June 4, 1929. E. M. CLAYTOR ET AL 1,716,164

ACCELERATING DEVICE

Filed June 25, 1927

Fig. 1.

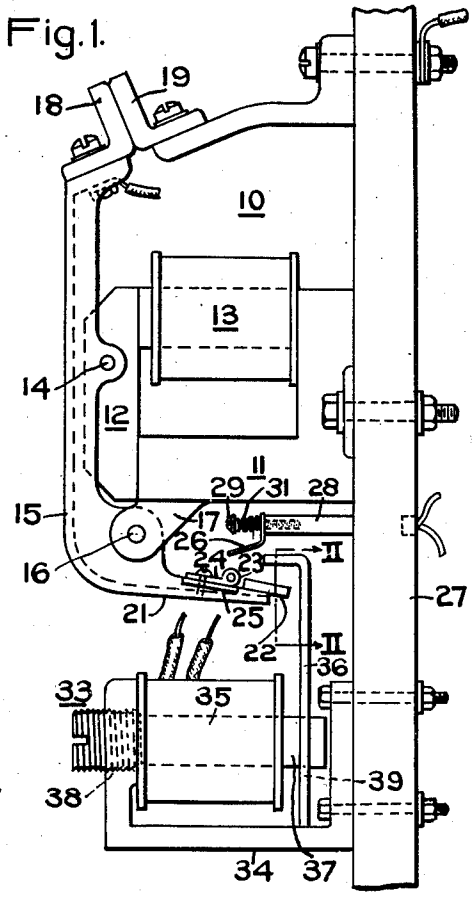


Fig. 2.

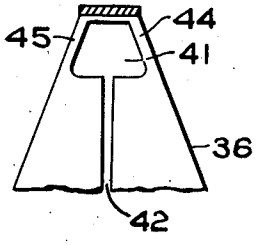


Fig. 3.

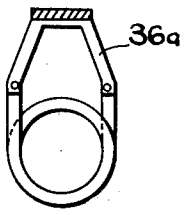
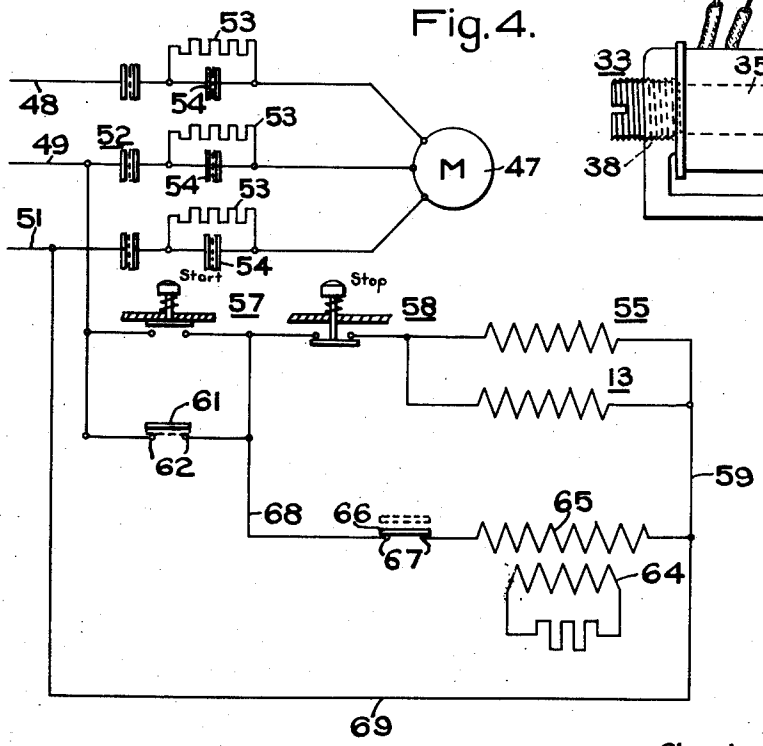


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ACCELERATING DEVICE.

Application filed June 25, 1927. Serial No. 201,524.

Our invention relates to motor control devices and particularly to devices for controlling the acceleration of motors or other electric energy translating devices.

An object of our invention is to provide a control device for controlling the acceleration of motors, or the initiation of electro-responsive devices, in accordance with a predetermined sequence of time interval, that shall be simple in construction and easily manufactured.

Another object of our invention is to provide means for accelerating or initiating devices, whereby the sequence or speed of initiation or acceleration may be adjusted to any desired value.

A further object of our invention is to provide an accelerating or initiating device that depends for its operation upon the change in magnetic permeability, affected by heat, of the element which effects the rate or speed of acceleration or initiation.

A still further object of our invention is to provide a switching device having a thermally controlled time element of operation.

In practicing our invention we provide an electro-magnetically operable switch and means for so controlling the operation thereof that the initiation or acceleration of devices controlled by the actuation of the switch from one position to another may be adjusted or regulated as desired.

For a fuller understanding of our invention reference may be had to the following description taken in conjunction with the accompanying drawings wherein,

Figure 1 is a view, in side elevation, of an electro-magnetic accelerating or initiating device embodying our invention.

Fig. 2 is a fragmentary view, partially in section, taken on line II—II of Fig. 1;

Fig. 3 is a view illustrating a modification of secondary coil shown in Figs. 1 and 2; and

Fig. 4 is a schematic illustration of circuits and apparatus embodying our invention.

Referring to the drawing, we have there illustrated our invention as applied to an alternating-current electro-magnetic switch or circuit interrupter 10 that comprises a stationary core 11 of substantially U-shape, an armature 12, and an actuating coil 13 that is supported by the upper leg of the core 11. It is to be understood that the switch 10 may be provided with single, double or a plurality of poles, as desired, depending upon the particular application to which the switch may be applied.

The armature 12 may be pivotally supported on a hinge pin 14 that is carried by a movable switch arm 15 which in turn is pivotally supported by a hinge pin 16 that passes through a lug portion 17 of the core.

The upper end of the arm 15 is provided with a contact tip 18 that has engagement with a stationary contact tip 19 when positioned as shown in Fig. 1 of the drawings.

To a rearwardly extending portion or tail piece 21 of the arm 15, a permanent magnet 22 and a contact bridging member 23 are secured for a purpose to be hereinafter set forth. The bridging member is carried by a clip 24 that may be insulated from the tail piece by a strip 25 of suitable insulating material.

It is to be understood that the permanent magnet 22 may be either in the form of a bar magnet or one of substantially U-shape, as desired.

The contact bridging member 23 cooperates with a pair of resilient spaced contacts 26 (only one of which is shown) that are located directly above the tail piece and in such position that they are engaged by the bridging member when the switch 10 is in a circuit interrupting position, that is, when the coil 13 is deenergized.

The entire switch mechanism may be supported on a base or panel 27 of insulating material in accordance with the customary practice.

The resilient contacts 26 may be yieldingly mounted on stud bolts 28 (only one of which is shown) by means of screws 29 and springs 31, the stud bolts being mounted on the base 27.

In order that the switch 10 may be held in, or restrained to, its open circuit or circuit interrupting position for a predetermined length of time after the coil 13 has been energized, an electromagnetic time delay thermal device 33 is provided. The thermal device comprises a bracket or yoke 34 (of magnetic material) of substantially U-shape, a primary induction coil 35, a secondary coil 36, and a core 37, the core being common to

both coils and extending through an opening 38 in the yoke to complete a magnetic circuit comprising the yoke and the core.

The core has screw thread engagement with the yoke in order that the reluctance of the magnetic circuit may be so varied that the amount of current induced in the secondary coil may be adjusted to any predetermined value.

The yoke, core and the induction coil may be considered as a transformer structure, which structure may be mounted on the panel 27 as shown.

The secondary coil may comprise one or more turns. When one turn is utilized, the coil may be made by a simple stamping operation from a blank of relatively thin material as shown in Figs. 1 and 2. The lower portion of the coil 36 is provided with an opening 39 through which the core 37 extends and the upper portion of the coil is provided with an opening 41, the openings being connected by a slot 42 (see Fig. 2).

The upper end of the coil 36 is bent over at an angle in order that the permanent magnet 22 will be in contact therewith when the switch is in the open circuit position. The material of which the coil 36 may be made is of such character that when normally cool it is magnetic, but when heated to a temperature of a predetermined value the material becomes non-magnetic. Thus it is evident that so long as the material, of which the coil 36 is made, is cool and magnetic the magnet will be held in engagement therewith because of the magnetic attraction therebetween, but if the coil 36 is heated to a temperature of a predetermined value, at which temperature it becomes non-magnetic, the magnet will not be held in engagement therewith by magnetic attraction.

The attraction between the permanent magnet 22 and the coil 36 when magnetic is of such value as to cause the switch 10 to remain in a circuit breaking position, even though the coil 13 has been energized but, if the coil 36 is heated to the temperature at which it becomes non-magnetic the magnetic pull of the coil 13 will cause the switch 10 to be actuated to its circuit closing position as shown in Fig. 1 of the drawings.

The coil 36 may be an alloy of approximately 35% nickel and 65% iron with minor additions of impurities. Such an alloy has the characteristic that when normally cool it is magnetic but when heated to a temperature of approximately 150° C. the material becomes non-magnetic. If the material is permitted to cool again below the temperature, the material or alloy again becomes magnetic. Because of this magnetic characteristic the alloy may be designated a reversible magnetic alloy, and the coil 36 a reversibly magnetic member.

It is to be understood that other alloys may be used but the one herein described has been found to be quite satisfactory for our present purpose.

The length of time required to heat the coil 36 by induction to a temperature of substantially 150° C. may be regulated or adjusted by the adjustable core 37, that is, the length of air gap between the right hand end of the core 37 and the yoke 34 may be varied by turning the core either in one direction or the other.

It is to be noted in Fig. 2 of the drawings that the opening 41 in the upper portion of the coil 36 is of such dimensions that the portions 44 and 45 of the coil are relatively small in section. Because of the relatively small section, the upper end of the coil 36 will be heated more intensively than the lower portion. This is desirable because only the upper portion of the coil that engages the magnet 22 need be heated to the temperature at which it will become non-magnetic.

If the secondary coil 36 comprises more than one turn, it may be constructed as shown in Fig. 3. As there illustrated, the coil comprises a plurality of turns the terminals of which are electrically connected by a member 36*a* of reversibly magnetic material. In this modification, the member 36*a* may be substantially similar to the upper portion of the coil 36 as shown in Figs. 1 and 2.

In Fig. 4 of the drawings one application of the device shown in Fig. 1 is illustrated in which the acceleration of a three phase alternating current motor 47 is controlled. The motor 47 may be connected to supply conductors 48, 49 and 51 by means of a three pole circuit interrupter 52. Between the circuit interrupter 52 and the motor 47 resistors 53 are connected in series with motor. The resistors may be short-circuited, after the circuit interrupter 52 has been closed for a predetermined length of time, by a three pole switch 54 that is similar in operation and construction to the switch 10 illustrated in Fig. 1.

The circuit interrupter 52 is provided with a closing coil 55 that is connected in parallel with the coil 13 of Fig. 1. The motor may be energized by closing a starting switch 57, upon the closing of which a circuit is established from the conductor 49 through the starting switch 57, a stopping switch 58, the coil 55, and a conductor 59 to the supply conductor 51. Since the coil 13 is connected in parallel with coil 55, the coils are energized simultaneously.

In order that the starting switch 57 may be released to the position shown in Fig. 4 and so that the coils 55 and 13 may be maintained in an energized condition, an interlock 61 is provided. The interlock may be actuated mechanically into engagement with

stationary contacts 62 the moment the switch 52 is actuated to the circuit closing position, thereby establishing a circuit around the starting switch 57 and through the coils 13 and 55.

Since coil 36 is cool and magnetic when the main circuit interrupter 52 is in a circuit closing position, the switch 10, designated by the three pole circuit interrupter 54 in Fig. 3, is prevented from closing upon the closing of the switch 52 because of the magnetic attraction between the magnet and the coil 36, until the coil 36 has been heated to its non-magnetic state. Thus, it is seen that the resistors 53 are caused to be in circuit with the motor 47 to thereby limit the initial current through the motor to a safe value until it has accelerated to a predetermined speed.

When the motor has increased in speed to such a value that the current through the motor has dropped to a reasonably small value, the coil 36 will have been heated to that temperature at which it becomes non-magnetic. When this temperature is attained the three pole circuit interrupter 54 is actuated to a circuit closing position, thereby shunting the resistors 53 out of the motor circuit and causing full voltage to be applied to the motor 47, which is the desired operating voltage of the motor.

The coil 36 is designated schematically in Fig. 3 by a coil 64, the coil 35 by a coil 65, the contact bridging member 53 by a bridging member 66 and the resilient contacts 26 by contacts 67.

When the starting switch 57 has been closed to complete the energizing circuit of the coils 13, and 15, and the interlock 61 has been actuated to a circuit closing position, the coil 65 will have been energized, the energizing circuit being from the supply conductor 49 through the interlock 61, conductor 68, contact bridging member 66, the coil 65 and a conductor 69 to the conductor 51. When the coil 65 is energized, the coil 64 will have a current induced therein, which will cause the same to be heated to the temperature at which it becomes non-magnetic at which temperature the coil 13 will be effective to cause the contact bridging member 66 (contact bridging member 23 in Fig. 1) to be actuated to its circuit interrupting position to effect deenergization of the coil 65. Thus, it is seen that the coil 64, having been deenergized by the deenergization of the coil 65, will be permitted to cool to the temperature at which it becomes magnetic so that the accelerating or initiating switch 10 may again be ready for operation.

Various modifications may be made in the device embodying our invention without departing from the spirit and the scope thereof. We desire therefore that only such limitations shall be placed thereon as are imposed by the prior art and the appended claims.

We claim as our invention:

1. In combination, a switch, an electromagnet coil for actuating said switch from one position to another, a permanent magnet carried by said switch, a reversibly-magnetic member for maintaining said switch in one position, when normally cool, against the magnetic pull of said electromagnet coil and for releasing said switch when said magnetic member has been heated to a temperature of a predetermined value, means energized substantially simultaneously with the energization of said coil for heating said magnetic member by electromagnetic induction, and means for varying the rate of heating of said member.

2. In combination, a switch, an electromagnet coil for actuating said switch from one position to another, a permanent magnet carried by said switch, a reversibly magnetic member for maintaining said switch in one position, when normally cool, against the magnetic pull of said electromagnet coil and for releasing said switch when said magnetic member has been heated to a temperature of a predetermined value, and means for heating the magnetic member by transformer action, said means comprising a primary coil and a core, said core being common to said primary coil and magnetic member.

3. In combination, a switch, an electromagnet coil for actuating said switch from one position to another, a permanent magnet carried by said switch, a reversibly magnetic member for maintaining said switch in one position, when normally cool, against the magnetic pull of said electromagnet coil and for releasing said switch when said magnetic member has been heated to a temperature of a predetermined value, and means for heating the magnetic member by transformer action, said means comprising a primary coil, a core, said core being common to said primary coil and magnetic member, and means for varying the reluctance of said core, whereby the rate of heating of said reversibly magnetic member may be adjusted to any predetermined value.

4. In combination, a switch, an electromagnet coil for actuating said switch from one position to another, a permanent magnet carried by said switch, a reversibly magnetic member for maintaining said switch in one position, when normally cool, against the magnetic pull of said electromagnet coil and for releasing said switch when said magnetic member has been heated to a temperature of a predetermined value, means energized substantially simultaneously with the energization of said coil for heating said magnetic member of electromagnetic induction, and means for effecting deenergization of said electromagnetic induction means upon the

actuation of said switch from its restrained position to another position, whereby cooling of said reversibly magnetic member to a temperature at which it becomes magnetic is effected.

5. An electromagnetic thermal time-delay device for delaying the actuation of a circuit interrupter from one position to another, said device comprising an induction coil and a short circuited coil of reversibly magnetic material inductively coupled thereto, said reversibly magnetic member being magnetic when normally cool and non-magnetic when heated to a temperature of a predetermined value.

6. An electromagnetic thermal time-delay device for delaying the actuation of a circuit interrupter from one position to another, said device comprising an induction coil, a short circuited coil of reversibly magnetic material inductively coupled thereto, said reversibly magnetic material being magnetic when normally cool and non-magnetic when heated to a temperature of a predetermined value, and means for varying the reluctance of said magnetic circuit whereby the rate of heating said magnetic reversible material may be adjusted to a predetermined value.

7. The combination with a circuit interrupter, and a magnet coil for actuating said circuit interrupter from one circuit controlling position to another, of electromagnetic time-delay thermal means for delaying the actuation of said circuit interrupter from one position to another for a predetermined length of time after the energization of said magnet coil, said means comprising a permanent magnet carried by said interrupter, a reversibly magnetic member engaging said magnet for restraining the interrupter from movement when normally cool but for releasing the same when heated to a temperature of a predetermined value, and an induction coil inductively coupled to said reversibly magnetic member for causing the same to be heated to said temperature.

8. In combination, a switch, a closing coil therefor, and means for delaying the closing of said switch for a predetermined length of time after the energization of said closing coil, said means comprising a reversibly magnetic member, a permanent magnet for holding said switch in one position by the magnetic attraction between said reversibly magnetic member and the permanent magnet, said reversibly magnetic member being magnetic when normally cool and non-magnetic when heated to a temperature of a predetermined value, and an induction coil for inducing an electric current in said reversibly magnetic member by induction whereby said reversibly magnetic member is heated to a temperature at which it becomes non-magnetic.

9. In combination, a switch, a closing coil therefor, and means for delaying the closing of said switch for a predetermined length of time after the energization of said closing coil, said means comprising a reversibly magnetic member, a permanent magnet for holding said switch in one position by the magnetic attraction between said reversibly magnetic member and the permanent magnet, said reversibly magnetic member being magnetic when normally cool and non-magnetic when heating to a temperature of a predetermined value, an induction coil for inducing an electric current in said reversibly magnetic member by induction whereby said reversibly magnetic member is heated to a temperature at which it becomes non-magnetic and means for varying the amount of current induced in said reversibly magnetic member.

10. In combination, a switch, a closing coil therefor, and means for delaying the closing of said switch for a predetermined length of time after the energization of said closing coil, said means comprising a reversibly magnetic member, a permanent magnet for holding said switch in one position by the magnetic attraction between said reversibly magnetic member and the perpermanent magnet, said reversibly magnetic member being magnetic when normally cool and non-magnetic when heated to a temperature of a predominated value, an induction coil for inducing an electric current in said reversibly magnetic member by induction whereby said reversibly magnetic member is heated to a temperature at which it becomes non-magnetic, and means for deenergizing said induction coil subsequently to the heating of said reversibly magnetic member to the temperature at which it becomes non-magnetic.

In testimony whereof, we have hereunto subscribed our names this 21st day of June, 1927.

EDWARD M. CLAYTOR.
CHARLES H. HODGKINS.