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RELAY SYSTEM FOR MEASURING THE TIME OF THE CONTINUOUS FLOW OF AN ELECTRIC CURRENT

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Fig. 1.

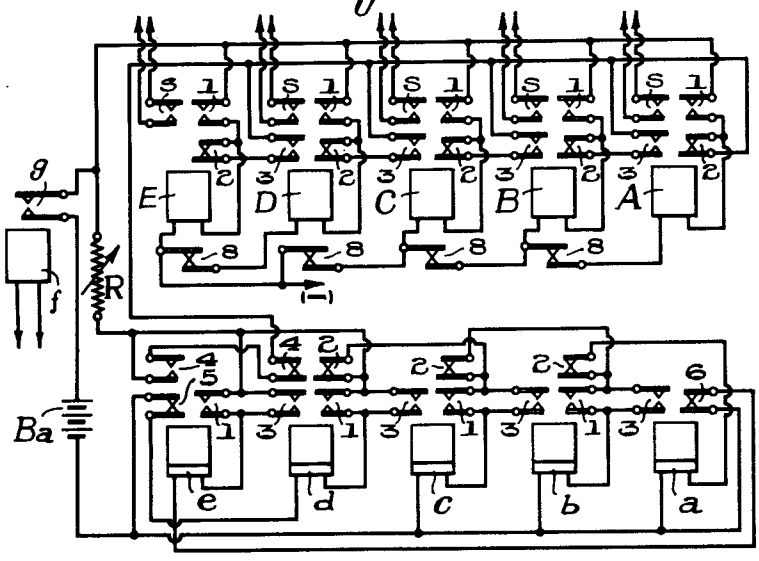
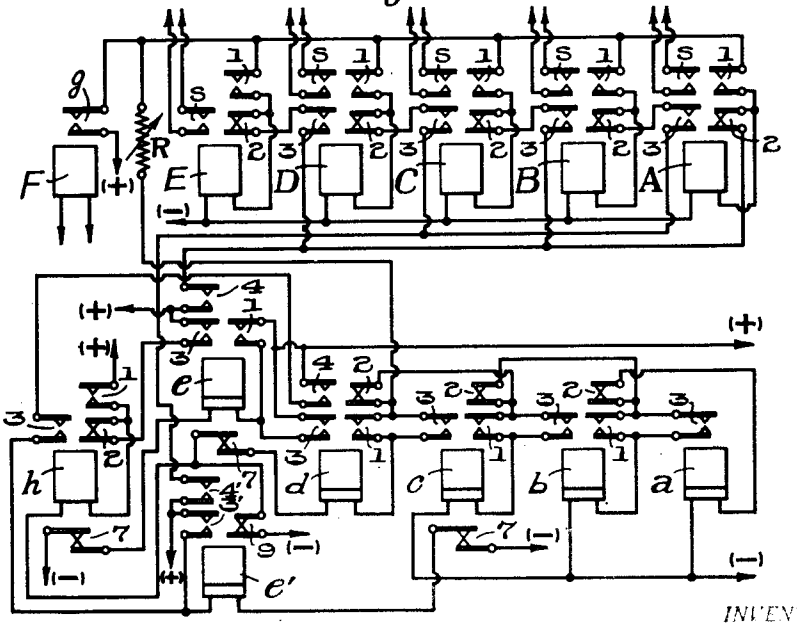


Fig. 2.



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RELAY SYSTEM FOR MEASURING THE TIME OF THE CONTINUOUS FLOW OF AN ELECTRIC CURRENT

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The present invention relates to a relay system for measuring the time of the flow of an electric current, which comprises a primary relay series consisting of many time-limit relays operating one by one, a secondary relay series consisting of many relays operating successively to close their respective controlling circuits and a master relay operating throughout the period of the flow of an electric current, the operation of the primary relay series being continued circularly during the operation of the master relay and the relays of the secondary series being operated successively one by one at every circulation of the operation of the primary relay series. The object of this invention is to examine whether an incoming electric signal has the correct lasting time or not, by making the desired operating circuit responsive to an electric current flowing continuously for a certain time by a relay system and thus controlling the same, especially by making the master relay responsive to a series of signal current or waves transmitted continuously at a certain time interval and thus operating the primary relay series circularly.

Referring to the appended drawing,

Figure 1 shows the electrical connection of the relay system according to this invention and

Figure 2, its modification.

In the drawing, for the sake of brevity and clearness all relays of the same character are represented by the same notations and also the contacts of the relays having the same operation are denoted by the same numerals.

In an example of performing this invention shown in Figure 1, *a*, *b*, *c*, *d* and *e* are the relays of the primary series each having a certain time-limit for its operation, the relay *a* having closed and open contacts **6** and **3**; each of the relays *b* and *c*, closed contact **2** and open contacts **1**, **3**; the relay *d*, closed contacts **2**, **4** and open contacts **1**, **3** and also the relay *e*, closed contact **5** and open contacts **1**, **4**, when they do not operate.

A, B, C, D and E are the instantaneous relays of the secondary series adapted for opening the contacts **1**, **3** and S and closing the contacts **2** and **8** when in an inoperative state. E lacks the contact **3**. *g* is the contact of the master relay. In this example, it has its opening and closing operations controlled by an instantaneous relay *f*. R is a rheostat for adjusting the time-limits of the primary relays properly by regulating their voltages and B*a* is an electric source. Now, if the relay *f* operates to close the contact *g*, the relay *a* is energized through the contacts **2** of each of the relays *d*, *c* and *b* to operate at its time limit and close its contact **3** to energize the relay *b*. Consequently, said relay *b* is operated at its time limit to close its contacts **1** and **3** and open **2**, thus maintaining its operation at the contact **1** and energizing the relay *c* at the contact **3** of the relay *b*. On the other hand it opens the circuit of the relay *a* at the contact **2** and resets said relay. Next, the relay *c* operates at its time limit to energize the next relay *d* in the similar manner to that described above and resets the relay *b* operated before it. The relay *d* closes its contacts **1** and **3** and opens **2** and **4** at its time limit. Then, at the open contact **2** of the relay *d* it opens the circuit of the relay *c* and resets said relay. At the closed contact **3** of the relay *d* it energizes the last relay *e*, so that the latter operates at its time limit and opens its contact **5**, thus cutting off a current which passes through the relay *d*. Then, the contacts **2** and **4** of the relay *d* are reclosed and by means of the contact **2** of said relay *d* the first relay *a* will be energized. When the relay *e* operates, the relay A of the secondary relay series is energized instantaneously by the contact **4** of the relay *e* and the already-closed contact **4** of the relay *d* and thus is operated. When said relay A is operated, firstly a holding circuit is formed by its contact **1** and then the contact **2** is opened. Further, when the contact **3** of the relay A has been closed and then the time-limit relay series *a*, *b*, *c*, *d* and *e* have completed the operation successively, the relay B is operated, whereupon its contact **8** is opened to reset the relay A.

Every time upon completion of the circulation of the operation of the primary relay series, the relays C, D and E operate in turn in the above manner and also B, C and D are reset. When one circulation of the operation of the primary relay series has completed at the time of the operation of the last one E of the secondary relay series, said relay E continues its operation, while the relay A is operated. The time may be thereafter measured by the present system until B and C operate.

Each relay of the secondary series is provided with a contact S which is connected with an indicating or recording apparatus and which is adapted to be closed when the corresponding relay operates. The last relay E of the secondary series is not given the continuity of operation, so that the operation of this series may be repeated many times, beginning with A. Further, by providing more than the tertiary relay series, associating them with the operation of the relay E

and operating them successively it is possible to measure a comparatively long time.

Figure 2 shows the other example of performing this invention.

In this system, two last relays *e* and *e'* of the primary series are operated alternately. That is to say, either the relay *e* or *e'* is operated according to whether the number of the circulation of such operation is cardinal or even and then the operation of the relays of this series is repeated, beginning with *a*. For the purpose of operating said relays *e'* and *e* alternately there is provided an auxiliary relay *h*.

In the drawing showing the above example, the numeral 1 denotes the contacts for maintaining the operation of their own relays; 3, the contacts for opening and closing the succeeding relays; and 2, 7 and 9, contacts for cutting off the circuits of the already-operated relays, the open and closed condition of each contact when the relays do not operate, being as shown in the drawing.

In this example, the operation of the relay F adapted to be energized by the arriving electric current or waves is substantially the same with that described in the preceding example. That is, firstly the relay *a* is energized to operate at a certain time limit, such operation extending to the relays *b*, *c* and *d* successively till it reaches the relay *e*. When said relay *e* operates, its contact 7 is opened to reset the relay *d*, on one hand closing its contacts 3 and 5, and thus energizing the first relay *a* through the contact *g*, the resistance R and contacts 2 of the relays *d*, *c* and *b*, while on the other hand the relay *h* is energized and operated by the contact 3 of the relay *e*, when the contacts 1 and 3 of the relay *h* are closed and 2 and 7 opened, so that the relay *e* is reset by said open contact 7 and the relay *h* is held in the operating condition by its own contact 1.

When the operation of the relays of the primary series reaches as far as the relay *d* at the second circulation and closes its contacts 3 and 4, the relay *e* is not energized, because the relay *h* has been continuing the operation and opened its contact 7 and closed 3. However, in its place the relay *e'* is energized and maintains its own operation at its self-holding contact 3', while at the contact 9 of the relay *e'* it cuts off the circuits of the relays *h* and *d* to reset them. The relay *e'* is adapted to be reset when the relay *e* operates next time and opens its contact 7. Also, by the resetting of the relay *d* the relay *a* starts the third operation in the manner mentioned above. Thus, the relays *e* and *e'* are operated alternately at the end of every circulation of the operation of the primary series.

As the operation of the relay *e* at the first circulation closes its contact 4, the first relay A of the primary series is energized to be operated. Then, at the second circulation the circuit of the next relay B is completed through the closed contact 4' of the relay *e'* and the previously-closed contact 3 of the relay A, the similar operation being made with regard to the succeeding relays C, D and E. But in this example the relays of the secondary series when they operate, do not reset the previously-operated relays and as each relay is provided with a contact 1 for maintaining its operation, it continues to operate once when it has operated, till the whole series are reset. As in the preceding example, each relay is provided with a contact S which is connected with an indicating or recording apparatus.

Although in the above explanation the secondary relay series are instantaneously-operated ones, it need not be said that a satisfactory result may be obtained by giving them a certain time-limit as the primary series.

Thus, in the present invention the primary series consisting of any desired number of relays are operated successively and circularly by continuous electric current and the relays of the series of the bigger orders are operated successively at every circulation, such operations being all carried out electrically, so that however quickly the operations may be made by reducing the time limit, there is no trouble to be caused by the inertia of motion, nor does this system contain minute mechanical constructional parts and also the lasting time of an electric current may be measured accurately.

I claim:

1. Relay arrangement for measuring the duration or time of flow of an electric current, comprising two groups of time relays, said arrangement having the distinctive feature that it is provided with a primary relay series consisting of several retardation time relays entering into operation consecutively, a secondary relay series consisting of several relays which close their pertinent circuits one after the other and a main relay responding during the time during which the electric current flows and the actuation of the primary relay series occurring in a cycle while the main relay responds and the relays of the secondary series entering into operation one after the other, one each during each actuation cycle of the primary relay series.

2. Relay arrangement in accordance with claim 1 having the distinctive feature that the primary relay series contains a pair of relays which responds at the closing of the operating cycle in connection with which the relays of this pair respond alternately during each cycle.

3. Relay arrangement in accordance with claim 1 having the distinctive feature that the primary relay series contains a pair of relays which responds at the closing of the operating cycle in connection with which the relays of this pair respond alternately during each cycle and the relays of the last pair of relays of the primary relay series being actuated alternately by an auxiliary relay.

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