

Oct. 11, 1949.

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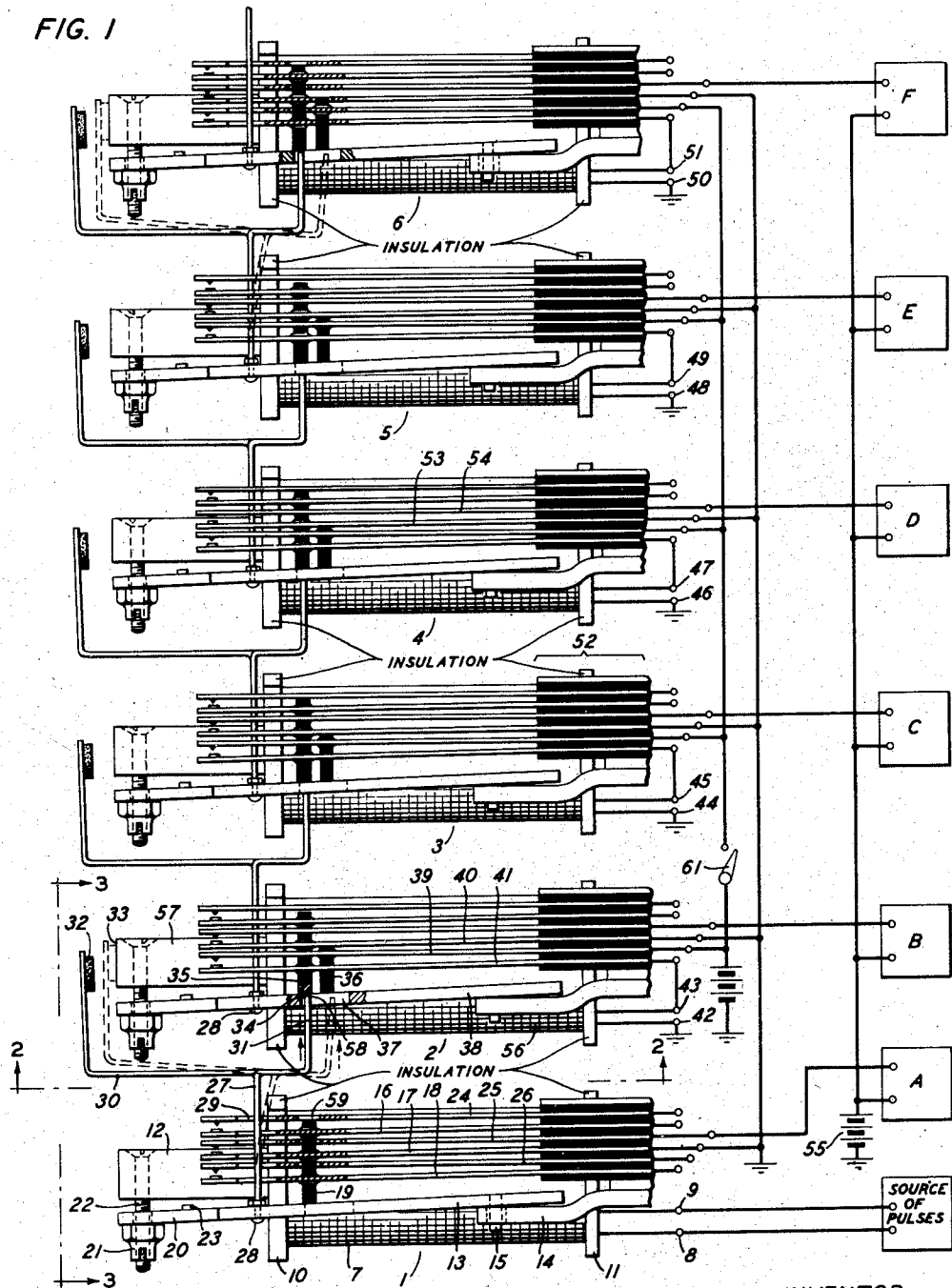
2,484,224

ELECTROMAGNETIC RELAY MECHANISM

Filed Nov. 23, 1946

2 Sheets-Sheet 1

FIG. 1



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2 Sheets-Sheet 2

FIG. 2

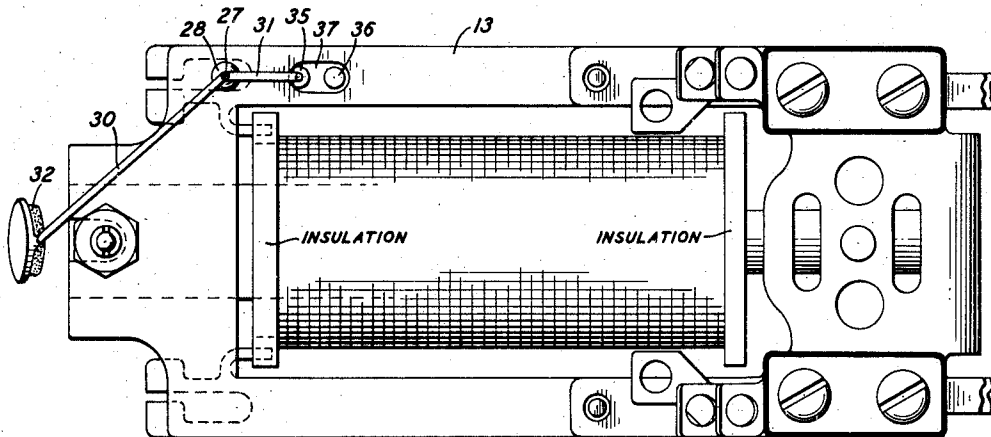
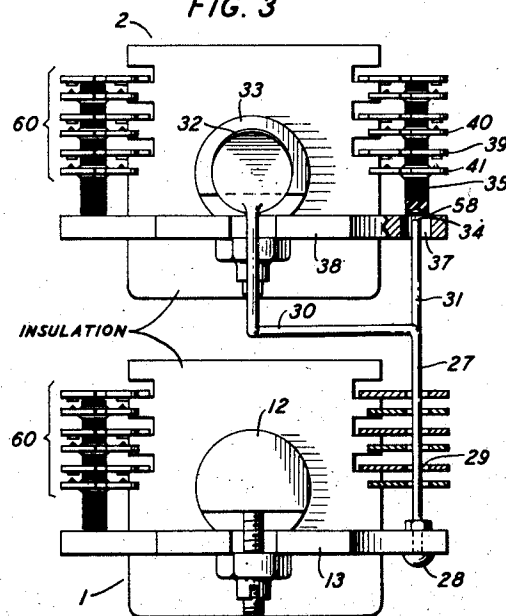


FIG. 3



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ELECTROMAGNETIC RELAY MECHANISM

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8 Claims. (Cl. 177—353)

1

This invention relates to pulse-dividing or counting relays and more specifically to such relays functioning by means of a mechanical mechanism interconnecting and actuating same.

Well known pulse-dividing systems commonly employed are made to function by reason of electrical circuits interconnecting a series of relays. The invention herein described permits such a system to function by reason of a simple mechanical means interconnecting a series of relays such that the operation of a preceding relay will, by reason of this mechanical linkage to a succeeding relay and by reason of additional means on both relays, actuate the succeeding relay half the number of times the preceding one is operated.

In an exemplary embodiment of the invention as disclosed herein there are provided a series of windings each with an associated armature. Each winding, after the first, also has associated therewith contacts through which a circuit path passes to operate and maintain operated the said winding and may include a pair or any convenient number of pairs of working contacts for operating or controlling associated equipment. The first winding with its armature has no contact of its own but is associated with the locking contacts of the second winding by interconnecting mechanical means to control these latter contacts in a manner such that upon the first operation it closes them and upon the second operation opens them. Each successive winding and armature, after the first, controls the next member of the series in a manner similar to that in which the first controls the second. Any suitable or convenient pulse supplying means is provided for furnishing pulses to the first winding. Assuming that all the windings are deenergized the first pulse initiates operation of all the armatures of all the windings and closes their locking contacts whereby they are all, except the first, locked in operated position; the second pulse enables reoperation of the first armature and release of the second; the third pulse enables reoperation of the first armature and reoperation of the second armature and release of the third; the fourth pulse enables reoperation of the first armature, release of the second, the third and subsequent numbers of the series being unchanged; the fifth pulse enables reoperation of the first, second and third armatures and release of the fourth; the sixth pulse enables reoperation of the first armature, release of the second, the third and subsequent ones being unchanged; and so on as discussed hereinafter. Thus, it will be seen that

2

the first armature operates on every pulse. Let us for the moment neglect the first armature and assume that there are five others in a consecutive series numbered two to six inclusive. It will be found upon analysis that the second armature operates on alternate pulses, the third once on every fourth pulse, the fourth once on every eighth pulse, the fifth once on every sixteenth pulse, the sixth once on every thirty-second pulse. This shows that the arrangement may be used as a pulse dividing system in which a particular device is operated once for each single pulse, each second pulse, each fourth pulse, each eighth pulse, and so on, the series being extended as far as necessary or desirable. Furthermore, it will be seen that the series functions as a binary counter. Thus, a series of one operating winding and five controlled windings will execute operations corresponding to thirty-two binary numbers. Alternatively, it may be found upon making a table of the operated and unoperated relays that for every thirty-two consecutive pulses there are set up combinations of operated and unoperated conditions of the windings corresponding to the combinations of a five unit permutation code.

This invention may be incorporated into most flat type relays by slight modifications thereto, whereby said relays may be operated as pulse-dividers or binary counters or as other obvious uses without necessitating the employment of any additional special circuit elements other than batteries or other electrical energy sources normally available.

The invention is described in the following specification in one of its forms thought best illustrative of its features. The following are general descriptions of the drawings which form a part of this disclosure.

Fig. 1 illustrates an exemplary embodiment of the invention and one manner of employing same in a relay system to control electrical circuits;

Fig. 2 is an enlarged view taken along the lines 2—2 of Fig. 1; and

Fig. 3 is an enlarged view taken in the direction of lines 3—3 of Fig. 1.

In Fig. 1 six relays of well known general construction are illustrated as mechanically interconnected by means of the invention. Fig. 1 in addition illustrates the utility of this invention as will be set forth hereinafter.

A short discussion is presented to describe briefly the constructional features of the type of relay disclosed in Fig. 1. With reference to relay 1, a winding 7 with terminals 8 and 9 is

supported between spoolheads 10 and 11 on core 12. An armature 13 is pin-hinged to the core return frame 14 at the aperture and pin hinge 15. Normally, when winding 7 is not energized, armature 13 is biased to the position shown by means of the tension in contact springs such as 16, 17 and 18 which are attached to spring separator 19 which in turn rests on armature 13 as shown. The free end 20 of armature 13 rests on an adjusting nut 21 on the threaded member 22 rigidly attached to core 12. In its operated or attracted position the armature operated stop pin 23 prevents residual magnetism effects as is well known.

The spring separator 19 passes through clearance holes such as 59 in contact springs such as 24, 25 and 26. One end of a flexible wire like member 27 is rigidly fixed in the armature 13 by means of a rivet head and shoulder arrangement indicated by numeral 28, which is a well known fastening means. In addition, the member 27 is freely movable within clearance holes such as 29 in the contact springs. The fastening means 28 and clearance holes 29 are more clearly illustrated in Fig. 3.

The flexible member 27 has two extensions 30 and 31. Extension 30 carries a magnetic member 32 adapted to cooperate with the pole face 33 of core 57 of relay 2 as hereinafter described. The extension 31 is adapted by means of the end 34 thereof to actuate either of two spring separators 35 or 36 of relay 2 as will be explained later. As shown more clearly in Figs. 2 and 3, the end 34 of extension 31 is freely situated in hole 37 in the armature 38 of relay 2 and is thus capable of the lateral movement indicated in dotted lines in Fig. 1.

As illustrated in Figs. 1 and 2, the spring separator 35 has its cross section overlapping the end of the hole 37 such that the separator 35 rests on the armature 38 and cannot enter the hole 37. On the other hand spring separator 36, which is fixed to contact spring 39 and freely movable in clearance holes in contact springs 40 and 41 as indicated by similar construction in the top relay 6 of Fig. 1, is free to enter hole 37 and at no time engages armature 38.

The remaining construction is similar to the foregoing or is well known as illustrated and needs no further description.

In regard to circuit connections it has already been stated that the terminals of winding 7 of relay 1 appear at 8 and 9. The winding terminals for relays 2, 3, 4, 5 and 6 appear respectively at 42 and 43, 44 and 45, 46 and 47, 48 and 49, 50 and 51. All contact springs of all relays are insulated from each other by well known means in the respective spring pile-up sections as 52 for relay 3. All circuit connections are external and indicated to the right of the respective relay spring pile-up sections of Fig. 1. It is to be noticed that the circuit of each winding, after relay 1, is completed only through a pair of cooperating contacts, such as 39 and 41 of relay 2, of the relay of which it is the winding and switch 61. In addition, each relay is indicated as controlling a device or circuit such as device D for relay 4 which device is controlled by contacts 53 and 54 of relay 4 by an obvious circuit through battery 55 and ground. No attempt is made to illustrate all possible applications of my invention, the particular embodiment and application thereof illustrated and described herein being merely exemplary of same.

A description of the operation of the disclosure will now be set forth.

A source of pulses is connected to the winding 7 of relay 1. Prior to providing the winding 7 with pulses of current the relay system of Fig. 1 will have assumed the positions of relay armatures indicated, the normal positions of flexible members such as 27 being indicated by solid lines.

When winding 7 of relay 1 is energized by pulse number one, armature 13 will be attracted to core 12. Member 27 will be actuated by armature 13 such that the end 34 of extension 31 of said member 27 will actuate spring separator 35 of relay 2. Spring separator 35 in being actuated may close all contacts of all cooperating contact springs on the right side of relay 2 as shown in Fig. 3 including the contacts of springs 39 and 41 to thereby complete the energizing circuit for winding 56 of relay 2. It is, of course, possible and in some cases advisable to omit all springs on the right sides of the relays, such as of relay 2 in Fig. 3 for instance, except springs 39 and 41 to impose upon member 27 as little loading as necessary. The remaining springs, if it is desired to retain same, may be actuated by an additional spring separator which in turn could be moved by the armature of its relay, such as 33 of relay 2 in Fig. 3. In this connection it is to be noted that each relay may have a second set of springs, such as 60 in Fig. 3, actuated by a spring separator which in turn is actuated only by the armature of its respective relay. Various combinations of the foregoing indicated variations and modifications may be made and need no further description. When winding 56 is energized the core 57 will attract both armature 38 and magnetic member 32 of extension 30 of flexible member 27. When armature 38 is attracted to core 57 the spring separator 35 will be engaged by armature 38 and held in elevated position wherein the contacts of cooperating contact springs of relay 2 are held or locked closed. In addition, when magnetic member 32 is attracted to core pole face 33, the member 27 and extension 31 thereof will assume essentially the same positions as indicated by the solid lines, the extension 30 being resiliently deformed to assume the dotted position. It should be noted at this point that the end 34 of extension 31 of member 27 is engaged in the slightly concave end 58 of spring separator 35 and will at this time in the operation of member 27 remain there.

The previously described action of relay 2 will be repeated for each relay in the network such that as a result of energization of winding 7 of relay 1 by pulse number one all relays are operated, relays 2 through 6 being locked operated as well.

When the first pulse is removed from the winding 7 of relay 1, the armature 13 thereof will release. In so releasing, armature 13 of relay 1 will pull member 27 therewith such that the end 34 of extension 31 of member 27 will be extracted from the concave end 58 of spring separator 35. Due to the tension in member 27 produced by attraction of extension 30 thereof to core 57 of relay 2 the member 27 and extension 31 thereof will at this time assume the indicated dotted position.

No further change in conditions occurs until pulse number two is provided to the winding 7 of relay 1. Under this condition armature 13 re-operates thus moving member 27 so as to permit the extension 31 thereof to actuate spring separator 36. Spring separator 35 in operating opens the connection between contacts of springs 39

5

6

and 41 and thus opens the circuit of winding 56 of relay 2 allowing the armature 38 thereof to release. Pulse number two is then removed from winding 7 of relay 1 and relay 1 releases such that relay 1 and relay 2 are released and all others are operated. It is understood at this point that pulse three will operate relay 1 and relay 2 and release relay 3, leaving relays 4, 5 and 6 operated. Also pulse four will operate relay 1, release relay 2, leaving relay 3 released and relays 4, 5 and 6 operated.

The cooperation of any one relay with the next succeeding relay is the same throughout the chain of such interconnected relays and further repetition of operating description is not necessary. It is found by a complete graphical analysis that each succeeding relay of the chain operates at half the rate of its immediate predecessor.

It is noticed that device A is controlled by relay 1 at the same rate as that at which pulses are supplied to the winding of relay 1. Device B is operated at half the rate of device A since relay 2 operates at half the rate of relay 1 and device C is operated at half the rate of device B since relay 3 operates at half the rate of relay 2, and so on.

The latter analysis is recognized as a binary counting means whereby relay 1 can operate once per pulse input to relay 1, relay 2 once per two pulses, relay 3 once per four pulses, relay 4 once per eight pulses, relay 5 once per sixteen pulses and relay 6 once per thirty-two pulses, and so on as long as desired.

My disclosure of blocks such as A, B, C, etc. will be appreciated to represent many devices such as relays, lamps, circuits, etc. too numerous to illustrate as such, and of obvious application. The invention contemplates among other variations and embodiments than the one disclosed, such relay interconnecting members as may be rigid, non-flexible members freely pivoted to the respective armatures, suitably guided in bearings and adapted with springs for bias to replace the inherent flexibility or resilience of my disclosed embodiment. It is obvious as well that any device such as A, B or C, etc. may be arranged to be actuated by a series circuit including contacts of more than one relay of such a system and that release as well as operate conditions may be used to control devices or register or record the number of pulses in a given group if switch 61 is arranged to open to release all relays except relay 1 after the latter relay has received and acted upon all pulses of each group to be registered. In this respect it is seen that N number of relays may afford $(2N-1)$ different conditions involving at least one operated or one released relay and that N number of relays may afford $2N$ different conditions without the preceding limitation and so represent conditions corresponding to an N unit permutation code.

The following claims are set forth to describe the scope of my invention which is not to be construed to be limited to the specific illustration and description set forth in the exemplary disclosure herein.

What is claimed is:

1. A first electromagnetic relay including an armature, a second electromagnetic relay including a core and a coil and a coil current circuit and contacts in series with said circuit, and mechanical means mechanically actuated by the armature of said first relay and magnetically influenced by the core of said second relay to control the coil current circuit contacts of said second relay.

2. A first electromagnetic relay including an

armature, a second electromagnetic relay including a core and a coil and a coil current circuit and contacts in series with said circuit, and a member having a first portion thereof mechanically actuated by the armature of said first relay and a second portion thereof magnetically influenced by the core of said second relay to enable a third portion thereof to control the coil current circuit contacts of said second relay.

3. A first electromagnetic relay including an armature, a second electromagnetic relay including a core and a coil and a coil current circuit and contacts in series with said circuit, and a member having a first portion thereof mechanically actuated by the armature of said first relay and a second portion thereof magnetically influenced by the core of said second relay to enable a third portion thereof to control the coil circuit contacts of said second relay, said second portion adapted under the influence of said core to move said third portion to two different controlling positions relative to said coil current circuit contacts controlled thereby under the control of said first portion.

4. A first electromagnetic relay including a first armature, a second electromagnetic relay including a second armature and a core and a coil and a coil current circuit and contacts in series with said circuit and controlled by said second armature, and a member having a first portion thereof mechanically actuated by said first armature and a second portion thereof magnetically influenced by the core of said second relay to enable a third portion thereof to control the coil circuit contacts of said second relay, said second portion adapted under the influence of said core to move the third portion of said member to two different controlling positions relative to said coil current circuit contacts controlled thereby said first armature when actuated mechanically actuating said first portion to move said third portion while in its first position to close said contacts to energize said coil, said coil when energized energizing said core and actuating said second armature, said second armature when actuated holding said contacts closed and said core when energized attracting said second portion to move said third portion to its second position, said first armature when reoperated mechanically actuating said first portion to move said third portion while in its second position to open said contacts to deenergize said coil, said coil when deenergized deenergizing said core and releasing said second armature, said second armature when released returning said contacts to normal and said core when deenergized releasing said second portion to its first position, said first armature when reoperated effective to repeat the above cycle.

5. A first electromagnetic relay including a first armature, a second electromagnetic relay including a second armature and a core and a coil and a coil current circuit and contacts in series with said circuit and controlled by said second armature, and a flexible member having a first portion thereof rigidly connected to and actuated by said first armature and a second portion thereof having attached thereto a magnetic material adapted to be influenced magnetically by the core of said second relay when said core is energized to move a third portion thereof to two different controlling positions relative to said contacts controlled thereby under the control of said other portions, said first armature when actuated mechanically actuating said first portion to move said third portion while in its first position to

7

close said contacts to energize said coil, said coil when energized energizing said core and actuating said second armature, said second armature when actuated holding said contacts closed and said core when energized attracting said second portion to move said third portion to its second position, said first armature when reoperated mechanically actuating said first portion to move said third portion while in its second position to open said contacts to deenergize said coil, said coil when deenergized deenergizing said core and releasing said second armature, said second armature when released returning said contacts to normal and said core when deenergized releasing said second portion to its first position, said first armature when reoperated effective to repeat the above cycle.

6. A first electromagnetic relay including a first winding and a first armature controlled by said first winding and contacts in circuit with said first winding and controllable by said first armature, a second electromagnetic relay including a second winding and an armature controlled by said second winding, and mechanical means connected to said second armature and successively actuated by successive operations of said second armature under the control of said second winding to alternately open and close said contacts in cooperation with said first armature to thereby control the energization and deenergization of said first winding, said first armature adapted when actuated by said first winding to hold said contacts closed until same are opened by said means.

7. An electromechanical system comprising a plurality of windings, a magnetizable core indi-

8

vidual to each winding and energizable thereby, an individual armature associated with and operable by each respective core, a source of impulses to be supplied to the first of said plurality of windings, individual contacts serially included in each of the circuits of said windings subsequent to the first of said plurality of windings and controllable by the corresponding armature, and individual mechanical means associated with each armature, said means mechanically actuated by its associated armature and magnetically influenced by the next succeeding core thereby to control the contacts of the winding circuit of the next successive winding in said series of windings.

8. A first electromagnetic structure including a first armature, a second electromagnetic structure including a second armature and a magnetizable core for actuating said second armature and a coil for energizing said core and a coil current circuit and contacts serially included in said circuit and controlled by said second armature, and mechanical means mechanically actuated by said first armature and magnetically influenced by said core for controlling said contacts in cooperation with said second armature.

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