

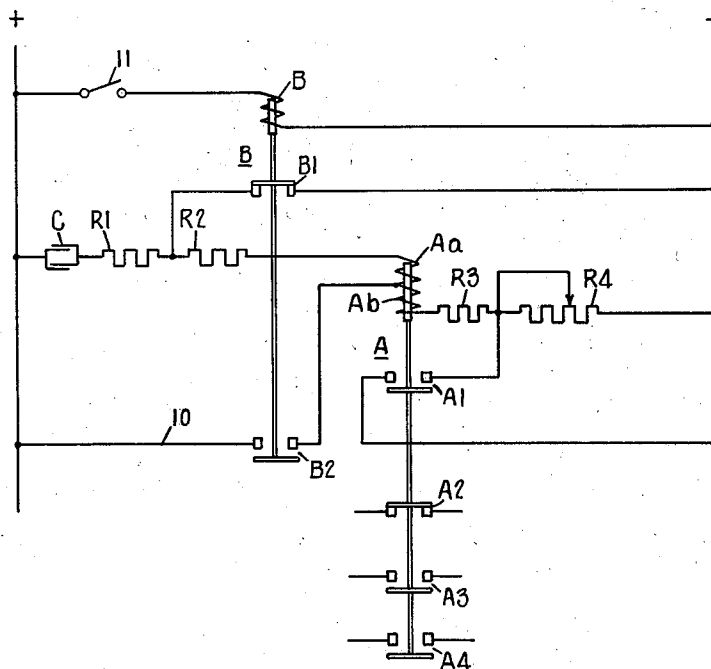
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TIMING OF ELECTROMAGNETIC SWITCHES

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TIMING OF ELECTROMAGNETIC SWITCHES

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The invention relates to the timing of electromagnetic switches.

There are various direct current control circuits for electromagnetic switches in which condensers are utilized for timing the operation of the switches. In some arrangements the condensers are utilized to time the going in of the switch, in others the dropping out of the switch and in still others to time both the going in and dropping out of the switch. It is important not only that accurate and uniform timing be obtained but also that the cost of various items employed be kept at a minimum. Paper condensers are relatively expensive while electrolytic condensers are unreliable in timing under conditions when the length of time that the condenser is discharged is considerable and varies.

One feature of the invention resides in a timing arrangement in which the parts are simple and inexpensive.

Another feature of the invention resides in the provision of a timing circuit for an electromagnetic switch in which accurate and uniform timing may be obtained utilizing an electrolytic condenser.

Other features and advantages of the invention will become apparent from the following description and appended claims.

In carrying out the invention according to the arrangement which will be described, the timing condenser is in a charged state when the electromagnetic switch controlled thereby is not operated. To operate the switch, a circuit is completed to cause a magnetizing force to be exerted for operating the switch. At the same time, the condenser is connected to cause by its discharge a magnetizing force to be exerted to delay the operation of the switch. In the case of certain types of switches, a resistance may be provided which is short circuited when the switch contacts engage to increase the operating magnetizing force to pull the switch to full operated position. This enables a smaller condenser to be utilized with such switch to obtain the desired timing. In dropping out the switch, the condenser may be recharged by a circuit which causes sufficient magnetizing force to be exerted to maintain the switch operated until the charging current decreases to a certain value. If desired, the condenser may be recharged without affecting the operation of the switch, in which event the switch is dropped out immediately and the charging is effected quickly in preparation for a subsequent operation.

The single figure of drawing is a wiring dia-

gram of a simple circuit illustrating the control of a switch in accordance with the invention.

The switch to be controlled is designated A. The coil of this switch is connected in series with condenser C across the supply lines + and -. This coil is tapped to provide two portions designated Aa and Ab. An electromagnetic switch B is provided for connecting the portion Ab of the switch coil across the supply lines by a circuit 10 which also connects the condenser C across the portion Aa of the coil. The construction of the switch is such that the portion Ab alone when connected across the supply lines is capable of operating the switch. For convenience the coil of switch B is illustrated as controlled by manually operable switch 11. Resistance R1 is a protective resistance for the condenser. Resistance R2 is to facilitate obtaining the desired ampere turns of coil portion Aa. Resistance R3 serves to facilitate providing the desired number of ampere turns of coil portion Ab without undue heating. Resistance R4 is for adjusting the time of operation. It is preferred to employ a separate protective resistance R1 especially where several condensers are employed in parallel as this permits each condenser to have its own protective resistance. However, where only one condenser is utilized as illustrated, resistance R1 may be omitted and the right hand side of contacts B1 connected between the coil of switch A and resistance R3, thereby utilizing resistance R3 also as a protective resistance.

With switch B deenergized, the condenser is charged with the voltage of the supply lines while the voltage applied to the coil of switch A is zero. To operate switch A, manual switch 11 is closed causing the energization of the coil of switch B. Switch B operates to separate contacts B1, breaking the shunt circuit for the coil of switch A and resistances R2, R3 and R4. It also engages contacts B2 which connect portion Ab of the coil of switch A across the supply lines in circuit with resistances R3 and R4. The closing of these contacts also connects the condenser C in series with resistances R1 and R2 across the portion Aa of the coil of switch A. Thus condenser C discharges into the portion Aa of the coil of switch A with the current flowing in a direction to cause the magnetizing force due to portion Aa of the coil to oppose the magnetizing force due to portion Ab of the coil. This prevents the immediate operation of the switch. The condenser discharges until a point is reached where the magnetizing force of coil portion Aa becomes low enough to permit coil portion Ab to operate the

switch. The rate at which the condenser discharges is determined by the capacity of the condenser and the value of resistance R2 and the resistance of portion Aa of the coil of the switch, resistance R1 being of a relatively low value. The ampere turns of the portions of the coil of switch A, the capacity of the condenser and the value of resistance R2 and the resistance of coil portion Aa are so coordinated and the value of resistance R4 is so adjusted as to cause the switch to operate at the expiration of the desired time interval. With a given rate of discharge of the condenser, the time of operation of the switch may be adjusted by adjusting the value of resistance R4.

When switch A operates it engages contacts A1 to short circuit resistance R4. This arrangement is particularly desirable where switch A is a power switch, as for example having contacts in the lines from a power supply to a motor. Such contacts have strong contact springs which after the contacts engage must be compressed as the switch is pulled all the way in. This requires a larger number of ampere turns in the coil portion Ab. By utilizing auxiliary contacts A1 of the switch to short circuit resistance R4 at the time the contacts engage, the current is increased in coil portion Ab to a point sufficient to pull the switch into fully operated position against the contact springs. A given size condenser may be utilized to provide the same time of operation of a switch with heavy contact springs where contacts A1 are utilized as of a switch without such springs and without utilizing contacts A1. Thus, contacts A1 may be omitted where the switch does not have to pull all the way home against relatively strong contact springs.

To drop out switch A, switch B is opened causing the deenergization of switch B. Switch B upon dropping out separates contacts B2 to break circuit 10, disconnecting coil portion Ab of switch A from the + line and opening the bypass for the condenser and coil portion Aa. Switch B also reengages contacts B1 which connects the condenser directly to the supply lines through resistance R1. Thus condenser C recharges immediately and there is no tendency for coil of switch A to hold the switch in operated condition. Therefore, switch A drops out immediately.

If it be desired to delay the dropping out of switch A, the circuit through contacts B1 is omitted in which event, upon the dropping out of switch B, the condenser recharges through the coil of switch A. Thus the resistance of the coil of switch A, resistance R2 and also resistance R4, where contacts A1 are not provided, delay the charging of the condenser so that sufficient current flows through the coil of switch A to maintain the switch operated. As soon as the condenser charges to a certain point this current flow is no longer sufficient to hold switch A operated and it drops out.

The above described arrangement is especially suitable for controlling the operation of accelerating switches, say for an elevator hoisting motor. In such case switch B might be a switch which operates to connect the motor to the supply lines or operates the same time such connection is effected, whereas switch A might be the first accelerating switch. In such event contacts A2 and A3 may be utilized to control the operation of a second accelerating switch in the same manner as contacts B1 and B2 respectively of switch B control the operation of switch A. Con-

tacts A4 would then be utilized to control a work circuit such as effecting the short circuiting of a resistance step in circuit with the motor. It is to be understood that the application of the above arrangement to controlling the operation of one or more accelerating switches is only illustrative and that the arrangement may be utilized for various other purposes.

It is seen therefore that the timing of the operation of a switch is controlled in a very simple and reliable manner by the discharge of a condenser to create a magnetizing force in opposition to the operating magnetizing force. Also a very simple and reliable control of the timing of the dropping out of a switch is effected by utilizing the charging of the condenser to maintain the switch in operated condition. By proper design of the portions of coil of switch A, resistances R2 and R3 may be omitted. Also the coil portions Aa and Ab of switch A may be separate coils instead of part of a single coil. The control is particularly suitable for electrolytic condensers as the condenser is in a charged state when the switch is not operated. However, other types of condensers may be used if expedient.

It is to be understood that in applying the invention to various control systems, changes may be made with a view to adapting the invention more readily to such systems. Other changes may also be made which do not depart from the spirit and scope of the invention. It is therefore intended that all matter contained in the above description and shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An electromagnetic switch having two coil portions, a condenser, means including a direct current source of supply for causing said condenser to be in a charged state and both coil portions deenergized when the switch is not operated, and means for causing excitation of one of said coil portions sufficient to operate said switch and for connecting said condenser across the other coil portion to cause through the discharge of the condenser excitation of said other coil portion so as to delay the operation of the switch.

2. An electromagnetic switch having two coil portions, a condenser, means including a direct current source of supply for causing said condenser to be in a charged state when the switch is not operated, and means for causing excitation of one of said coil portions sufficient to operate said switch and for at the same time connecting said condenser across the other of said coil portions to cause through the discharge of the condenser a magnetizing force to be exerted by said other coil portion in opposition to the magnetizing force exerted by said one coil portion sufficient to delay the operation of the switch until the condenser discharges to a certain voltage.

3. An electromagnetic switch having two coil portions, a source of direct current, a condenser connected to said source so as to be in a charged state when the switch is not operated, and means for connecting to said source one of said coil portions to cause sufficient magnetizing force to be exerted thereby for operating said switch and for at the same time connecting said condenser across the other of said coil portions to cause through the discharge of the condenser magnetizing force to be exerted by said other coil portion in opposition to the magnetizing force exerted by said one coil portion to delay the operation of the switch.

4. An electromagnetic switch having two coil portions, a source of direct current, a condenser connected to said source in series with said coil portions, and means for connecting one of said coil portions to said source through a circuit by-passing said condenser and the other of said coil portions to cause the operation of said switch by said one coil portion after a delay due to the magnetizing force exerted by said other coil portion by the discharge of the condenser therethrough being in opposition to the magnetizing force exerted by said one coil portion.

5. An electromagnetic switch having two coil portions, a source of direct current, a condenser connected to said source so as to be in a charged state when the switch is not operated, means for connecting to said source one of said coil portions to cause magnetizing force to be exerted by said coil portion sufficient to operate said switch and for at the same time connecting said condenser across the other of said coil portions to cause through the discharge of said condenser magnetizing force to be exerted by said other coil portion in opposition to the magnetizing force exerted by said one coil portion to delay the operation of the switch, and a variable resistance in series with said one coil portion for adjusting the time delay of said switch.

6. An electromagnetic switch having a coil, a source of direct current, a condenser connected to said source in series with said coil, and means for connecting a portion of said coil to said source through a circuit by-passing said condenser to cause said coil portion to exert magnetizing force sufficient to operate said switch, said by-pass circuit providing a discharge path for said condenser through the remainder of said coil to cause said coil remainder to exert magnetizing force in opposition to the magnetizing force exerted by said portion of said coil to delay the operation of the switch until the opposing magnetizing force decreases due to the discharge of the condenser to a point where the net magnetizing force is sufficient to operate the switch.

7. An electromagnetic switch having a coil, a source of direct current, a condenser connected to said source in series with said coil, a circuit shunting said coil when the switch is not operated, and means for breaking said shunt circuit and for connecting said condenser across a certain portion of said coil to cause through the discharge of the condenser therethrough a magnetizing force to be exerted by said certain portion of said coil in opposition to the magnetizing force exerted by said remaining portion of said coil sufficient to delay the operation of the switch until the condenser discharges to a certain voltage.

8. An electromagnetic switch having a coil, a source of direct current, a condenser connected to said source in series with said coil, means for connecting a portion of said coil to said source through a circuit by-passing said condenser to cause said coil portion to exert magnetizing force sufficient to operate said switch, said by-pass circuit providing a discharge path for said condenser into the remainder of said coil to cause said coil remainder to exert a magnetizing force in opposition to the magnetizing force exerted by said portion of said coil sufficient to delay the operation of the switch until the condenser discharges to a certain voltage, and means for shunting said coil to cause the dropping out of said switch and the quick recharge of the condenser.

9. An electromagnetic switch having a coil, a source of direct current, a condenser connected in series with said coil to said source so as to be charged to the voltage of said source, and means for closing a circuit which connects a portion of said coil to said source, said coil portion when so connected exerting sufficient magnetizing force to operate said switch, and which also connects said condenser across the remainder of said coil to cause said coil remainder to exert magnetizing force in opposition to that of said coil portion to delay the operation of said switch.

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