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ELECTRICAL CONTROL MEANS

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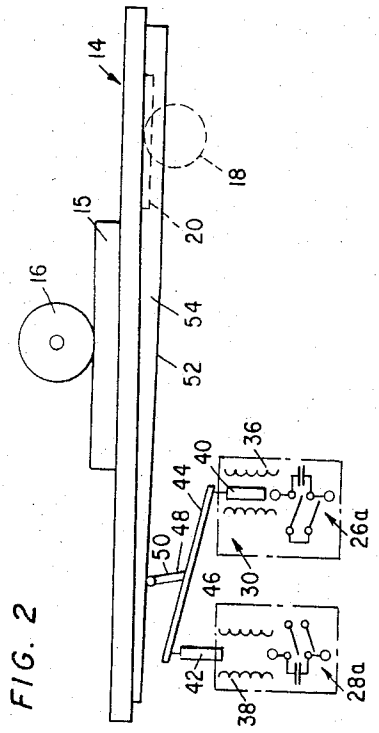


FIG. 2

FIG. 1

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ELECTRICAL CONTROL MEANS

Arthur K. Littwin, Lincolnwood, Ill., assignor to Arthur K. Littwin, Robert L. Littwin, Donald F. Littwin, and Horace A. Young, Chicago, Ill., as trustees under trust, dated Jan. 2, 1951, known as Littwin Family Trust No. 1

Original application May 23, 1962, Ser. No. 197,053, now Patent No. 3,213,342, dated Oct. 19, 1965. Divided and this application Dec. 10, 1964, Ser. No. 417,338
8 Claims. (Cl. 317—142)

The present application is a division of my co-pending application Ser. No. 197,053, filed May 23, 1962, now Patent No. 3,213,342, issued Oct. 19, 1965.

The present invention relates to electrical control means.

An object of the invention is to provide novel electrical control means for producing positive impulse and control thereof in a timing operation, and minimizing the time interval of the impulse and reliably controlling the duration thereof.

Other objects and advantages of the invention will appear from the following detailed description, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a diagram of a circuit portion utilized in the apparatus of the invention; and

FIG. 2 is a fragmentary and partially diagrammatic illustration of certain control elements of apparatus of a character to which the present invention is particularly adapted.

The invention includes electrical timing means utilizing a novel principle of providing a positive impulse that continues until interrupted in the original energizing source, and further in which the impulse can be made of short interval and accurately controlled as to duration. An example in which the timing means is particularly advantageous is in connection with switch means that is thrown over to a new position and not returned as relates to the impulse in question. For example, in the case of a reversing table, switch means is actuated and remains in its new position until again actuated at a much later time and for a purpose other than controlling the timing operation. So far as presently known, there is no effective timing means that can be accurately timed in response to timing the actuating means, particularly one that is capable of timing to such a small interval of time as in the present coil, such for example as ⅝ cycle of alternating current. As an example of difficulties encountered, a mechanical actuator or the switch contacts may become worn, or similar inaccuracies will occur in connection with hydraulic or pneumatic mechanisms, and corresponding inaccuracies would occur in the timing operation. Those difficulties are overcome by the present invention.

The present invention may be advantageously adapted to control of a reciprocating table, such as disclosed in the parent application referred to above, Ser. No. 197,053, and in my prior Patent No. 3,045,165, issued July 17, 1962. Such a reciprocating table is shown at FIG. 2 herein, which is identical with the reciprocating table of FIG. 2 of the parent application. FIG. 2 herein also includes certain switches (26*a* and 28*a*) actuated, indirectly, by the reversing movements of the reciprocating table. These switches are included in FIG. 1 of the above-mentioned application, as will be referred to again hereinbelow.

Such reciprocating table is indicated at **14** in FIG. 2 herein, this table **14** being incorporated in a machine tool in which a workpiece **15** is placed thereon for grinding by a grinding wheel **16**, the table being reciprocated for moving the workpiece back and forth under the grinding wheel. The table **14** may be reciprocated by any suitable means, and as here represented is a pinion **18** engageable with a rack **20** on the table, the pinion being driven by, for example, an electric motor, hydraulic motor, pneumatic motor, etc., the principal consideration being that the control operation performed on the means for moving the table is controlled under the control elements included in the circuit of FIG. 1 herein.

As the reciprocating table **14** reaches opposite ends of its range of movement, according to the setting of the apparatus, the respective switch **26***a* or **28***a* is actuated in accordance with the operation described in the parent application. Specifically, after each switch **26***a* or **28***a* is actuated, it remains closed until the opposite switch means is actuated. For example, assuming switch **26***a* is actuated at one end of the movement of the table, and the table thereupon reverses, that switch remains closed until the switch **28***a* is actuated at the opposite end of the movement of the table.

Referring now to FIG. 1, swiches **104** and **106** are shown at the lower right-hand corner, which may be the same as or actuated at the same time as switches **26***a* and **28***a* respectively. In other words, these switches **104** and **106** are actuated by the relay coils **26** and **28** respectively of FIG. 1 of the parent application, and therefore, when the table moves to the right, for example, the switch **104** is closed and at the opposite end, the switch **106** is closed. Each remains closed until the other is closed, and is then opened. Assuming the switch **104** is closed at one end of the movement of the table, the grid transformer **124** is energized through the following circuit: conductor **105** from post #2 of the source (bottom, right), switch **104***b*, conductor **107**, normally closed switch **112***b*, conductors **109**, **111**, **113**, the transformer **124**, and conductors **115**, **122**, **116** to post #4 of the source (bottom, center). This imposes a positive bias on the tubes **126**, through secondaries **124S**, and renders them conducting and they energize the coil **128** through conductors **117**, **119**, **121**, **123**, the secondary of transformer **118**, and conductor **125**; the transformer **118** is energized at this time through conductors **116** and **120**. This closes the switch **128***a* or moves it to its position opposite that shown, closing a circuit through coil **112** as follows: from post #2 of the source (bottom, center), conductors **120**, **127**, the switch **128***a*, conductors **129**, **114**, the coil **112**, conductor **110**, switch **104***a*, and conductor **131** to post #4 of the source (bottom, right); this sets up a holding circuit through switch **112***a* and opens switch **112***b*, the holding circuit being from post #2 of the source (bottom, right), conductor **105**, switch **104***b*, conductor **107**, switch **112***a*, coil **112**, conductor **110**, switch **104***a*, and conductor **131**. Opening of the switch **112***b* interrupts the circuit to the grid transformer **124**, but the momentary impulse thereon was sufficient to fire the tubes **126**, and the latter then remain conducting due to their inherent characteristics, and hold the circuit through the coil **128**.

While the switch **128***a* is in its rest position, or that shown in the drawing, a charge builds up on the condenser

130 through conductor 120 from post #2 of the source (bottom, center), conductors 133, 136, 137, the condenser, conductor 139, switch 128*a*, conductors 141, 116 in return to post #4 of the source. The condenser 130 is controlled by the potentiometer 134 and when the coil 128 is energized and the switch 128*a* moved to its alternate position, the condenser 130 discharges and produces a negative bias on the tube 132 through conductors 137, 136, 133, an alternating current potentiometer 134, one of the conductors 143, the tube, and conductors 145, 139. The tube 132 is connected in series with the potentiometer 134. The bias of the potentiometer 134 is overcome by the discharge of the condenser 130 which prevents conduction of the tube 132. When the positive bias of the potentiometer 134 again overcomes the negative bias of the condenser 130 because of and following the discharging of the condenser, the tube 132 conducts and causes a voltage drop across the resistor 135 which produces a negative bias on the tubes 126. This circuit through the resistor 135 includes conductor 147, resistor 135, conductors 121, 149, 122, 116, to post #4 of the source; it continues from post #2 through conductors 120, 139, 136, 133, the potentiometer 134, and a conductor 143, in return to the tube 132. As a consequence, the latter tubes become non-conducting, and the circuit is returned to its starting condition.

The condenser 130 under the control of the potentiometer 134 can be set for completion of its discharge and consequent control operation for a very short period, such as that mentioned above, namely, in the neighborhood of 5/8 of an alternating current cycle.

The switch 104 remains closed during the next movement of the table, as noted above, and remains closed until the table reaches the opposite end of its movement and the switch 106 closes, and when that happens, the same kind of control function is performed, but through the coil 140 and corresponding switches 140*a* and 140*b*. In the circuit as thus set up, the conductors 151, 153, 155, 138, correspond respectively to conductors 107, 105, 131, 110. When the switch 140 opens, the coil 112 is deenergized.

A solenoid 102 is energized during the interval in which the tubes 126 are conducting, through the following circuit: from post #4 of the source (bottom, center), the solenoid 102, conductors 151, 129, the switch 128*a* which is in abnormal position, and conductors 127, 120, to post #2 of the source; this solenoid when thus energized performs the desired work, such as advancing the grinding wheel 16 between passes of the table 14. Whatever the purpose the apparatus of the invention is put to, the solenoid 102 is utilized for performing such functions as opening a valve, moving a mechanical part, etc. The invention is of such breadth as to be useful, for example, in demagnetizing operations in performing reversing functions, as well as many other operations.

A manual impulse control means 142 may be provided for convenience in manually operating the apparatus.

Although the present invention is disclosed as being adaptable to control of a reciprocating table, it is to be understood that it is not limited thereto, and may be used in any of a wide variety of applications, the end result being manifested by the energization of the solenoid 102, it being possible and practicable to incorporate such solenoid and the working results thereof in any of the above-mentioned wide variety of applications.

An extremely great advantage of the invention is realized in that regardless of the time interval involved in actuating the switch 104 or 106, or any inaccuracies encountered in means for actuating the switches, or in any part of the apparatus, the timing function can be accurately controlled, a positive impulse is produced and the source of the impulse itself is interrupted through the switch 112*b* (or 140*b*) at the end of the interval in question.

While I have shown herein a certain preferred form of the invention, it will be understood that changes may be made therein within the scope of the appended claims.

I claim:

1. Electrical control means including a first circuit having a starting condition, an electrically controlled work element in the circuit, a first switch operable by a device to be controlled, tube means in the circuit, means energizing the tube means in response to closure of the first switch, the tube means when energized being operative for energizing the work element, condenser means and means for charging it when the circuit is in starting condition, means controlled by the tube means when the latter is energized for putting the circuit in a second condition, the condenser means discharging in response to the circuit being placed in said second condition and being thereby operable for de-energizing the tube means.

2. The invention set out in claim 1 and including a holding circuit in the first circuit, a relay controlled by the tube means operable for energizing the holding circuit, and the tube means upon being de-energized being operative for re-energizing the holding circuit and thereby de-energizing the first circuit.

3. The invention set out in claim 1 and including a second switch for energizing the work element and a third switch for de-energizing the work element in response to de-energization of the tube means.

4. The invention set out in claim 1 wherein the first circuit includes a first relay energized in response to actuation of the first switch and includes a switch in the holding circuit, the first relay upon energization thereof establishes the holding circuit and energizing the work element through the second switch and the holding circuit, the first circuit also includes a second relay controlled by the tube means and having a switch controlling the work element and operative upon de-energization of the tube means for de-energizing the work element.

5. The invention set out in claim 4 wherein the second relay when de-energized is operative for energizing the condenser, and when energized operative for discharging the condenser for thereby de-energizing the tube means.

6. The invention set out in claim 5 wherein said tube means are normally non-conducting, second tube means is provided for controlling the first tube means, and the condenser controls the second tube means.

7. The invention set out in claim 6 wherein the second tube means is operative for de-energizing the first tube means, and the condenser is operative in response to and during discharge thereof for disabling the second tube means.

8. Electrical control means comprising a circuit including a source of current and an electrically controlled work element and having a first switch operable by a device to be controlled, a first relay and a second relay having switches which in normal position are in series with each other and with the work element, and operable for effecting energization of the work element upon actuation of the first switch, the first relay being energized in response to actuation of the first switch and thereby establishing a holding circuit for itself and the work element, first tube means normally non-conducting but continuing conducting upon being fired, means in response to actuation of the first switch when the first relay is in normal position for initially firing the tube means, means in circuit with the tube means operable for energizing the second relay from said source upon conduction of the tube means, second tube means operative for placing a negative bias on the first tube means and render it non-conducting, a condenser for disabling the second tube means, the switch of the second relay being operative when in its normal position for effecting charging of the condenser and when in its abnormal position pursuant to energization of that relay operative for discharging the condenser and thereby disabling the second tube means, the second tube means being operative following

discharge of the condenser for de-energizing the first tube means, and means for adjustably predetermining the charge on the condenser.

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