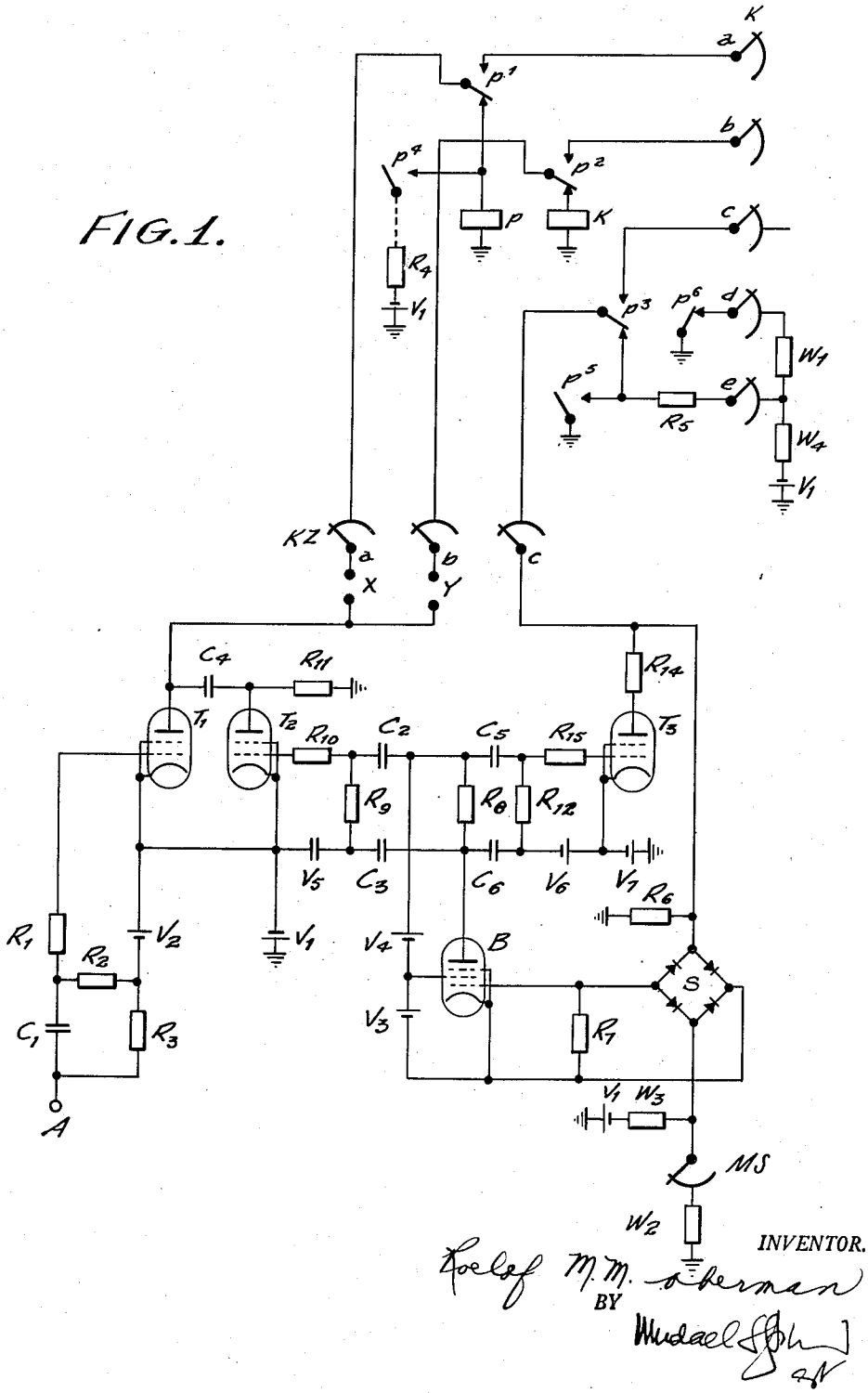
Feb. 5, 1952 R. M. M. OBERMAN 2,584,153

ZERO VOLTAGE IDENTIFICATION DEVICE FOR SELECTOR POSITIONING

Filed Sept. 5, 1947 2 SHEETS—SHEET 1

FIG. 1.



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ZERO VOLTAGE IDENTIFICATION DEVICE FOR SELECTOR POSITIONING

Filed Sept. 5, 1947 2 SHEETS—SHEET 2

Fig. 2

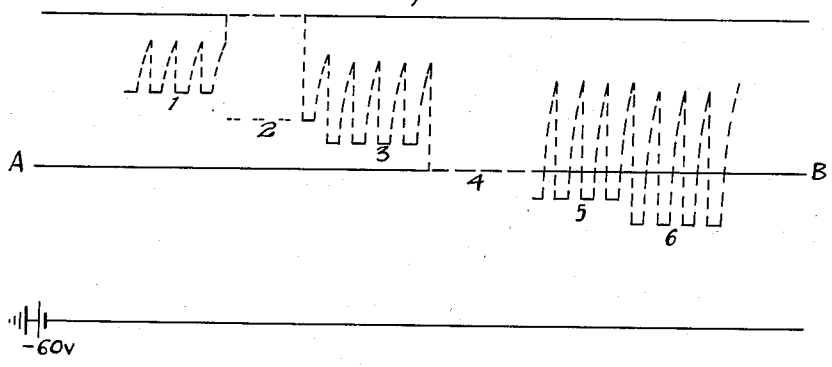
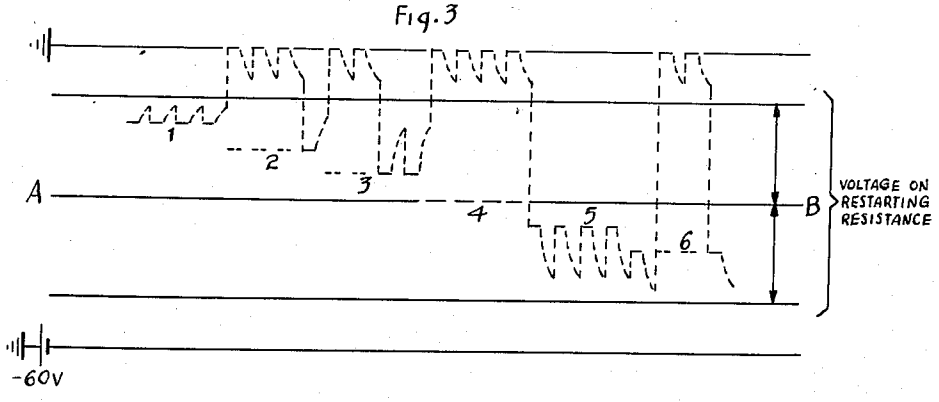


Fig. 3



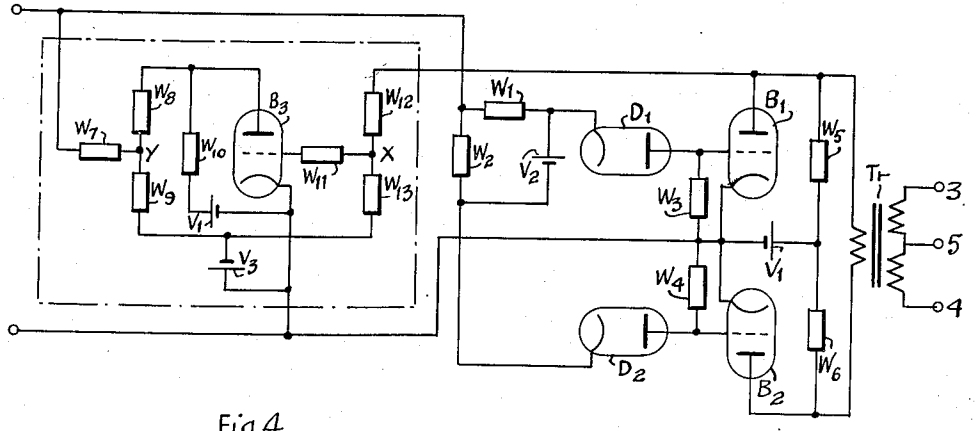


Fig. 4

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ZERO VOLTAGE IDENTIFICATION DEVICE FOR SELECTOR POSITIONING

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Patent expires September 14, 1965

3 Claims. (Cl. 177—353)

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The invention refers to a zero voltage identification circuit for positioning selectors, finders and the like by a bridge marking method.

The control wipers of selectors to be positioned in a bridge marking system should preferably not overlap in order to avoid bridging of two contacts having unequal potential whereby at instants disturbance of marking potential might be produced.

When using a non-overlapping wiper the zero voltage device will in the absence of particular measures momentarily remain, during the interval between contacts in the condition determined by the contact which the wiper has just left.

If a zero voltage device wipes a contact which becomes free at the exact moment that the wiper leaves it the device will operate. The selector concerned is stopped with its wipers between two contacts or on a succeeding contact.

In the latter case no difficulties arise but in the former case they do, for the selector movement should be resumed immediately.

A zero voltage identification device according to the invention comprises a test tube including a cathode, grid and anode, a direct voltage source, a potentiometer connecting the anode of the tube to the negative pole of the voltage source, the positive pole of the voltage source being connected to the cathode of the tube, an auxiliary tube including a cathode, grid and anode, the grid of the auxiliary tube being connected to an intermediate point of the potentiometer, a second potentiometer connecting the anode of the auxiliary tube to the negative pole of the voltage source, a control wiper wire, and means for connecting the control wiper wire with an intermediate point of the second potentiometer.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a circuit diagram for explaining the zero voltage identification device in general and the difficulties arising with such a device which are overcome by the present invention;

Fig. 2 is a diagram showing the potential markings of selector contacts under certain conditions;

Fig. 3 is a diagram showing the potential markings of selector contacts with the device according to the invention; and

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Fig. 4 shows an embodiment of a circuit according to the invention which may be connected to a device as shown in Fig. 1, as more fully explained hereinafter.

Referring now to the drawings and first to Fig. 1, the outlets of the selector K, which can be used as a group selector as well as a final selector, are provided with a marking wiper *e* which wipes the potentials on the contact of the appropriate bank, said potentials being derived from the potentiometers of which only the potentiometer W_1/W_4 is shown. Current is supplied to this potentiometer by the high voltage battery V_1 connected to ground, said potentiometer being connected to ground over the wiper *d* of the selector. The selector K is positioned by a coupling magnet also denoted by K to which current is supplied from the register. The selecting stage comprises a switching relay P to effect the switching on to a following stage or to a subscriber.

The register is provided with a marking switch MS. Obviously it was sufficient to explain the mode of operation for one digit, for every digit of the subscriber's number another marking switch being provided with the associated switching means. A potentiometer W_2/W_3 supplies the marking potential to a rectifier network S. Said rectifier network S is connected over the wiper *c* of the cord finder KZ to the control wiper *e* of selector K, the negative terminal of said network being connected to the control grid of the test tube B and the positive terminal to the cathode of said tube. The anode circuit of said test tube B is connected to the control grids of two thyratrons T_2 and T_3. The connection to thyratron T_2 includes condensers C_2 and C_3 and resistors R_9 and R_{10}. The connection to thyratron T_3 includes condensers C_5 and C_6, and resistors R_{12} and R_{13}. The anode circuit of thyratron T_2 is connected over a condenser C_4 to the anode circuit of a thyratron T_1 by which the coupling magnet of the selector K is energized, the thyratron T_1 being brought to conductive condition by applying ground to the control grid thereof by grounding the terminal A.

The operation of this device is as follows:

The marking switch MS is positioned in a well known way, for instance by the subscriber's dial. It is supposed to be positioned on the contact which is connected to resistor W_2. When sufficient digits are received the register is started for positioning the selectors. The start impulse is issued by applying ground to terminal A so that the grid potential of thyratron T_1 is changed over condenser C_1 and resistor R_1 so much so as to ignite this tube. The thyratron T_1 will remain

conductive when the grid bias has reached the battery potential of source V_2 over resistors R_2 and R_1. The circuit for the coupling magnet K is now closed from ground over coupling magnet K, contact p_2 of relay P, wiper *b* of the cord finder KZ, contact Y of a sequence switch, thyratron T_1 to high voltage battery V_1 and ground.

The selector K will now wipe the outlets and by means of wiper *e* wipe the control potentials marking the outlets derived from potentiometer W_1/W_4. To avoid current consumption the other terminal of the said potentiometer is connected to the corresponding contact of the bank *d* which is connected to ground over its appropriate wiper and contact p_6 of relay P, so that only a circuit is closed for the outlet which is tested. The wiped potential is transmitted to the rectifier network S in the register over resistor R_5, back contact p_3, wiper *c* of the cord finder KZ to said network. The other terminal of said network is connected to the potentiometer W_3/W_2 which forms part of the marking switch MS. The rectifier network imparts the supplied potentials to the test tube B in such a way that the control grid is kept negative with respect to the cathode, this being the object of said network.

When wiper *e* of the selector K reaches a contact which has a potential substantially equal to the potential supplied by potentiometer W_3/W_2, a bridge equilibrium according to Wheatstone is obtained. The control grid will now carry a potential substantially equal to the cathode potential so that the tube B will be rendered conductive. The anode circuit of tube B is provided with a resistor R_8, which is coupled over the condensers C_2 and C_3 with the grid circuit of the thyratron T_2 and over condensers C_5 and C_6 with the grid circuit of the thyratron T_3. It is also possible to effect a coupling by means of a transformer.

The selector to be positioned is rotated by the common driving equipment which is coupled by the magnet K. This magnet is operated over the ignited thyratron T_1. The selector K is stopped by igniting the gaseous discharge tube T_2.

The voltage caused in the grid circuit of thyratron T_2 when the searched bridge equilibrium is reached, reduces the negative bias of this tube so that it is suddenly ignited. Owing to this phenomenon a voltage impulse is transmitted over condenser C_4 to the anode of the thyratron T_1, owing to which the voltage between the anode and the cathode of this tube is so reduced that it is extinguished. Thus the selector K is stopped because the coupling magnet is de-energized. When quickly operating selectors are used as is possible in systems operated in bridge equilibria the rotary speed of the selectors is not limited by impulse speeds. To avoid a delaying electromechanical link in the form of test relays the rotation of the selectors is to be controlled by means of thyratrons. In the register the tube B determines the bridge equilibrium and then interrupts almost without delay of time the current in the thyratron T_1 in the circuit to the coupling magnet of the selectors that is to be positioned, so that a proportionately long brake route remains available for the wiper set.

When the selector which is to be positioned, is stopped, the functioning of the described arrangement is not ready. An outlet of a selector marked by a potentiometer has to be busied by grounding the control wiper *e* over a resistor R_5, so that the voltage at the contact changes by a certain amount, in such a manner that the testing devices of other registers wipe this outlet as busy.

This busying is effected in the arrangement according to the invention by means of the thyratron T, the grid circuit of which is connected over the condensers C_5 and C_6 and over resistors R_{13} and R_{12} to the anode circuit of the tube B. When the group selectors are positioned, this tube is also ignited under the same conditions as mentioned with regard to the tube T_2, for stopping and finding a free line are identical notions for group selectors.

In the arrangement shown, the anode of the thyratron T_3 is connected over the resistor R_{14} to the circuit to the control wiper *e* of the selector K which is to be positioned, while the voltage source V_7 for the current supply of this tube is connected to the cathode. When the thyratron T_3 becomes conductive and the resistors W_1, W_2, R_5, R_{14} are well dimensioned, a voltage drop of e. g. 1 v. will be effected at the tap of the potentiometer W_1, W_4.

The thyratron T_3 busies the engaged outlet in about 10^{-6} to 10^{-4} sec. This depends on the value of the applied bridge resistors and the capacities of the circuit to the control wipers of the selectors to be positioned. As these periods of testing and bushing are very short, it is not necessary to provide devices in the register to make an investigation for double testing.

A normal electronic tube is chosen for the tube B, which should preferably have a slight grid swing and if possible a great mutual conductance. For attaining a stable operation, the anode current should only in a small degree be dependent on the anode voltage, as it is the case with pentodes.

Gaseous discharging tubes are not fit for the function of said tube B, as for the marking of the necessary number of potentials they have to be biased too close to the ignition. Under such conditions the operation of the gaseous discharging tubes is unstable, slight interferences from the outside rendering the tube conductive.

If the potentiometer W_2/W_3 is positioned by the marking switch MS on a potential of −30 volts, this being ½ the potential of battery V_1, during the rotation of the control wiper over the contacts or groups of contacts which start with a potential of ½ v. 1—20 volts and rise at steps of 1 volt to a potential of ½ v. 1+20 volts, the bias of the tube B will decrease step by step by the same difference, and if no means are provided to stop the selector, the grid bias, after having been zero during the wiping of a contact or a group of contacts, will increase step by step to a high negative value. A slight grid swing having been chosen, the tube B is brought to cut off by a large number of potential steps wiped by the wiper *e*, so that no or at most a negligibly small anode current flows through this tube. When applying a tube which for 1 volt potential intervals is brought to cut off at a grid bias of a little less than 1 volt, it will carry a normal anode current only when the required equilibrium is reached by the wiper *e*. Thus a perfect selectivity is obtained.

Tubes with a greater grid swing than the smallest interval to be tested can also be applied. The tube of the type EF6 is e. g. practically brought to cut off at a −4 v. grid voltage.

At an anode voltage of 250 v., a screen grid voltage of 100 v., and control grid voltage of −3, −2, −1, and 0 v., plate currents of 1, 3, 5½, and 7¾ mA., respectively, are flowing.

When bridge equilibrium is reached, the current variation amounts of about 50% when this type of tube is used. This marginal effect can be used to control a thyratron reliably. The control wiper e of the selector K should preferably be non-overlapping, so that no through connection is caused between the contacts when the wiper is moved from one contact to another. The non-contacting of the control wiper e decreases the grid bias of the tube B regularly to zero, so that, if no special measures are taken, an anode current will flow in tube B as if an equilibrium had been reached in the bridge.

If the wiper e is non-contacting the tube B should be brought to cut off. For this purpose the high resistor R_6 is provided in the register between ground and the circuit to the wiper e. If the wiper e is non-contacting, the grid of the tube B gets a negative voltage with respect to the cathode, which voltage is equal to the potential indicated by the wiper of the marking switch MS. The tube B should be made to cut off by the lowest potential to be indicated by the wiper of the marking switch MS. By the movement of the control wiper e a pulsating direct voltage is applied to the grid of the tube B, so that an anode current begins to flow only near the bridge equilibrium.

A special situation, however, has to be considered. It is possible that just at the moment when a busied outlet is released, a wiper which hunts for this outlet wipes over the contact. The testing device is operated by the short response time. During the braking action thereof the control wiper can leave the relevant contact and stop between the contacts, or may be even on a subsequent not desired contact. The first case can be easily determined by the register, the latter case, however, not. When potentiometers are used to characterize the various outlets of the selectors, the possibility that a selector outlet is busied can be restricted (by biassing the tube B in a special manner with respect to the voltage intervals that are to be wiped) to those outlets which are not busy when the control wiper is moving on. If a tube of the type EF6 is used as tube B the voltage intervals mount to 2 v., while the outlets of a group selector are busied by a potential shift of 1 v. Thus the anode current will increase to 7¾ mA. when the bridge equilibrium is reached, while the current will increase only to 5¼ mA. when a busy outlet in the desired group of outlets is wiped. When a busy contact in the desired group of outlets is released when the control wiper is wiping it, the anode current of the tube B increases from 5¼ to 7¾ mA. This change cannot fire the tubes T_2 and T_3, thus it cannot extinguish the tube I. In this case the limit value for the ignition of the thyratrons T_2 and T_3 should be determined by a grid voltage change of the tube B from −4 to −½ v. The potentiometer of the busied outlet can again be made non-conductive by a contact of the switching relay P, so that it is only conductive during the actual test of the relevant outlet.

Another solution is obtained by connecting the restarting resistance to a source positive with regard to the marking potential while the control wiper wipes selector contacts which are also positive to it whereas this resistance is connected to a source negative to marking voltage, while contacts are wiped which are also negative to it.

Hereby it is obtained that the zero voltage identification device input is not swung over relatively slowly past the zero position whereby the generation of uncertain impulses is avoided. The invention will be explained with reference to some figures.

Fig. 1 shows a diagram for the voltage markings of selector contacts in which the restarting resistance has fixed potential.

Fig. 2 shows a diagram of the voltage markings of selector contacts with automatically alternating potential on the restarting resistance.

Fig. 3 shows a circuit example.

The diagram of selector voltage markings with six groups of four contacts each with potentials between ground and −60 v. is shown by way of example in Fig. 1. The line AB indicates the marking potential from the register. Thus the selector should be directed to a free outlet in group four.

If the selector starts from home position the four contacts of group 1 are first wiped. The restarting resistance is supposed to be connected to ground. Therefore the zero voltage device input voltage alternates between the potential of line A—B to ground and the marking voltage of group 1 with respect to ground. As the selector contacts are marked by means of potentiometers having relatively low resistance the input voltage of the zero voltage device will jump to its final value practically instantaneously on the control wiper attaining a contact whereas it resumes its original value relatively slowly, due to the ground on the restarting resistance, when a contact is left. The contacts of the group 1 are all shown free in Fig. 2 whereas the first three contacts of group 2 are busy and marked by ground. The input voltage of the zero voltage device thus does not change at all when wiping busy contacts.

The first contact of the desired group four has been shown free so that on reaching it the zero voltage device will operate for stopping the selector concerned. So far no difficulty is met.

If, however, all contacts of group four are busy and the selector is of continuous hunting type the wiper will pass through succeeding groups the zero voltage device input voltage varying ever through zero on the control wiper making as well as breaking contacts in groups 5 and 6, at least in so far as the wiped contacts are free.

On wiping such a contact the shift over is so quick that no disturbance can result but on breaking the contact disturbing impulses can be produced by the zero voltage device, as described.

In Fig. 3 a voltage marking diagram for selector contacts is shown in which the restarting resistance is automatically connected to a voltage which is negative or positive by fixed amount with regard to the marking voltage level, this dependent on whether a contact with negative or positive potential with respect to the marking voltage is wiped.

The contacts of the desired group four are all supposed busy so that the selector hunts on; the group 5 contacts are all free and the second and the third contact in group 6 have been busied by ground. As this ground has low resistance the shift through zero is so quick that the zero voltage device can produce no undesired impulses.

Fig. 4 shows a zero voltage device circuit with which the voltage diagram of Fig. 3 may be obtained.

The device shown in Figure 4 comprises a transformer with a tapped winding the ends of which are denoted by 3 and 4 and the tap of which is denoted by 5. The device according to Fig. 4 is intended for replacing the restoring

resistor and the test tube according to Fig. 1 and to this end the terminals 3, 4, 5 are to be connected to the thyratrons T_2, T_3 and the midpoints thereof, respectively. The control wire leading to the wiper *e* of the selector K via wiper *c* of the cord finder KZ has to be connected to terminal 1 of Fig. 4 whereas terminal 2 of the same has to be connected to the marking switch shown in Fig. 1.

If terminal 1 of Fig. 4 is sufficiently negative with respect to terminal 2 both test tubes B_1 and B_2 are non-conductive, whereas for bridge equilibrium or small input voltages only tube B_1 is conductive. For large input voltages, for which terminal 1 is positive with respect to terminal 2 both tubes B_1 and B_2 are conductive. To the zero device proper the circuit in the mixed broken line has been added. This circuit provides the restarting resistance W_7 by means of the potentiometer consisting of resistances W_8 and W_9 with a voltage of desired polarity with regard to the conductor connected to terminal 2 of the circuit. Optionally the conductor to terminal 1 may be connected to point Y without interposition of W_7.

The potentiometer consisting of resistances W_{12} and W_{13} is at one end connected to tube B_1 anode and at the other end to voltage source V_3. These are of such value that tube B_3 is conductive when tube B_1 is non-conductive due to an appropriate voltage on the control grid via the protecting resistance W_{11} whereas on tube B_1 passing current the voltage across resistances W_{12} and W_{13} so far as decreases that tube B_3 is brought to cut off.

The voltage on point X may in this manner be made positive or negative with regard to the terminal 2 with the wire connected thereto, dependent on the state of conductivity of tube B_1. This is exactly in phase opposition to the voltage required for the restarting resistance.

The control grid of a tube B_3 has for this reason been connected in Fig. 4 to the point X for obtaining a phase inversion of the voltage. Point X of the potentiometer comprising resistances W_{12} and W_{13} and which is coupled to tube B_3 in thus negative with tube B_1 non-conducting and positive with tube B_1 conducting both with respect to the wire connected to terminal 2.

The tipping over of the voltage applied to restarting resistance W_7 occurs simultaneously with a change in the conductivity of tube B_1 due to the selector control wiper contacting a certain voltage. The tipping over occurs directly after the contact so that this may not influence the condition of the zero voltage device so long as the control wiper touches a contact due to the high value of the restarting resistance.

If necessary or desired the control grid circuit of the restarting tube B_3 may be coupled to the anode circuit of tube B_2 instead of B_1. The inversion of the restarting voltage polarity then occurs on modification of the state of conductivity of tube B_2 i. e. not on the device of Fig. 3 testing zero but on wiping an input voltage having positive polarity with regard to terminal 2.

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. Zero voltage identification device for the control of moving switches in a bridge marking circuit comprising, a control wiper wire; a resistance connected to said control wiper wire; a voltage source positive with respect to the marking potential; means for connecting said resistance to said voltage source when the control wiper of the switch is on a contact having a potential positive with respect to the marking potential; a voltage source negative with respect to the marking potential; and means for connecting said resistance to said last mentioned voltage source when the control wiper of the switch is on a contact negative with respect to the marking potential.

2. Zero voltage identification device for the control of moving switches in a bridge marking circuit comprising, a test tube including a cathode, grid and anode, a direct voltage source; a potentiometer connecting said anode of said tube to the negative pole of said voltage source; the positive pole of said voltage source being connected to said cathode of said tube; an auxiliary tube including a cathode, grid and anode, said grid of said auxiliary tube being connected to an intermediate point of said potentiometer; a second potentiometer connecting said anode of said auxiliary tube to the negative pole of said voltage source; a control wiper wire; and means for connecting said control wiper wire with an intermediate point of said second potentiometer.

3. Zero voltage identification device for the control of moving switches in a bridge marking circuit comprising, a test tube including a cathode, grid and anode, a direct voltage source; a potentiometer connecting said anode of said tube to the negative pole of said voltage source; the positive pole of said voltage source being connected to said cathode of said tube; an auxiliary tube including a cathode, grid and anode, said grid of said auxiliary tube being connected to an intermediate point of said potentiometer; a second potentiometer connecting said anode of said auxiliary tube to the negative pole of said voltage source; a control wiper wire; and a resistance for connecting said control wiper wire with an intermediate point of said second potentiometer.

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