

[54] **STEPPING SWITCH SYSTEM**

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[58] Field of Search 307/41, 141, 141.4; 317/139, 317/141

[56] **References Cited**

UNITED STATES PATENTS

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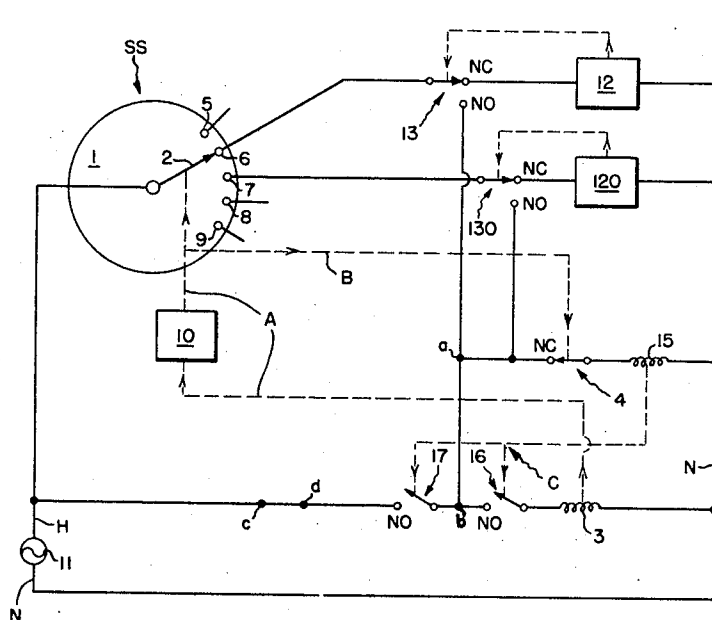
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[57] **ABSTRACT**

A stepping switch has loads connected to its fixed contacts via limit switches. The loads are energized sequentially as the movable contact of the stepping switch is stepped from fixed contact to fixed contact, dwelling on each fixed contact until the corresponding limit switch is actuated to produce an electrical pulse. Such pulse energizes a stretcher relay coil which both establishes a circuit which independently of the limit switches and the stepping switch contacts, keeps it energized and energizes the step coil of the stepping switch. The stretcher relay coil is energized through a normally-closed snap switch which opens temporarily at the end of a step, and de-energizes the stretcher relay coil which, in turn opens the aforesaid circuit, whereby to de-energize both the step coil and itself.

7 Claims, 2 Drawing Figures



STEPPING SWITCH SYSTEM

FIELD OF THE INVENTION

Sequentially, electrically-energizing loads from the fixed contacts of a stepping switch.

DESCRIPTION OF THE PRIOR ART

A typical prior art stepping switch has a mechanism energized by the magnetic force created by electrical energizing the stepping switch's step coil. The mechanism cannot be expected to step properly unless the pulse is suitable. The pulse can be unsuitable because of inadequate duration and/or magnitude. Depending on the exact nature of the mechanism, an unsuitable pulse can cause the stepping switch to make more than one step, or not to step at all. More particularly, the energization of the step coil depends on contact between the movable contact and the fixed contact to be stepped from, and also on the ability of the limit switch connected to the last said contact to produce a suitable pulse.

SUMMARY OF THE INVENTION

According to the present invention, the pulse from the limit switch is applied to energize the coil of a stretcher relay, whereby to energize the step coil independently of the stepping switch and limit switch. Completion of a step deenergizes the stretcher relay coil. At this point the movable contact of the stepping switch is at the next fixed contact and energizing a load through the corresponding limit switch, which must be made to produce a pulse before the stepping switch can step again.

In a preferred embodiment, a conventional snap switch on the stepping switch de-energizes the stretcher coil at the end of a step. Also, the initial energization of the stretcher relay coil establishes a circuit which, as well as energizing the step coil, keeps the stretcher relay coil energized, independently of the limit switch, said circuit being broken by the snap switch, at the end of a step.

The stepping switch, fitted out with stretcher relay according to the invention finds particular use where a number of loads are to be energized sequentially according to a predetermined sequence of events, time program, or the like. In systems of this sort, wherein the sequence of energization is often planned so that the loads cooperate with each other, in some way, as in automatic sterilizing systems, or other automated systems of handling and/or treating objects or materials, faulty stepping can cause the system to improperly treat or handle such material or objects. With the present invention, the stepping switch operates with practically perfect reliability.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic representation of a stepping switch system according to the invention, and

FIG. 2 shows a modification of such system, and is like FIG. 1, except only so much of the system is shown as to indicate how the modification applies to the system shown in FIG. 1. The designations NO and NC, as is conventional, identify normally-open and normally-closed contacts, respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, a stepping switch SS is shown in the common form having a circular, fixed disk 1, a rotatably-movable contact 2, a step coil 3, a normally-closed snap switch 4, a plurality of fixed contacts 5 through 9 (there may be more or fewer, of course), and stepping mechanism 10. While the style of the drawing does not show it, the enumerated structure is conventionally available, off-the-shelf, in a compact, mechanically-integrated assembly. Dashed-line A represents the usual functional interconnections of coil 3, mechanism 10 and contact 2, whereby mechanism 10 responds to the magnetic field, created by energizing coil 3, by moving contact 2 from one contact to the next, provide coil 3 be energized by a suitable pulse. Dashed-line B represents the functional interconnection between mechanism 10 and snap-switch 4, whereby at the end of the step, normally-closed switch 4 is opened temporarily. Conventionally, the snap switch is a standard option for making the stepping switch self stepping, and both interconnections are conventional in this respect. However, as will shortly be seen, snap switch 4 has a somewhat different purpose in the present invention.

Source 11 (110 volt AC "house current," say) has its hot wire H connected to the movable contact 1, and its neutral wire N connected to, among other things, the right hand ends of step coil 3 and loads 12 and 120. The left hand ends of loads 12 and 120 are connected, via respective limit switches 13 and 130, to terminals 6 and 7 of stepping switch SS.

In prior art systems, the normally-open contacts of the limit switches would all be at the left hand of coil 3, electrically speaking. The idea was to energize load 120, instead of load 12 by closing the normally-open contacts of switch 13, thereby to energize coil 3 from source 1, via the stepping switch contacts 2 and 6. As will be seen from the drawing, obtaining an adequate stepping pulse this way depends on contact 2 remaining in contact with contact 6, and the normally-open contacts of switch 13 remaining closed. In practice, such dependence leads to step failure, due to inadequate step pulses. According to the invention, such dependence is substantially eliminated and substantially perfect reliability of stepping is assured, by providing a stretcher relay comprising coil 15 and normally-open contacts 16 and 17, with coil 15 being connected at its left-hand end to the normally-open contacts of the limit switches, via snap switch 4, and its right-hand end being connected to the neutral wire N. It will be seen, therefore, that coil 15 will be energized through limit switch 13 and the contacts 2 and 6 of the stepping switch if the normally-open contacts of the limit switch 13 be closed.

When coil 15 is energized it will close its normally-open contacts 16 and 17. When these close, it will be seen from FIG. 1 that the hot wire H will be connected to the left-hand ends of coils 3 and 15 independently of the stepping switch contacts 2 and 6, and the normally-open contacts of limit switch 13. Coil 15 now holds itself closed, and, as well, maintains coil 3 energized, without regard to the state of limit switch 13 and of contact between contacts 2 and 6.

Accordingly, it is now assured that coil 3 will be energized adequately enough to make mechanism 10 move contact 2 a complete step, namely, into contact with contact 7, and out of contact with contact 6.

When the contact 2 completes such step, snap switch 4 will be mechanically actuated to open temporarily, thereby breaking the connection of coil 15 to the hot wire H, so that coil 15 deenergizes, causing its contacts 16 and 17 to resume their normally-open state. Consequently, all the contacts in FIG. 1 now are back in the positions shown, except that contact 2 is contacting contact 7, so that now load 120, but not load 12, is being energized.

If there is a load and limit switch circuit connected to contact 8 (and in practice, there usually will be more than two loads in the system), closing the normally-open contacts of switch 130 will step contact 2 to contact 8, just as closing the normally-open contacts of limit switch 13 stepped contact 2 to contact 7.

FIG. 2 shows a modification of FIG. 1, as to the connection of the stretcher relay. The modification consists of breaking the connections between points *a* and *b*, and between points *c* and *d*; and of connecting point *b* to point *c*, and point *a* to point *d*. Such modification does not make any change in the above described mode of operation.

While in the disclosed embodiment, the stretcher relay has been indicated to be of the type having magnetically-operated moving contacts, solid-state versions thereof, e.g., so-called transistorized switches, may be substituted therefore, and I consider such substitution to fall with the scope of the invention as claimed herein.

Other modifications may be made such as step skipping, since like conventional self-stepping systems, if contact 2 steps to a fixed contact having a complete connection via switch 4 to coil 15, the described stepping action will begin as soon as snap switch 4 recloses.

By way of example, the foregoing invention has been successfully practiced with MER type stepping switches manufactured by the Guardian Electric Manufacturing Company of Chicago, Illinois. For a full description of this sort of stepping switch, see U.S. Patent to Baker et al. U.S. Pat. No. 2,315,920.

The basic qualification possessed by the stretcher relay, for purposes of the present invention, is that it is sufficiently sensitive that the least-adequate pulse to be expected from the limit switches would energize its coil 15 sufficiently that its contacts 16 and 17 would close. As compared to the energization requirement of coil 3, the energization requirement of coil 15 is in no way difficult to satisfy.

The limit switches operated in response to conditions in the loads, such as temperature, and the like. For example, suppose load 12 to have been apparatus, energization of which increased temperature therein. Then, when said temperature attained a given value, a temperature sensing device (not shown) responded thereto to close the normally-open contacts of limit switch 13, thereby stepping the contact 2 to contact 6. Other modes of operating the limiting switches, such as timers, will be evident to those skilled in the art.

Having described my invention as required by 35USC114, I claim:

1. The combination of a stretcher relay with a stepping switch,

said stepping switch having fixed contacts, a movable contact, mechanism for moving said movable contact from fixed contact to fixed contact, a stepping coil for causing said mechanism to so move said movable contact, and a normally-closed snap switch adapted to automatically open, temporarily, upon completion of movement of said movable contact from any said fixed contact to the next said fixed contact;

said stretcher relay having normally-open contact means and a coil energizable to close said normally-open contact means;

said stepping switch having a circuit for connecting an electrical energy source to the last said coil both via said contacts of said stepping switch and independently of the last-said contacts, but in both cases via said snap switch, said circuit including said normally-open contact means connected between said source and said snap switch, said circuit also connecting said step coil to said source independently of the said last-said contacts, but via said normally-open contact means.

2. The combination of claim 1, wherein said normally-open contact means includes first normally-open contacts and second normally-open contacts connected in series with each other and between said source and said step coil, said snap switch connecting said coil of said stretcher relay to the connection between said first and second normally-open contacts.

3. A stepping switch system having fixed contacts, a movable contact, and a normally-closed snap switch connectible to each said fixed contact sequentially; said system having a first coil energizable from said fixed contacts via said snap switch, and having normally-open contact means closeable by said first coil, when said first coil is energized, for energizing said first coil independently of said fixed contacts but via said snap switch;

said system having a second coil energizable via said normally-open contact means, when said normally-open contact means is closed, but independently of said fixed contacts, for causing said movable contact to move to a said fixed contact, and said system having means for temporarily opening said snap switch in response to said movable contact reaching the last said fixed contact.

4. The stepping switch system of claim 3, wherein said normally-open contact means includes first normally-open contacts connected to said snap switch and closeable to energize said first coil independently of said fixed contacts, and also includes second normally-open contacts connected between said first normally-open contacts and said second coil, said first and second normally-open contacts closing in response to said first coil being energized from any of said fixed contacts.

5. The stepping switch system of claim 4, wherein normally-open switch means interconnects said fixed contacts and said snap switch for energizing said first coil from said fixed contacts and via said snap switch.

6. The stepping switch system of claim 3, wherein normally-open switch means interconnects said fixed contacts and said snap switch for energizing said first coil from said fixed contacts and via said snap switch.

7. A stepping switch system having a movable contact, fixed contacts, mechanism for stepwise moving said movable contact from fixed contact to fixed contact, and first coil means being pulse-energizable for causing said mechanism to so move said movable contact;

said system also having second coil means, normally closed snap switch means, and limit switch means, said limit switch means having normally-closed contacts for connecting loads to said fixed contacts, and said limit switch means having normally-open contacts connecting said second coil means to said fixed contacts;

said second coil means having normally-open contacts closeable in response to pulse-energization of said second coil means to establish a circuit for energizing said second coil means independently of said normally-open contacts of said limit switch

means, and independently of said fixed and movable contacts, but via said snap switch means, and for simultaneously energizing said first coil means independently of said limit switch means and of said fixed and movable contacts;

said limit switch means being operable to close its said normally-open contacts for pulse-energizing said second coil means, whereby said first coil means becomes energized and causes said mechanism to move said movable contact from that one of said fixed contacts connected to the last said normally-open contacts to the next of said fixed contacts, and said mechanism being adapted to temporarily open said snap switch means upon said movable contact reaching said next of said fixed contacts, whereby to deenergize said second coil means, and, therefore, said first coil means.

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