 114 is operated to the particular number desired to be fired. This sets the switch B to this number and when switch A has been advanced to the corresponding number and fired the number of fuses it stops and the switch may then be returned to normal.

If it is desired to fire any particular group of fuses in succession in any position in the series, the dial 114 is operated to the particular number in the series at which the first fuse in the desired group is located. This operates the switch B to this position as described hereinbefore. Then the advance without fire key 111 is operated and this advances switch A to the position of this first fuse. The circuit for advancing switch A under these conditions may be traced from battery, contacts 121, dial 114, contacts 15, key 111, stepping magnet 6, resistance 22 to ground. When the switch A has advanced to this position where firing shall begin, it stops due to its being short-circuited as hereinbefore described through bank 4 or 5 of switch A and bank 100 or 101 of switch B depending on where the series to be fired is located. If, for example, the eleventh to the twentieth fuses are to be fired, the select magnet 6 advances the brushes to the tenth terminals and then stops as it is short-circuited by the connection established through bank 5 of switch A and bank 100 of switch B over a circuit through contacts of cam 106. If on the other hand, for example, the firing was to begin on the thirtieth fuse, the short-circuit would have been extended through the banks 4 and 101 and contacts of cam 106. If the first fuse to be fired had been, for example, the fiftieth, the short-circuit would have extended through bank 5 and bank 100. When the selector A has advanced to the proper position, the lamp 115 will flash as hereinbefore described as an indication that the key 111 is to be released. When the key 111 is released, the dial is again operated to determine the number of fuses to be fired from the selected position in the series. This advances the switch B the desired number of steps, say for example 10 if ten fuses are to be fired and then the firing key 109 is operated to cause the ten fuses to be fired as hereinbefore described.

If after having fired a group of fuses anywhere in the series as described above, it is decided instead of restoring the switches to normal to fire a group of fuses that are located immediately after the fuses first fired, the operator will, as soon as the lamp 116 flashes, indicating that the first group of fuses have been fired, operates dial 114 to dial the number of succeeding fuses to be fired thereafter. This advances preselector switch B the corresponding steps and the operator then operates the firing key 109 whereupon selector switch A operates as before and fires the second group of fuses. When these fuses have been fired lamp 115 flashes as before and the switches may then be returned to normal as usual.

The device indicated as numeral 130 on Fig. 2 and located between the dial 114 and the lamps 117 is intended to represent a circuit protective device, such as a thermal relay. Such a device may operate in a number of ways such as to

open all the control circuits, except for motor 10 and lamp 18, upon excessive ambient temperature conditions or such as to open all the said control circuits upon passage of an excessive current through heating winding 131, the said current being chosen from any part of the circuits which may be worthy of excessive current protection.

What is claimed is:

1. In combination, a series of electrically fireable fuses, first electromagnetic switching means for preselecting for firing any desired group of said fuses, each group containing any desired plural number of succeeding fuses less than all among said series, and second electromagnetic switching means for thereafter selecting and firing said preselected fuses under the control of said first electromagnetic switching means.

2. In combination, a series of electrically fireable fuses, an electromagnetic preselector for preselecting for firing any desired group of said fuses, each group containing any desired plural number of succeeding fuses less than all among said series, and an electromagnetic selector for thereafter selecting and firing said preselected fuses under control of said preselector.

3. In combination, a series of electrically fireable fuses, a preselector, first means for actuating said preselector to preselect for firing any desired group of said fuses, each group containing any desired plural number of succeeding fuses less than all among said series, a selector, and second means for actuating said selector under the control of said first means and in accordance with the preselection made by said preselector to thereafter select and fire the said preselected fuses.

4. In combination, a series of electrically fireable fuses, pulsing means, a pulse actuated preselector, first switch means operative to associate said pulsing means with said preselector, said preselector set in response to the operation of said pulsing means and to the operation of said

first switch means for preselecting for firing any desired plural number of succeeding fuses less than all among said series, a pulse actuated selector, second switch means operative to associate said pulsing means with said selector, said selector responsive to the operation of said second switch means and under the control thereof and of said pulsing device and of said first switch means and in accordance with the preselection made by said preselector for thereafter selecting and firing the said preselected fuses.

5. In combination, a series of electrically fireable fuses, a pulsing device, a first step-by-step switch, a first key mechanism operative to associate said pulsing device with said first switch, said first step-by-step switch set in response to the operation of said device and to the operation of said first key mechanism for preselecting for firing any desired group of said fuses, each group containing any desired plural number of succeeding fuses less than all among said series, a second step-by-step switch, and a second key mechanism operative to associate said pulsing device with said second switch, said second step-by-step switch responsive to the operation of said second key mechanism and under the control thereof and of said device and of said first key mechanism and in accordance with the setting of said first step-by-step switch for thereafter selecting and firing the said preselected fuses.

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