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RELAY DISTRIBUTING CIRCUIT

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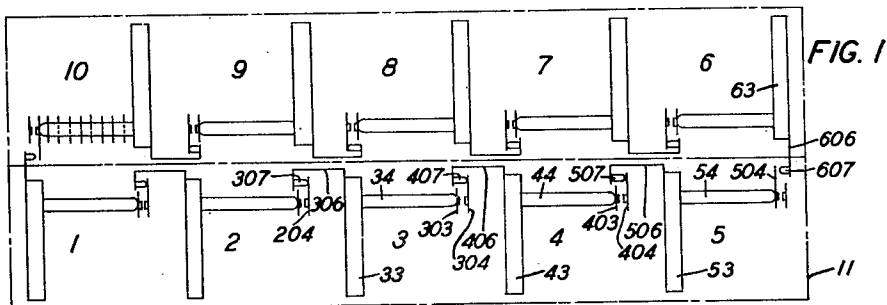


FIG. 1

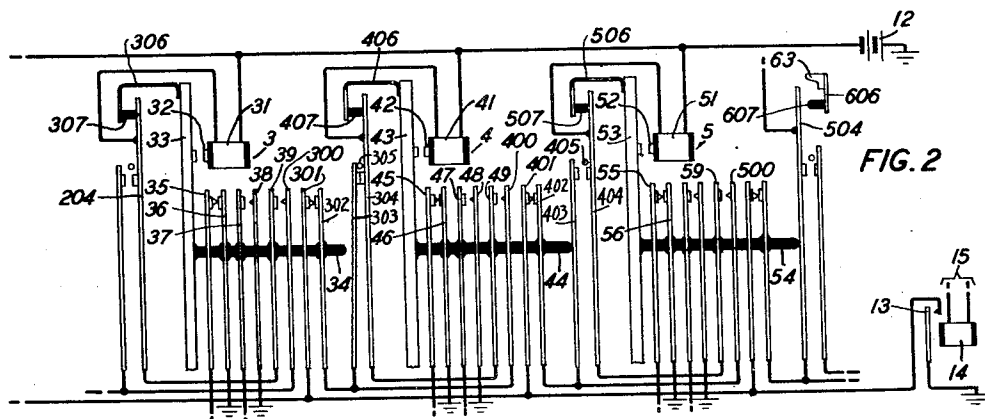


FIG. 2

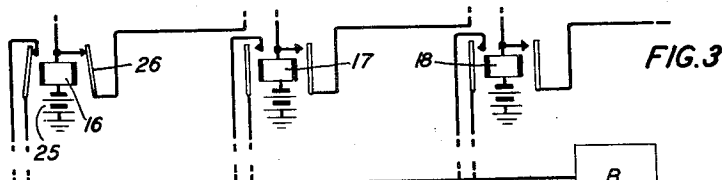


FIG. 3

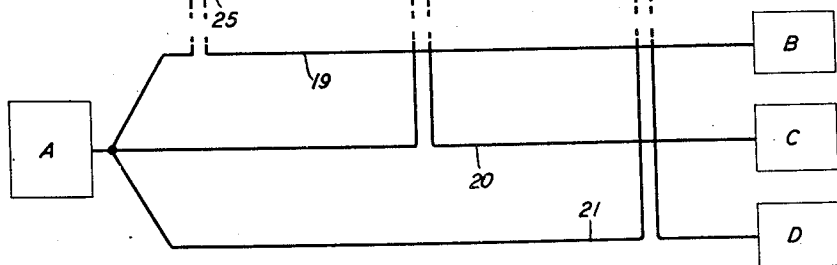


FIG. 4

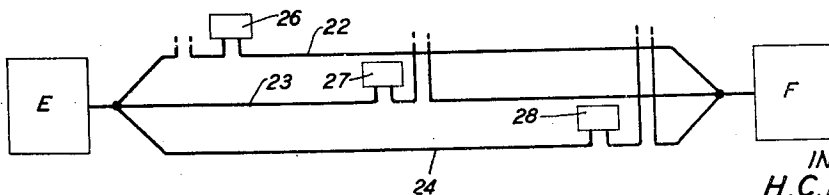


FIG. 5

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RELAY DISTRIBUTING CIRCUIT

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This invention relates in general to distributing or counting means and more particularly to a chain of electromagnetic relays arranged to perform functions of a distributor or a counter.

In accordance with the invention a reentrant chain of electromagnetic relays is provided wherein each relay has an energizing winding, an armature and contacting members actuated by the armature when the latter is moved under control of its associated energizing winding. Magnetic means is provided for each relay which may be in the form of a pair of cooperating contact members, both of which are of magnetic material and at least one of which is a permanent magnet, for holding said members in contact closure after being so closed by said armature when said winding is energized and after said armature is released when the said winding is subsequently deenergized. Each armature is provided with a mechanical part which is adapted to engage and separate the members magnetically held closed on the immediately preceding relay when the said armature is actuated. The energizing circuit for any one winding is completed in part by closure of the members magnetically held closed on the preceding relay and is opened or broken by this separation such that a given winding can be energized only if the immediately preceding relay has been energized and deenergized as the prior operation, the desired energization of the given winding. Each of the relays in the chain is provided with numerous other pairs of cooperating contact elements or members which of course may be employed to perform various operations when the associated winding is energized and which may be employed, if normally closed, to provide various circuit paths during the times when the associated winding is deenergized, as will be explained hereinafter.

Out of a chain of relays having a common source of energizing current and arranged according to the invention it is possible to employ the arrangement to select and energize a different relay each time the current is supplied to and cut-off from the chain, this current being controlled by any means desired and the length of time during which the current is supplied to or cut-off from the chain of relays being any amount desired. By means of this arrangement the chain of relays may be employed to distribute the load on several alternate transmission paths between two points or between one point and each of several other different points. The same means may be employed likewise to select dis-

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tributively and repeatedly in a given order reentrant upon itself a number of mechanisms or circuits or metering devices multiplied between two points of a transmission system but to be connected therebetween only one at a time. There are numerous other uses of the invention which will be suggested along the above lines as a result of this disclosure. One other such use is that of a counting relay chain.

The foregoing general statement of the invention is explained hereinafter in connection with an exemplary embodiment thereof illustrated in the drawings forming a part of the specification and for the various views of which drawings the following are general descriptions:

Fig. 1 shows a preferred mechanical layout arrangement of a relay chain embodying the invention and comprising ten relays;

Fig. 2 illustrates three of the relays of Fig. 1 set forth in a mechanical and electrical schematic presentation to facilitate description thereof;

Fig. 3 is a group of auxiliary relays controlled by the relay chain of Fig. 2; and

Figs. 4 and 5 are block diagrams illustrating in a general way how the invention may be used as a distributor when either Fig. 4 or Fig. 5 is used with Figs. 2 and 3 as indicated by the dotted circuit interconnections.

In Fig. 1 are shown ten relays 1 through 10 to be adapted in accordance with the invention and arranged in a reentrant fashion inside of a housing or relay panel 11 which may in turn be mounted on a relay rack (not shown) or any suitable support (not shown).

In Fig. 2 relays 3, 4 and 5 and parts of relays 2 and 6 have been illustrated in a manner adapted for ease of description rather than as any indication as to how such a chain of relays as Fig. 1 should be arranged for operation. The actual assembled layout may be adapted to fit circumstances. Each relay is provided with a winding 31, 41 or 51 mounted on a core 32, 42 or 52 which core 32, 42 or 52 is adapted, when energized by the associated winding to attract the respective armatures 33, 43 and 53 from their normal positions, as shown in Fig. 2. Each armature has attached thereto a contact spring separator stud 34, 44 or 54 made of insulation in accordance with well-known usage. Similarly arranged on each relay is a group of contact springs such as free contact springs 35, 38, 300 and 301 and those attached to the spring separators such as 36, 37, 39 and 302 on separator 34, all of relay 3. In addition to these groups of contact springs each relay is provided with

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two additional contact springs such as 303 and 304 of relay 3. Both of these springs 303 and 304, and of course similarly for all relays in the chain, must be of magnetic material or have the contacts thereof of magnetic material, at least one of these springs or contacts being a permanent magnet. Only one side of relays 3, 4 and 5 is shown in Fig. 2, but it is appreciated that there may be contact springs on the other side as well. In addition it is assumed that the contact springs are suitably assembled in a contact spring pileup assembly (not shown) as is well known. Each armature, such as 33 or 43 or 53 is provided with a hook-like extension such as 306 for relay 3 or 406 for relay 4 or 506 for relay 5. Upon the ends of these extensions are attached insulator knobs 307, 407 and 507, respectively and which are adapted to actuate contact springs 204, 304 or 404 respectively as will be explained hereinafter. Insulated stop pins, such as 305 and 405 are provided to limit the permissible movement of such contact springs as 303 of relay 3 when armature 43 of relay 4 engages and pulls spring 304 away from springs 303 to break the magnetic attraction between these springs or the contacts thereof. A source of energizing current, such as battery 12, is provided for energization of the windings of the relays under control of contacts 13 which may be operated manually or automatically by means of relay 14, which in turn may be controlled by any suitable means over wires 15.

The relays 16, 17 and 18 of Fig. 3 have been shown as controlled respectively by chain relays 3, 4, 5 and 6, jointly or singly as will hereinafter be explained. Relays 16, 17 and 18 may be used to select and connect circuits 19, 20 and 21, respectively of Fig. 4 or 22, 23 and 24, respectively of Fig. 5 as will also be explained hereinafter.

Each of the windings 31, 41 and 51 of the relays of Fig. 2 is connected on one side to the common battery 12. The other sides of the windings are connected to one of the magnetic springs of the immediately preceding relay, such as spring 204 for winding 31 of relay 3 and 304 for winding 41 of relay 4. The magnetic springs such as 204 and 304 and 404 are connected by wires to springs 39, 49 and 59, respectively of relays 3, 4 and 5 which normally are out of engagement with their mate springs 300, 400 and 500. For the condition when the magnetic springs are disconnected, such as 403 and 404 of relay 4, the circuit of winding 51 of relay 5 has no choice of a path except over contact springs 59 and 500 of relay 5, which are open. However, for the condition when the magnetic springs are in contact, such as 303 and 304 of relay 3, the circuit of winding 41 of relay 4 has a choice of two paths, one from spring 304 to open springs 49 and 400 of relay 4 or another from spring 304 to 303, through normally closed contact springs 302 and 301 of relay 3 to ground through contacts 13 when same are closed by relay 15 or by manual means. Thus only one winding or relay is able to be energized or operated at any one time and when it operates it connects the magnetic pair of springs of its own relay, such as 403 and 404 of relay 4, and simultaneously breaks the magnetic pair of the preceding relay, such as springs 303 and 304 of relay 3, by means of the armature extension and insulator knob, such as 406 and 407 respectively of relay 4. This will enable energization of relay 5 and relay 5 only, and so on along the chain, which as has been indicated is reentrant

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upon itself for continuous distribution in repeated cycles.

The operation of the chain is as follows assuming that the last relay to have been operated and released was relay 3 of Fig. 2, such that the connected condition of magnetic springs 303 and 304 will be a true condition of the chain as shown. Inspection of the energizing circuit of relay 16 of Fig. 3 will show that when relay 3 was operated the winding circuit of relay 16 was completed from ground through battery 25, winding of relay 16 and make contact springs 37 and 38 of relay 3 to ground. Thus relay 16 was operated and once operated it locked operated over a circuit from ground through battery 25, winding of relay 16, front contact and armature 26 of relay 16 and break contact springs 45 and 46 of relay 4 to ground. This locked condition of relay 16 completes circuit 19 of Fig. 4 between terminal points A and B of the transmission or control diagram of Fig. 4, the circuits 20 and 21 of Fig. 4 being open at relays 17 and 18. In this condition of the chain of relays of Fig. 2 has been effected a selection of circuit or path 19 of Fig. 4 which will continue to exist as long as contacts 13 of the current supply to the chain remain open as shown and as they would be after relay 3 had been deenergized.

By whatever means is desired contacts 13 are now closed for a suitable length of time. The energizing circuit of winding 41 of relay 4 is now completed over the previously traced circuit, whereupon relay 4 operates and attracts armature 43 to core 42. Knob 407 will break the connection of magnetic springs 303 and 304 of relay 3 but the energizing circuit for winding 41 of relay 4 will be remade at or before this time via magnetic spring 304 through make contacts 49 and 400 of operated relay 4 to ground through the break contact springs 301 and 302 of relay 3 and contacts 13 of the control device or relay 14. The stud 44 of relay 4 will connect magnetic springs 403 and 404 of relay 4 which will thereafter remain in contact due to the magnetic attraction between them. The winding circuit for relay 5 is broken at open springs 59 and 500 of relay 5 and opened contact springs 401 and 402 of relay 4 so that relay 5 will not operate. In addition the aforementioned locking circuit for relay 16 of Fig. 3 is opened and the energizing circuit of relay 17 of Fig. 3 is closed. Relay 16 will release opening circuit or path 19 of Fig. 4 and relay 17 will operate to enable circuit or path 20 between points A and C of Fig. 4. Upon opening of contacts 13 relay 4 will release, relay 17 will lock operated over the contact springs 55 and 56 of relay 5 and the whole chain is again in a position comparable to that shown except that relay 17 is operated instead of 16 of Fig. 3 and the connected magnetic springs have been switched from relay 3 to relay 4 in readiness for relay 5 to operate the next time instead of relay 4.

It will be apparent at this point that by a series of operations and releases of contacts 13 the chain of relays will operate to select first path 19 of Fig. 4, then 20, then 21 and so forth until ten different paths have been selected in turn at which point the distribution function of the relay chain will begin at the beginning and perform the same operations again.

Fig. 5 is a block diagram of two terminal points E and F of a control circuit, transmission path, or otherwise between which points E and F, wherein there are a number of possible circuit paths, such as 22, 23 and 24, each containing a

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piece of apparatus or a circuit which is required to handle its share of the load between points E and F as distributed over several equipments or circuits such as 26, 27 and 28. The relay chain set forth herein in accordance with the invention will provide an equal distribution of load between points E and F among the several circuits or pieces of apparatus 26, 27 or 28 under control of contacts 13 which as previously mentioned can be actuated by a relay 14 which in turn can be controlled over wires 15 from any desirable source, such as a signal from a point E that transmission to point F is desired. The distributor will regulate such transmission so that the mechanisms, apparatus or circuits such as 26, 27 and 28 will all handle an equal number of transmissions or perform an equal number of operations during a given period of time when contacts 13 will be actuated at least ten times to be consistent with the number of relays in the distributing chain.

It is not intended that the invention be limited to the actual disclosure used as exemplary thereof or to the restricted use of relays such as are shown in Fig. 3 and controlled by the relay chain nor to the use therewith of such systems as shown by Figs. 4 and 5 since all of these disclosures are merely illustrative of the utility of the invention and specifically of one or two specific utilities it may have. For instance, as is well known in the relay art, such a chain of relays as shown by Figs. 1 and 2 could be provided with a release magnet operating a draw bar or card adapted when actuated to intercept or engage all magnetic spring pairs on all relays to open all except those of any given relay and to close the latter. This would enable the relay chain to act as a counting chain which would be reverted to a normal condition at any time by operation of the release magnet. Since other such adaptations will be suggested for the invention, claims are appended hereinafter which alone define the scope of the invention.

What is claimed is:

1. A plurality of relays arranged in a series, each relay having a winding, a source of energizing current for the winding of each relay, and means controlled by energization and subsequent deenergization of the winding of one of said relays to enable energization of the winding of the next relay in the said series, only one relay winding being so enabled at any one time.

2. A plurality of relays arranged in a series, each relay having a winding, a source of energizing current for the winding of each relay, and contact members controlled by energization and subsequent deenergization of the winding of one of said relays to enable energization of the winding of the next relay in the said series, only one relay winding being so enabled at any one time.

3. A plurality of relays arranged in a series, each relay having a winding, a source of energizing current for the winding of each relay, and pairs of contacts serially included in the ener-

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gizing circuit of each relay winding, said pairs of contacts controlled by energization and subsequent deenergization of the winding of one relay to enable energization of the winding of the next relay in the said series, only one relay winding being so enabled at any one time.

4. A plurality of relays arranged in a series, each relay having a winding, a source of energizing current for the winding of each relay, and a first pair of normally open magnetic contacts and a second pair of normally closed contacts serially included in the energization circuit of each relay winding, said first pair of contacts controlled by energization and subsequent deenergization of the winding of one relay to make closure and remain closed by virtue of mutual magnetic attraction and said second pair opened upon energization and closed upon deenergization of the winding of said one relay to thereby enable energization of the winding of the next relay in the said series, only one relay winding being so enabled at any one time.

5. A plurality of relays arranged in a series, each relay having a winding, a source of energizing current for the winding of each relay, a first pair of normally open magnetic contacts, at least one of which contacts of said first pair is a permanent magnet and both of which first pair are serially included in the energization circuit of a relay winding, and a second pair of normally closed contacts serially included in the energization circuit of said relay winding, said first pair of contacts controlled by energization and subsequent deenergization of the winding of one relay to make closure and remain closed by virtue of mutual magnetic attraction and said second pair opened upon energization and closed upon deenergization of the winding of said relay to thereby enable energization of the winding of the next relay in the said series, only one relay winding being so enabled at any one time.

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