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2,367,509

HIGH OR LOW VOLTAGE DETECTOR

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FIG. 1

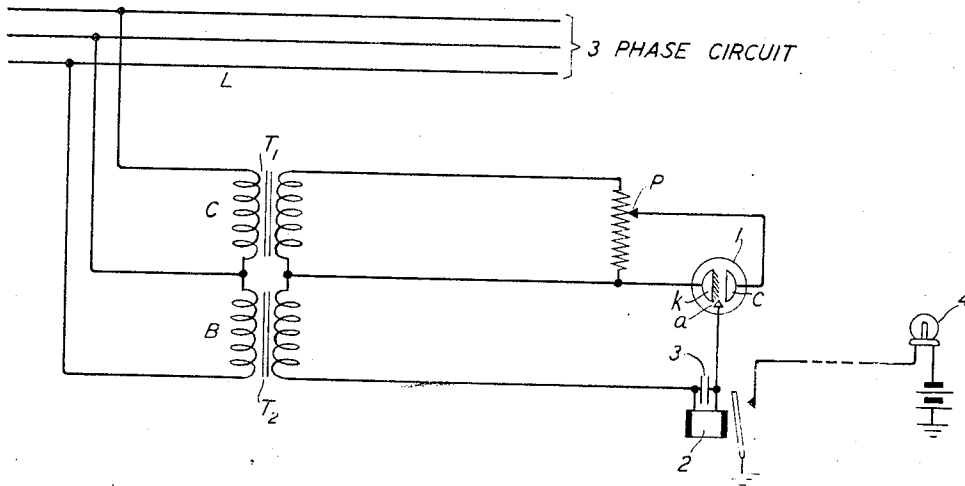


FIG. 2

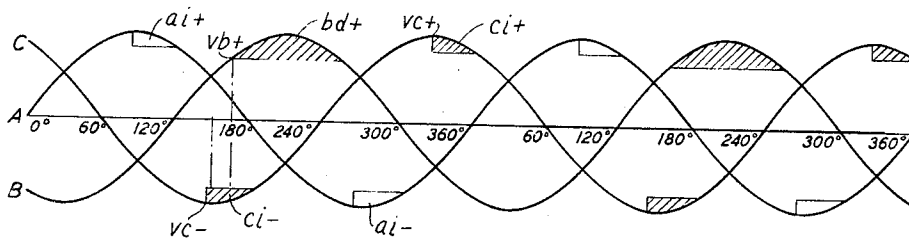
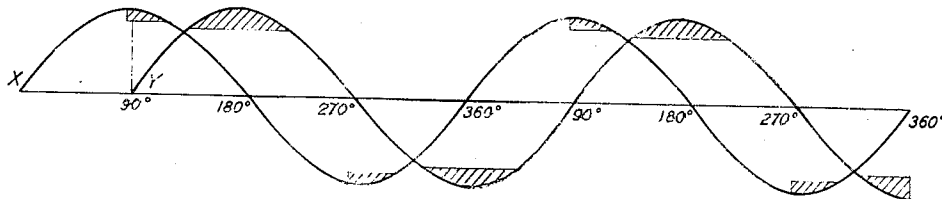


FIG. 3



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HIGH OR LOW VOLTAGE DETECTOR

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2 Claims. (Cl. 177—311)

This invention relates to an improved and simplified arrangement for detecting abnormal conditions in polyphase alternating current circuits such, for example, as a high or low voltage condition, but not both, or a reversal of phase rotation, and more particularly to the use of a single, or common, three-element gas-filled discharge device for detecting such abnormal conditions in two or three-phase transmission lines.

The use of a three-element gaseous device for detecting either a high or a low voltage condition in a single phase transmission line is old as shown for example in applicant's Patent 2,197,868, issued April 23, 1940, and it is obvious that were it desired to detect such conditions in more than one phase of a polyphase circuit, it would only be necessary to duplicate the arrangement of the patent for each phase to be monitored.

A feature of the present invention, however, resides in the use of a single three-element gas-filled discharge device having its control and main discharge circuits individually connected across different ones of said phases, and so adjusting the characteristic of said device and its connection to the phases that a predetermined potential across the phase to which the control circuit is connected will cause ionization of the device for an interval sufficient to permit a discharge to be established between the anode and cathode when the potential across the phase to which the main discharge circuit is connected also reaches a predetermined value thereby permitting the performance of any desired circuit function such as actuating a relay to control a signal device which may indicate a low voltage in either phase by its failure to operate.

Alternatively, a high voltage condition can be detected by employing a gas-filled device whose control gap will only discharge to cause ionization at above normal potential. When used as a high voltage alarm the control gap will break down only at higher than normal voltage in the phase to which it is connected, thus ionizing the device whereupon the main gap will fire to operate a relay and give an alarm.

It is, of course, understood that any voltage unbalance in one phase of a three-phase circuit will be reflected in the other two phases sufficient to affect ionization and discharge of the device connected thereto.

Further, if it is assumed that a reversal of rotation occurs between any two of the phases of a three-phase circuit if the discharge device has a relatively short deionizing time and the main gap is polarized, i. e., will conduct only on a positive

potential applied to the anode, ionization due to the control gap breakdown will cease before the potential on the anode has risen to a sufficient value to maintain the discharge across the main gap and therefore the signal relay will release to indicate an abnormal condition.

The invention will be understood from the following description when read in connection with the accompanying drawing:

Fig. 1 of which shows a three-phase transmission line to which is connected means in accordance with the invention for indicating a low voltage condition in any one of the three phases which it will be understood are 120 degrees apart;

Fig. 2 shows the relation of the voltages of three phases which it is desired to monitor; and

Fig. 3 shows the relation of the voltages of a two-phase circuit.

Referring to Fig. 1 of the drawing two transformers T_1 and T_2 are connected "open delta" to a three-phase line L and the cathode k of the cold cathode gas-filled device 1 is connected to the common point of the two secondary windings. The control anode c is connected by means of potentiometer T to the free terminal of the secondary winding of transformer T_1 and the main anode a is connected in series with a relay 2 to the free terminal of the secondary of transformer T_2 . A condenser 3 is connected in shunt to relay 2 for the purpose of preventing the relay from releasing between successive pulsations of current applied thereto. The transformation ratios of the transformers T_1 and T_2 and the setting of the slider of potentiometer P are such that the control gap $k-c$ of the device 1 will break down near the peak of the normal line voltage in phase C and the main gap $a-k$ of the device will fire a short interval after ionization occurs. For example by referring to Fig. 2, which shows the relation of the three phases A , B and C , it will be noted that when phase C approaches its negative peak voltage $vc-$, the control gap will fire as shown by the shaded area $ci-$, thus ionizing the device and that almost immediately thereafter the potential of phase B reaches a point $vb+$ which is high enough to permit the main gap of the device 1 to fire thus operating relay 2 , thereby opening the circuit of the pilot lamp 4 . Condenser 3 charges in parallel with relay 2 and when the voltage of phase B drops below the sustaining voltage of the main gap, thus stopping the discharge, the condenser 3 will discharge through the relay thus holding it operated until the main gap is again fired on the next cycle.

It will be obvious from the foregoing that if the

voltage of either phase C or B falls below its normal value, relay 2 will release thus closing the circuit of lamp 4.

As stated previously if the voltage of phase A drops below its normal value, it will reflect an unbalanced condition in phases C and B thus preventing device 1 from operating and permitting the relay to release.

If the device 1 is polarized, that is, its main discharge path conducts in only one direction (anode-cathode) relay 2 will be energized once each cycle, i. e., when phase C approaches the peak of its negative half wave and phase B approaches its positive peak whereas if the device 1 is not polarized, that is, will discharge in either direction, then relay 2 will be energized twice each cycle, once when the phase C reaches its negative peak and phase B is approaching its positive peak and again when phase C reaches its positive peak and phase B is approaching its negative peak.

Obviously, if a phase reversal occurs in the line and the voltage applied to the control electrode C of device 1 is derived from phase A, instead of phase C, the periods when the device will be ionized will be represented by the unshaded portion $ai+$ and $ai-$ and if the device has a short deionizing time, deionization will be completed and the device restored to normal before there is sufficient voltage in phase B to initiate and maintain an arc. This provides a check circuit sensitive to phase rotation and relay 2 will be released and lamp 4 lighted in case such a reversal occurs. If, however, the device 1 is so constructed as to have a relatively long deionizing time, which is sufficient to hold over until the voltage of phase B approaches its peak value, then relay 2 will hold operated regardless of whether the control electrode c is connected to phase C or A.

It will be understood that by employing a discharge device having a relatively long deionizing time the foregoing arrangement, shown in Fig. 1, as connected to a three-phase system, can be adapted for use on a two-phase circuit the relation between the phases of which is shown in Fig. 3, that is if the control gap is connected to phase X, and the main gap to phase Y, ionization of the device occurs near the peaks of phase X and the main gap will fire as the voltage of phase Y approaches its positive peak, i. e., once per cycle and if the device is non-polarized it will fire twice per

cycle, that is when the voltage approaches both the positive and negative peaks.

If the foregoing arrangement is employed as a high voltage alarm, then it is only necessary to adjust the circuit elements in such a manner that the control and main gaps of the device 1 will not fire until a predetermined higher than normal potential is reached and to connect lamp 4 in such a manner that it will be lighted when relay 2 is operated instead of released.

What is claimed is:

1. In a system for detecting a non-standard condition in polyphase transmission lines, a gas-filled discharge device having an anode, a cathode, a control electrode and an output circuit, circuit means for connecting said control electrode and cathode to a first phase of said line, and other circuit means for connecting the anode and cathode in series with said output circuit to a second phase, said device being so constructed and said circuits being so adjusted and arranged that the device will ionize when the voltage of the phase to which the control electrode is connected reaches a predetermined value and will remain ionized until the voltage applied to the anode from the second phase reaches another predetermined value whereupon a glow discharge will be established between said anode and cathode, and means for indicating the failure of said device to establish a glow discharge during a cycle of said alternating current.

2. A three-phase supply circuit, a gas-filled discharge device having an anode, a cathode, and a control electrode, circuit means for connecting said cathode and control electrode to a first phase and the cathode and anode to a second phase, said device being so constructed and said circuits being so adjusted and arranged that the device will ionize when the voltage of the phase to which the control electrode is connected reaches a predetermined value and will remain ionized until the voltage applied to the anode from the second phase reaches another predetermined value whereupon a glow discharge will be established between said anode and cathode, and means for indicating the failure of said device to establish a glow discharge during a cycle of said alternating current.

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