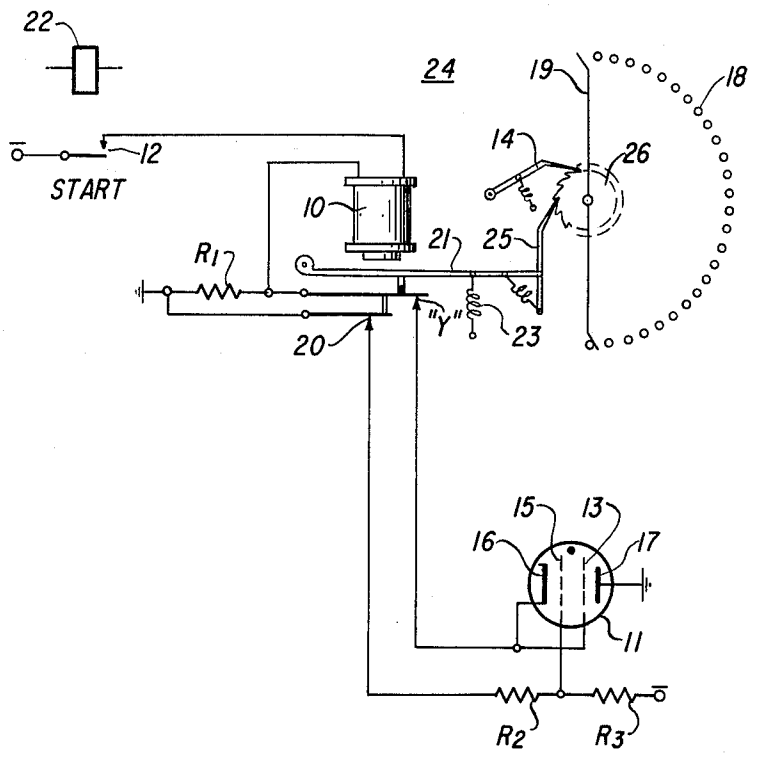
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FULL STROKE ENERGIZED ROTARY MAGNET

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FULL STROKE ENERGIZED ROTARY MAGNET

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This invention relates to an interrupter arrangement for an electromagnetic device, and more particularly, to an improved circuit for controlling the interrupting action of a stepping switch, for example, of the type used in telephone switching systems.

One of the objects of this invention is to insure completion of both the operating and release strokes of the armature of an electromagnetic device.

More specifically, an object of this invention is to keep the magnet of an electromagnetic device, such as that of a stepping switch, energized through most of the operating stroke of the armature, while maintaining the magnet de-energized through most of the release stroke.

Another object of this invention is to provide a novel interrupter circuit for a stepping switch which will be simple and inexpensive to manufacture.

Generally speaking, the principal feature of the invention is the utilization, for the control of the magnet of an electromagnetic device such as a stepping switch, of a bistable electronic switching means whose state is in turn controlled by contacts of the magnet.

Briefly, the embodiment of the invention described herein comprises a stepping switch having bank contacts, wipers, a motor magnet with an armature having self-interrupter contacts, and a linkage for stepping the wipers over the bank contacts. A thyratron tube is used in combination with the stepping switch to provide a bistable switching means for controlling the operation of the motor magnet. The thyratron tube is controlled by the self-interrupter contacts of the armature in such a way that this tube keeps the motor magnet energized throughout virtually all of its operating stroke and de-energized throughout virtually all of its release stroke.

Although a preferred embodiment of the invention is herein disclosed and discussed, it is to be understood that this invention is not limited to this embodiment, but may easily be adapted to other uses either in its present form or by slight alterations.

The single FIGURE of the drawing shows this preferred form of the invention. Referring to the figure, the arrangement disclosed consists of a stepping switch 24 having a contact bank 18, wipers 19 to engage the contacts of this bank, and a motor magnet 10 having an armature 21. A start contact 12 is interposed between one terminal of the motor magnet and battery and operated by start relay 22. Break contacts 20 and "Y" are operated by the armature, and the armature actuates a stepping mechanism to step the wipers responsive to the armature movement. This stepping mechanism comprises a ratchet wheel 26, a pawl 25 engaging said ratchet wheel, an armature spring 23, and a detent 14 to prevent wiper rotation in the reverse direction. The stepping switch may be either of the "direct-stepping" or the "indirect-stepping" type, both of these types being well known in the art. The arrangement also includes a thyratron tube 11 having a cathode 16 serially connected with the "Y" contact and the motor magnet, an anode 17 connected to ground, a control grid 15 connected to contact 20 through a resistor R_2 and connected to negative battery through a resistor R_3, and an optional shield grid 13 connected to the cathode lead. A resistor R_1, placed between ground and the other terminal of the motor magnet allows the motor magnet to be pre-energized when start contact 12 is closed.

Contact 20 is adjusted so as to open shortly after the beginning of the operating stroke, and consequently this contact recloses shortly before completion of the return stroke. Contact "Y" is adjusted to open near completion of the operating stroke and hence recloses shortly after the beginning of the return stroke.

Thyratron tube 11 "fires" or begins conducting only when both contacts are closed. Due to the above adjustments of contacts 20 and "Y," this condition is met once each cycle shortly before completion of the release stroke. Once "fired" tube 11 will continue to conduct as long as the "Y" contact remains closed, that is, tube 11 will be extinguished shortly before the end of the operating stroke.

Now a relationship between the operation of tube 11 and the function of the stepping switch can be established. In the normal state of the system, magnet 10 is in the un-operated condition and contacts "Y" and 20 are closed. Start relay 22 is operated by known methods (such as a line relay in a telephone subscriber's circuit) to close start contact 12. When closed, start contact 12 completes the pre-energizing circuit for magnet 10 extending through resistor R_1 to ground, the current flowing in the circuit, however, being insufficient to cause the operation of magnet 10. Closure of start contact 12 also extends battery through the winding of motor magnet 10, through the "Y" contact, hence to cathode 16. Control grid 15 normally has a relatively positive bias while anode 17 is connected to ground. In this condition, ionization occurs causing the gas discharge tube 11 to "fire" or begin conducting.

It will be seen from the drawing that the main conducting path including cathode 16 and anode 17 extends serially both through contact "Y" and through magnet 10 to battery. Thus motor magnet 10 is now sufficiently energized through this path to attract its armature. Contact 20 breaks as the armature starts its operating stroke, biasing control grid 15 negative. The negative bias on control grid 15 has no effect at this time however. The "Y" contact breaks shortly before completion of the operating stroke, removing battery from cathode 16. As a result, tube 11 de-ionizes, opening the last-mentioned circuit, thus substantially de-energizing the motor magnet.

The armature now starts its release stroke and the "Y" contact immediately recloses. Since the control grid 15 remains biased negative by open contact 20, the tube will not conduct and motor magnet 10 will remain substantially de-energized throughout most of the release stroke. Contact 20 recloses shortly before completion of the release stroke, biasing the control grid 15 positive.

At this time control grid 15 has a positive bias and battery has previously been extended to cathode 16 by the closing of the "Y" contact. Thus, ionization again occurs and tube 11 "fires," reoperating the motor magnet 10 and starting the armature on its operating stroke again. This cycle will repeat itself until the circuit is opened by known methods at start contact 12. On each cycle stepping switch 24 takes one step under the control of the stepping mechanism in the well-known manner.

It should be noted that in the disclosed embodiment, a gas discharge tube is used in combination with the self-interrupter contacts on the armature of a motor magnet to control the energization of this magnet. This type of control achieves nearly instantaneous response of the motor magnet to its control contacts 20 and "Y." More particularly, there is no time lag between closing the circuit to "fire" the gas discharge tube near the end of the release stroke and energization of the motor magnet. There is also no time lag between opening the circuit near the end of the operating stroke and the extinguishing of the tube and de-energizing of the magnet. In this manner, completion of both the operating and release strokes of the armature and hence completion of each

step of the stepping mechanism of the switch is fully insured.

What is claimed is:

1. In combination with an electromagnetic device having a magnet, an armature actuated by said magnet and first and second contacts controlled by said armature: a self interrupting arrangement for said magnet insuring completion of both the operating and release stroke of said armature, said arrangement comprising a source of potential, a bistable switching means having a control electrode, output electrodes, and a circuit including said output electrodes, said magnet, and said second contact, said first contact being arranged to operate near the end of said release stroke to connect said control electrode to said potential, said bistable switching means being switched to one of its states in response to the last mentioned connection to cause said magnet to be energized under the control of said output electrodes, and said second contact being arranged to operate near the end of the operating stroke of said device to switch said switching means to its other state and de-energize said magnet.

2. The combination as claimed in claim 1, wherein said electromagnetic device is the motor magnet of a stepping switch, said stepping switch comprising: a plurality of bank contacts; movably mounted wipers for engaging said

bank contacts; and a stepping mechanism linked to said armature for stepping said wipers over said bank contacts.

3. The combination as claimed in claim 1, wherein said bistable switching means is a thyratron tube.

4. The combination as claimed in claim 3, wherein said thyratron tube is fired responsive to said first contact impressing said source of potential on said control electrode, and wherein said second contact is a break contact serially interposed in said output circuit, said contact being opened near the end of said operating stroke of said device to extinguish said thyratron tube and de-energize said magnet.

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