

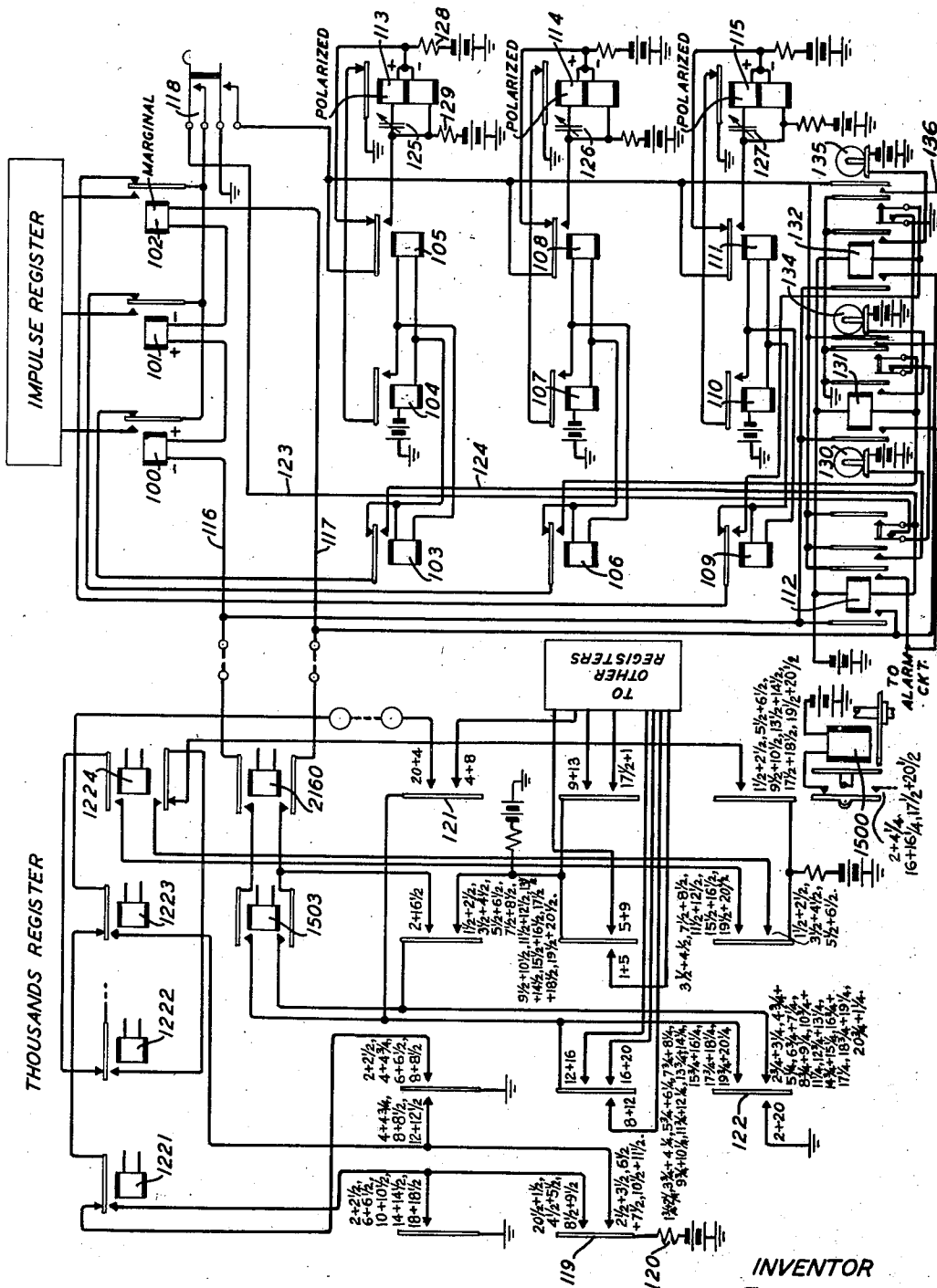
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IMPULSE TESTING DEVICE

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IMPULSE TESTING DEVICE

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This invention relates to impulse testing devices and more particularly to means for measuring the length of current impulses employed in telephone systems.

Very brief closures or false closures of the means which control the transmission of the impulses may result either in the false operation or the failure to operate of the responsive apparatus depending upon said impulses. In accordance with the present invention, therefore, means have been provided whereby if the exact length of an impulse is known, all impulses can be tested for this length and anything shorter than the prescribed impulse measuring interval will be detected. This is accomplished by means of a condenser-timed relay whose time of operation may be controlled by the rate of condenser charging current through its winding as is fully described in Patent No. 1,811,858, to O. R. Miller, granted June 30, 1931. The standard impulse time to which the time of operation of the timed relay is adjusted functions the test circuit for a satisfactory test; any impulse shorter than standard, blocks the circuit and sounds an alarm. This invention finds one specific embodiment in testing the impulses transmitted by full mechanical senders. Lack of adjustment of the impulse device, due to wear or other reasons, may result either in the production and transmission of short false impulses or in the production and transmission of regular impulses of shorter length than required. Under such circumstances, the impulse responsive apparatus may either respond falsely or not at all to the transmitted impulse and thereby cause an improper setting of the cooperating equipment which depends on the response of apparatus to impulses of proper length. It is desirable, therefore, in making the test of a sender, to detect the transmission of short false impulses as well as regular impulses of shorter duration than that for which the impuser of the sender is adjusted. By means of the present invention, it is possible to accomplish both of these results and, by such detection, cause the subsequent adjustment of the sender impuser before wrong numbers are produced in service.

A better conception of the scope and purpose of the invention will be obtained from a consideration of the following detailed description taken in connection with the attached drawing which shows a simple adaptation of the use of my invention with an impulse switch of a sender used in automatic telephone systems. To the left of the drawing is schematically illustrated an impulse switch of the kind disclosed in Patent

1,840,182, T. H. Roberts, granted January 5, 1932, shown wired in cooperation with a group of numerical registers and designed to transmit over the line in cooperation with these registers battery impulses of different polarity and intensity but of uniform duration; while to the right of the drawing is the receptive circuit network of my invention for detecting impulses of whatever polarity and intensity transmitted but of a shorter duration than what is transmitted by said impulse switch when in proper adjustment. The designation of the thousands registers and that of the impuser switch magnet are the same as shown in the above mentioned patent and it is assumed for the purpose of this description that they are operated completely in accordance with the manner described in said patent. Since, in this description a disclosure of the thousands registers is sufficient to illustrate the principle of the invention the wiring of the remaining switch contacts to other registers is not shown but is simply diagrammatically illustrated.

The essence of the structure of my invention is the provision of an impulse responsive relay for each component element of the transmitted impulse and a relay for each different kind of impulse having an operating time equal to the duration of the impulse. Since in the means chosen to illustrate the invention there are three kinds of impulses involving as many different elements either singly or in combination there are shown in the drawing three impulse relays 100, 101 and 102 which are responsive respectively to a positive impulse, a negative impulse and a negative marginal impulse, that is, an impulse whose direction of current flow is determined by the application of the negative pole of the transmitting battery to conductor 116 and whose intensity is determined by a definite current value flowing through the circuit. It is to be understood, however, that my invention is not limited to any kind or time of impulses or any limiting number of elements thereof but may be expanded to test any number of impulses regardless of their duration or their component elements. With these qualifications the further description of the apparatus will become evident from the detailed description of the operation of the circuit.

Assume that by any suitable means conductors 116 and 117 are extended to a source of impulses such as that shown to the left of the drawing, and that the impulse switch magnet 1500 is about to be operated to cause the revolution of the impulse switch. Key 118 is operated. The opera-

tion of the key connects ground to the armatures of the respective impulse receiving relays 100, 101 and 102 and also to conductor 123, over a path from ground on the normal contacts of relay 132, normal contacts of relay 131, normal contacts of relay 112, conductor 123, top contacts of key 118 to the armatures of relays 100, 101 and 102. This closes the following circuits: (1) ground on armature and back contacts of relay 100, back contacts of 103, winding of relay 104 to battery. Relay 104 operates and closes a locking path for itself through the winding of relay 105 and its own contacts to ground on the contacts of relay 113. Relay 105 does not operate, however, due to the short-circuiting ground on the other side of its winding from the back contacts of relay 103. Relay 103, which is in parallel with relay 105, likewise, does not operate for the same reason. (2) In the same way ground is extended from the back contact of relay 101, back contacts of relay 106, winding of relay 107 to battery, operating this relay and establishing a short circuit for relays 108 and 106 from ground on the back contacts of relay 114. (3) Similarly ground is likewise extended from the back contacts of relay 102, back contacts of relay 109, winding of relay 110 to battery, operating this relay and establishing a short circuit for relays 111 and 109 from ground through the contacts of relay 115. With relays 104, 107 and 110 operated the testing device is conditioned to test the length of the incoming impulses.

The impulses generated by the switch are transmitted, according to the above mentioned patents to Roberts, in the following order: (1) positive impulse or blank, (2) negative or negative marginal impulse, (3) positive or blank, and (4) negative or negative marginal. As described more fully in the above mentioned patent, the duration of each impulse is governed by the rotation of the switch and the time of commutation between the switch cam and cooperating brush through which the impulse circuit is carried. Before the switch begins to rotate, relays 1221, 1503 and 2160 are operated and the first impulse, which is assumed to be positive by virtue of the operated registers, is traced as follows: Source of negative battery through high resistance 120, upper contact of cam 119, front contact of thousands register relay 1221, back contact of relay 1223, upper contact of cam 121, top contacts of relay 1503, top contacts of relay 2160, conductor 116, windings of relays 100, 101 and 102, respectively, conductor 117, bottom contacts of relays 2160 and 1503, bottom contacts of cam 122 to ground. The polarity of this impulse of current is proper for the operation of relay 100 but not for relays 101 and 102 both of which are negatively polarized. Relay 100 operates over this impulse circuit and connects ground to an impulse receiving register of any suitable known construction to record the reception of impulses such, as for example, the one disclosed in Patent No. 1,844,147 to E. H. Clark and issued February 9, 1932. In the meanwhile the removal of ground from the back contact of relay 100 removes the short circuit around relays 103 and 105 which now operate. Relay 103 extends the back contact of relay 100 to conductor 124 and thence to the winding of relay 112. Since, however, relay 100 is operated and its back contact is opened, relay 112 does not operate at this time.

It will be observed that relay 113 is polarized and has two windings the upper one of which is in series with variable condenser 125. Hence

with relay 105 normal and key 118 operated the ground from the lower contacts of the key is extended over the back contacts of relay 105 to resistance 128, which is connected in parallel with both windings of relay 113. The same thing is true with relays 114 and 115 both of which are polarized, each has a variable condenser in series with its respective upper winding and all have ground from the lower contacts of key 118 connected to their respective windings. Consequently with the short circuit of the battery connected to one side of resistance 128 by the aforesaid ground, a charging circuit is established for condenser 125 from the ground through the top winding of relay 113, condenser 125, resistance 129 to battery while another circuit is established through the lower winding of relay 113 from the aforesaid ground, lower winding of relay 113, resistance 129 to battery. The current flow through this lower winding is in a direction not to operate the relay. The current flowing through the charging condenser, however, is in a direction to charge it but its charging strength is not enough to overcome the magnetic force produced by the current through the lower winding so that relay 113 remains normal. When, however, relay 105 operates at the beginning of an impulse, direct ground is disconnected from resistance 128 and applied over the front contact of relay 105 to the other side of condenser 125 and also to resistance 129. The effect of this transposition of ground is to reverse the current flow through the lower winding of relay 113 in a direction to operate it and also provides a discharge path for the energy stored in the condenser. This discharge current, however, is in a direction to oppose the direction of the current through the lower winding so that, for an interval, the currents neutralize each other until the discharge current through the condenser is dissipated to the point where the magnetic force of the current through the lower winding can overcome its further effects and thereby cause relay 113 to operate. The time during which the relay remains normal after relay 105 is operated, that is, from the instant the impulse is received, is governed, then, by the discharging time of condenser 125 which may be varied in accordance with the time desired to have relay 113 remain normal after relay 105 has operated. Assuming, however, that the capacity of condenser 125 has been selected with respect to some known time interval which is to measure the standard length of transmitted impulses, then, so long as relay 100 remains operated for a length of time equal to or greater than the standard impulse, the time taken to discharge condenser 125 will be exceeded by the impulse time of relay 100. As already mentioned, the direction of current flow through the lower winding of relay 113 is such as to cause said relay to operate, so that each time impulse relay 100 is operated for a longer time than the time it takes to discharge condenser 125, relay 113 will operate before relay 100 releases. The operation of relay 113 releases relays 105, 104 and 103, thereby disconnecting the back contact of relay 100 from the conductor 124 which extends to positive impulse alarm relay 112. When, at the termination of the impulse, relay 100 releases relay 104 will reoperate as already described and the subsequent transmission of the succeeding impulse, that is, if it is a positive impulse, will cause the reoperation of relays 105 and 103 for repeating the time measuring cycle.

Should it come to pass, however, that the length of the impulse transmitted by the impulse switch is shorter than the prescribed standard time interval measured by the discharging time of condenser 125, and consequently the operating time of relay 113, relay 100 will release before relay 113 operates in which event the ground connected to the back contact of the prematurely released relay is extended to conductor 124 and closes a circuit for operating relay 112 which locks over its right outer contacts to ground on key 118. Over its left contacts, relay 112 short-circuits conductors 116 and 117 to prevent reception of any further impulses, thereby preventing any disturbance of the test circuit from its condition of impulse failure. Over its right middle contacts an obvious circuit is closed for lighting lamp 130 thereby indicating a failure of a positive impulse while the breaking of its right middle contact disconnects ground from the armatures of the impulse relays. Over its right inner contacts relay 112 closes ground to conductor 136 which connects with a common alarm circuit of any suitable kind to indicate the failure of the test circuit to check an impulse. The impulse register, on the other hand, has also ceased functioning with a failure to receive other impulses so that by comparing the condition of said register with the lighted alarm lamp, it is possible to determine precisely which impulse out of a train of impulses has not measured up to the required length.

The next transmitted impulse is either a light negative impulse or a negative marginal impulse, depending on the setting of the registers, the former causing the operation of relay 101 while the latter that of relay 102 in addition to that of relay 101. In the first group of four impulses whether a light negative impulse or a heavy negative impulse is transmitted as a second and fourth impulse depends upon the setting of the numerical registers of the sender. The impulse switch is connected with the impulse registers in such a manner that the transmission of one or the other of the two kinds of impulses is determined in accordance with the complete description and disclosure contained in the above mentioned patent to T. H. Roberts. Assuming, however, that a light negative impulse is transmitted, then relay 101 operates in response thereto and causes the operation of relays 106 and 108 in parallel but in series with relay 107 in an identical manner as the operation of relay 100 caused the operation of relays 105 and 103 in series with relay 104. Similarly, if the impulse is a negative marginal one and relay 102 is operated at the same time as relay 101, relays 111 and 109 will operate in series with relay 110. Relays 114 and 115 which are the impulse time measuring relays for the light negative and negative marginal impulses, respectively, receive the same preliminary preparation for measuring the length of their respective impulses as relay 113 received. The operation of relays 108 and 111 cause discharging circuits to be closed through condensers 126 and 127, respectively, and if either or both of these relays are still unoperated at the time when relays 101 or 102 or both are released, obvious circuits are closed for relays 131 and 132 which operate and remove ground from the armatures of the impulse relays. The former relay further closes a circuit to light lamp 134 as an indication of light negative impulse failure and the circuit to the common alarm while the latter closes a

circuit to light lamp 135 as an indication of negative marginal impulse failure and also the circuit to the common alarm. As in the case of relay 100, a release of either of relays 101 and 102 prior to the operation of their respective time measuring relays indicates a failure to transmit the required standard impulse. On the other hand, if the impulse relays release after the operations of their respective impulse measuring relays 114 and 115 the cycle is repeated so long as impulses are being transmitted.

While my invention has thus been shown disclosed in skeletonized form, it is evident that it can be adapted in combination with other elements of well known test circuits which are designed to test different features of various electrical and mechanical apparatus.

What is claimed is:

1. An impulse testing device for measuring standard impulse periods comprising impulse responsive means, circuit control means and impulse time measuring means, said last mentioned means being adapted to operate said circuit control means to stop testing on an impulse response of less than standard duration and to continue testing on an impulse response of standard or longer than standard duration.

2. An impulse testing device comprising impulse responsive means, impulse time measuring relays, an alarm and a control circuit responsive to both said means and said relays for operating said alarm when said relays operate on an impulse shorter than that measured by said impulse time measuring relays.

3. An impulse testing device comprising a plurality of impulse responsive relays, each responsive to a different characteristic of an impulse, an impulse time measuring relay for each of said impulse responsive relays, a common alarm, and a control circuit for each of said impulse responsive relays and its cooperating impulse time measuring relay for operating said alarm when said impulse relay operates on an impulse of shorter duration than the operating time of said cooperating impulse time measuring relay.

4. In an impulse testing system, impulsing means, an impulse responsive relay, a time measuring relay adjusted to operate in the standard time of an impulse period, a circuit for said time measuring relay, an alarm circuit, means responsive to the operation of said impulse relay for operating the circuit of said time measuring relay to measure said impulse period, by the time taken to operate said relay in said circuit, and means responsive to the release of said impulse relay after the termination of an impulse and before the operation of said time measuring relay for closing said alarm circuit.

5. An impulse testing device comprising a plurality of impulse responsive relays, each of said relays being responsive to an impulse of a different character, an impulse time measuring relay for each of said impulse responsive relays, each of said impulse time measuring relays being adjusted to operate in the standard time of the impulse for which its associated impulse relay is responsive, an alarm circuit for each different character of impulse, and separate means each responsive, respectively, to each of said impulse relays for operating said alarm circuit to denote a shorter impulse than standard when any of said impulse relays operate before its cooperating impulse time measuring relay.

6. An impulse testing device comprising a plurality of impulse responsive relays, each of said

relays being responsive to an impulse of a different character, a time measuring relay for each of said impulse responsive relays, each of said time measuring relays being adjusted to
 5 operate in the standard time of the impulse for which its associated impulse relay is responsive, a circuit for each of said time measuring relays, an alarm circuit, means responsive to the operation of each of said impulse relays for operating
 10 the circuit each of said time measuring relays to measure said respective impulse periods by the time taken by each of said relays in each of said circuits, and means responsive to the release of any of said impulse relays after the termination
 15 of an impulse and before the operation of its said cooperating time measuring relay for operating said alarm circuit.

7. An impulse testing device comprising a plu-

rality of impulse responsive relays, each of said relays being responsive to an impulse of a different character, an impulse time measuring relay for each of said impulse responsive relays, each of said time measuring relays being adjusted to
 80 operate in the standard time of the impulse for which its associated impulse period is responsive, an indicating device for each different character of impulse, and separate means for each of said impulse responsive relays and its cooperating im-
 85 pulse time measuring relay for operating said required indicating devices to indicate impulse failure when each of said impulse relays operate on an impulse of shorter duration than the ad-
 90 justed operating time of its said cooperating im- pulse time measuring relay.

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