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RELAY CIRCUIT WITH A NUMBER OF COUNTING RELAYS FOR RECORDING A NUMBER OF CLOSURES MADE BY AN IMPULSE CONTACT

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FIG. 1.

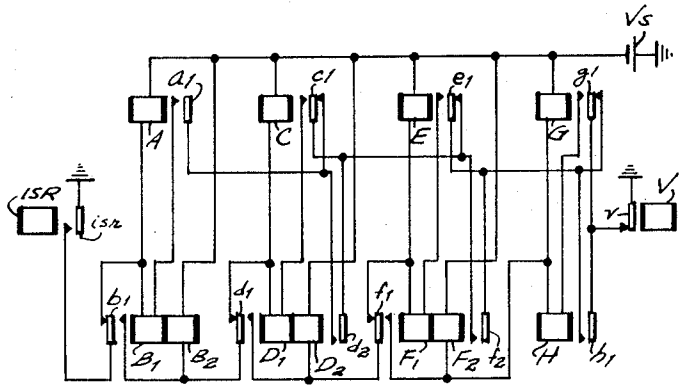
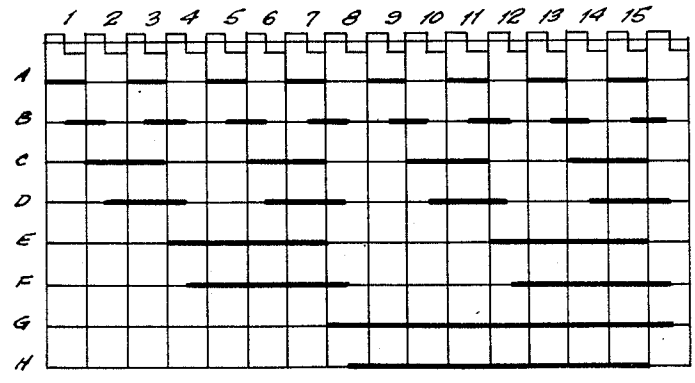


FIG. 2.



INVENTOR.

ROELOF MAARTEN MARIE OBERMAN

BY

Michael S. Striker

Agt.

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RELAY CIRCUIT WITH A NUMBER OF COUNTING RELAYS FOR RECORDING A NUMBER OF CLOSURES MADE BY AN IMPULSE CONTACT

Roelof M. M. Oberman, The Hague, Netherlands

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The invention refers to a relay circuit with a number of counting relays for recording the number of closures made by an impulse contact in which all combinations of operating relays obtainable with these counting relays are successively made and in which an auxiliary relay is added to each counting relay.

The invention provides a circuit obtaining such a result with a considerably reduced number of contacts and contacts springs to which end the provision on some auxiliary relays of an extra windings is sufficient. In the invention the extra circuit for preventing an untimely operation of the auxiliary relay, which was necessary in the prior circuit for avoiding extra impulses, is absent. In the invention extra impulses are avoided by establishing, before the release of a counting relay, a circuit comprising an extra winding of the corresponding auxiliary relay in series with the impulse circuit, whereby this relay cannot release before the interruption of the impulse circuit at the impulse contact, premature release of the relay on the interruption of the holding circuit of the group concerned consisting of counting and auxiliary relay being avoided. Such interruption of the impulse circuit at an auxiliary relay armature and the consequent undesired action are thereby prevented.

The invention will be explained in detail with reference to the drawing in which

Fig. 1 shows an embodiment of a binary system; and

Fig. 2 shows a diagram of the sequence of the operation of the relays. The circuit of Fig. 1 is designed for counting the number of impulses received by a relay *isr* having an armature *isr*; the circuit relays are operated in a certain combination when a certain number of impulses have been received. Four consecutive binary stages each including a pair of relays are shown, viz. A, B belonging to the first stage; C, D, belonging to the first intermediate stage; E, F, belonging to the second intermediate stage; and G, H belonging to the final stage; fifteen impulses as a maximum may be recorded because the number of combinations is equal to $2^4=16$ which number is diminished by one corresponding to the normal position in which none of the relays is operated.

A is termed hereinafter the first counting relay, C and E the first and second intermediate counting relays, respectively, and G the final counting relay. It is to be understood that the counting relays control contacts (not shown) in dependence on the combination of the operated relays indicating the number of closures of the

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impulse contact *isr*. B, D, F and H are the corresponding auxiliary relays termed hereinafter the first, the first intermediate, the second intermediate, and the final auxiliary relays, respectively. The auxiliary relays B, D and F each have two windings denoted, respectively, by B_1 and B_2, D_1 and D_2, F_1 and F_2. The final auxiliary relay H has only a single winding. The first winding B_1 of relay B is connected in series to the single winding of relay A whereas the second winding B_2 of relay B is connected in parallel to the single winding of relay C, which in turn is connected in series to the first winding D_1 of relay D. The second winding D_2 of relay D is connected in parallel to the single winding of relay E which in turn is connected in series to the first winding F_1 of relay F. The second winding F_2 of relay F is connected in parallel to the single winding of relay G which in turn is connected in series with the single winding of the final auxiliary relay H. The relays control contacts indicated by corresponding small letters, respectively. Thus, contact a^1 is controlled by the first counting relay A, contact b^1 by the first auxiliary relay B, etc. The contacts b^1, d^1 and f^1 are switch-over contacts, termed hereinafter, respectively, the first, first intermediate, and second intermediate switch-over contacts. All the contacts are shown in the drawing in their normal position, i. e. with none of the relays energized. The contact a^1 is normally open and connected in series to the first winding B_1 of the first auxiliary relay B. The first switch-over contact b^1 establishes in the normal position thereof a connection from the impulse contact *isr* to a first stationary contact connected to the junction of the single winding of the first counting relay A and the first winding B_1 of the first auxiliary relay B, and in the off-normal position of contact b^1 to a second stationary contact connected to the second winding B_2 of the first auxiliary relay B. The switch-over contacts c^1, e^1 and g^1 establish in the off-normal position thereof a connection, respectively, with the windings D_1, F_1 and H. In normal position (shown in the drawing) the switch-over contacts c^1, e^1 and g^1 establish a series connection to a grounded contact *v*. The switch-over contacts d^1 and f^1 are analogues to the switch-over contact b^1. In normal condition (shown in the drawing) the switch-over contact d^1 is in contact with a first intermediate stationary contact and connects the second winding B_2 of the first auxiliary relay B with the junction of the single winding of the first intermediate counting relay C and the first winding

D_1 of the first intermediate auxiliary relay D whereas in off-normal position the switch-over contact d^1 is in contact with a second intermediate stationary contact and connects the second winding B_2 of the first auxiliary relay B and the second winding D_2 of the first intermediate auxiliary relay D. The contact d^2 is connected in parallel to the switch-over contact c^1 and is normally open. Similarly the normally open contact f^2 is connected in parallel to the switch-over contact e^1, and the normally open contact h^1 is connected in parallel to the switch-over contact g^1 termed hereinafter the final switch-over contact. The impulse contact *isr* is grounded. The counting relays A, C, E and G and the second windings B_2, D_2 and F_2 of the auxiliary relays B, D, F, respectively, are connected to the negative terminal of a battery Vs shown in the upper right hand corner of Fig. 1 the other terminal of which is grounded. The contact *v* connecting the end of the circuit to ground is actuated by a relay V.

If armature *isr* moves against the contact at the receipt of the first impulse a circuit is established from ground, armature *isr*, back contact b^1, relay A to battery Vs. Relay A operates and prepares the following circuit for itself in series with auxiliary relay B: ground over back contacts *v*, g^1, e^1 and c^1, front contact a^1, winding B_1 of relay B, relay A, battery Vs to ground. Relay A holds itself in this circuit when armature *isr* moves back from its front contact so that relay B is operated in series with relay A at the end of the first impulse.

At the beginning of the second impulse relay C operates as the impulse circuit is now switched through at front contact b^1. Armature c^1 moves over to the front contact thereof thus interrupting the holding circuit for relays A and B over winding B_1 and preparing a holding circuit for relays C and D over the first winding D_1 of relay D which is energized in this circuit at the end of the second impulse. The prematureness of operation is avoided by the invention in which the auxiliary relays have two windings. The auxiliary relay B is provided with a second winding B_2 which is energized across relay C so that the impulse circuit is held over these relays and an untimely operation of relays D and A is prevented. At the end of the second impulse the impulse circuit is broken at the armature *isr* whereby relay B releases and relays C and D are operated in series.

At the third impulse contacts a^1 and b^1 are in their normal position whereas contacts c^1, d^1 and d^2 are in off-normal position Thus, relay A will be energized as explained above for the first impulse; when contact a^1 has closed winding B_1 will be energized and contact b^1 will be switched over. The result is that relays A, B, C, D are all energized, and contacts a^1, b^1, c^1, d^1 and d^2 are in off-normal position.

At the beginning of the fourth impulse contact *isr* is connected by off-normal contacts b^1 and d^1 to windings D_2 and E which are therefore energized. Thus, contact e^1 switches over into off-normal position and closes a holding circuit for relay E from battery to winding of relay E, winding F_1, contact e^1, normal contact g^1, normal contact *v* to ground. At the same time the holding circuits for relays A and C, in series with windings B_1 and D_1 of relays B and D, respectively, are interrupted at contact e^1 so that relays A and C are de-energized at the beginning of the fourth impulse. The auxiliary relays B and D hold

themselves by means of their windings B_2 and D_2 via front contacts b^1 and d^1 until the impulse contact *isr* has opened again. At this moment winding F_1 of relay F is energized in series with relay E, relays B and D being de-energized. The result is that relays E and F are energized, contacts a^1—d^2 in their normal position, and contacts e^1, f^1 and f^2 in off-normal position.

The fifth impulse is a repetition of the first one, except that relays E and F remain energized. Thus, relays A, B, E and F operate.

The sixth impulse is a repetition of the second one except that relays E and F remain energized. Thus, in the sixth impulse relays C, D, E and F are energized.

The seventh impulse is a repetition of the third one except that relays E and F remain energized. Thus, in the seventh impulse relays A, B, C, D, E, F, are energized and at the end of the impulse contacts a^1—f^2 are in off-normal position.

At the beginning of the eighth impulse, relay G is energized, and contact g^1 is switched over into off-normal position. By this the holding circuits for relays A—F_1 is interrupted. When contact *isr* is in normal position (at the end of the impulse) only relays G and H are energized with contacts a^1—f^1 and *v* in normal position, the other contacts being off-normal.

Now the cycle repeats itself with respect to relays A—E, relays G and H remaining energized. That is, in the ninth impulse A, B, G and H are energized, in the tenth, C, D, G and H. At the eleventh impulse, the relays A, B, C, D, G and H are energized, at the twelfth, relays E, F, G and H. At the thirteenth impulse relays A, B, E, F, G and H are energized, at the fourteenth impulse relays C, D, E, F, G and H, at the fifteenth impulse all relays A, B, C, D, E, F, G, H are energized.

After the fifteenth impulse the final auxiliary relay H is short-circuited in a circuit containing the impulse contact *isr*, the switch-over contacts b^1, d^1, f^1 in the off-normal position thereof, the switch-over contact g^1 also in the off-normal position thereof and the contact *v* thereby applying ground potential to both ends of the single winding of the final auxiliary relay H. In consequence thereto the final auxiliary relay H is de-energized before the final counting relay G which is de-energized by the last opening of the impulse contact *isr*. Thus it is seen that the counting relays A, C, E, and G are energized in a binary relation according to the number of impulses given by the impulse contact *isr*.

While I have illustrated and described what I regard to be the preferred embodiment of my invention, nevertheless it will be understood that such is merely exemplary and that numerous modifications and rearrangements may be made therein without departing from the essence of the invention.

I claim:

1. A binary relay arrangement for counting successive electrical impulses, comprising in combination, a current source having a first terminal and a second terminal; an impulse contact being temporarily closed by each successive impulse and connected to said second terminal of said current source; a plurality of consecutive binary stages each including a counting relay having a single winding connected with one terminal thereof to said first terminal of said current source, and an auxiliary relay having a first winding connected in series to said single winding of said counting relay and a second winding con-

nected with one terminal thereof to said first terminal of said current source; a plurality of contacts controlled, respectively, by said counting relays and said auxiliary relays of said consecutive stages, said consecutive stages being interconnected by said contacts so as to energize said counting relays in a binary relation; a final stage including a final counting relay having a single winding connected with one end thereof to said first terminal of said current source, an a final auxiliary relay having a single winding connected in series to said single winding of said final counting relay, the junction of said single windings of said final counting relay and said final auxiliary relay being connected to the other end of said second winding of said auxiliary relay belonging to said stage preceding said final stage; a final switch-over contact controlled by said final counting relay and having a normal position and an off-normal position, said final switch-over contact establishing in the normal position thereof a connection between said second terminal of said current source and said contact controlled by said counting relay belonging to said stage preceding said final stage, said final switch-over contact establishing in the off-normal position thereof a connection between said second terminal of said current source and said single winding of said final auxiliary relay; and a normally open contact controlled by said final auxiliary relay and establishing upon closure thereof a connection between said second terminal of said current source and said contact controlled by said counting relay belonging to said stage preceding said final stage, whereby said final auxiliary relay is short-circuited just before de-energization of said final counting relay in a circuit containing said impulse contact, said contacts controlled by said auxiliary relays of said consecutive stages, and said switch-over contact controlled by said final counting relay.

2. A binary relay arrangement for counting successive electrical impulses, comprising in combination, a current source having a first terminal and a second terminal; an impulse contact being temporarily closed by each successive impulse and connected to said second terminal of said current source; a plurality of consecutive binary stages each including a counting relay having a single winding connected with one terminal thereof to said first terminal of said current source, and an auxiliary relay having a first winding connected in series to said single winding of said counting relay and a second winding connected with one terminal thereof to said first terminal of said current source; a plurality of contacts controlled, respectively, by said counting relays and said auxiliary relays of said consecutive stages, said consecutive stages being interconnected by said contacts so as to energize said counting relays in a binary relation; a final stage including a final counting relay having a single winding connected with one end thereof to said first terminal of said current source, and a final auxiliary relay having a single winding connected in series to said single winding of said final counting relay, the junction of said single windings of said final counting relay and said final auxiliary relay being connected to the other end of said second winding of said auxiliary relay belonging to said stage preceding said final stage; a final switch-over contact controlled by said final counting relay and having a normal position and an off-normal position, said final switch-over contact establishing in the normal position thereof a connection between said second terminal of said current source and said contact controlled by said counting relay belonging to said stage preceding said final stage, said final switch-over contact establishing in the off-normal position thereof a connection between said second terminal and said current source and said single winding of said final auxiliary relay; a normally open contact controlled by said final auxiliary relay and establishing upon closure thereof a connection between said second terminal of said current source and said contact controlled by said counting relay belonging to said stage preceding said final stage; and a normally closed contact connecting said final switch-over contact controlled by said final counting relay and said normally open contact controlled by said final auxiliary relay to said second terminal of said current source, whereby said final auxiliary relay is short-circuited just before de-energization of said final counting relay in a circuit containing said impulse contact, said contacts controlled by said auxiliary relays of said consecutive stages, and said switch-over contact controlled by said final counting relay, all said contacts controlled by said counting and said auxiliary relays being restored to normal by opening said normally closed contacts connecting said final switch-over contact controlled by said final counting relay and said normally open contact controlled by said final auxiliary relay to said second terminal of said current source, thereby disconnecting all said counting and said auxiliary relays from said second terminal of said current source.

ROELOF M. M. OBERMAN.

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