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SEQUENTIAL SELECTION OR HUNTING ARRANGEMENTS

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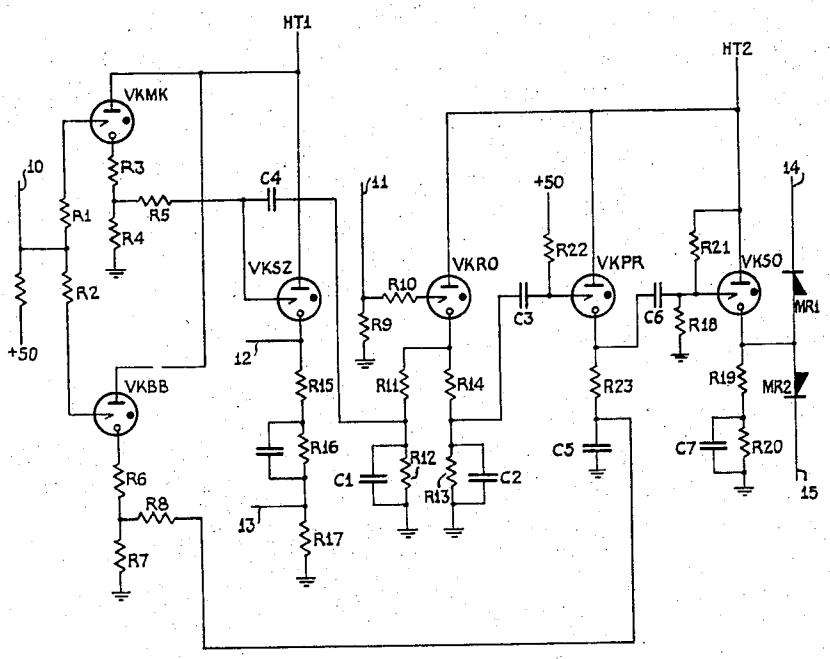
Fig. 1



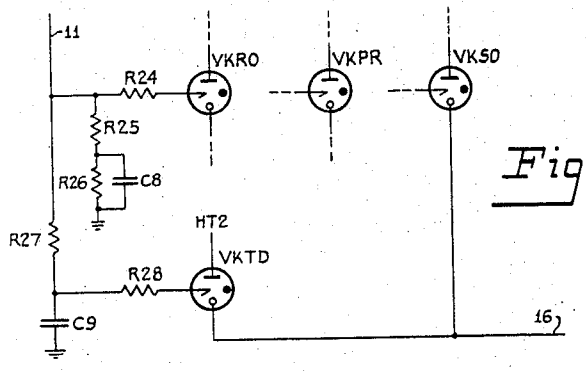


Fig. 2

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SEQUENTIAL SELECTION OR HUNTING ARRANGEMENTS

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5 Claims. (Cl. 315—84.5)

The present invention relates to switching devices having a plurality of selection stages and is more particularly concerned with switching devices having a plurality of serially-connected stages each corresponding to one outlet of the device, the stages being arranged to operate in succession in response to a signal applied to one of the stages from an external source.

It is well known to employ cold cathode gas discharge tubes in a switching device of this type and although these have proved efficient and reliable in operation the possibility exists that should any stage fail to operate correctly then subsequent outlets can no longer be tested. Thus if the failure occurs in a stage at or near the beginning of the operation of the device, the number of outlets which may be tested in subsequent operations will be severely restricted.

The object of the present invention is to provide a high speed switching device which is capable of testing all outlets associated with it, irrespective of a fault in any stage.

According to one feature of the invention, in a switching device having a plurality of serially-connected stages each corresponding to one outlet of the device, the stages being arranged to operate in succession in response to a signal applied to one of the stages from an external source each stage includes a pair of gas discharge tubes connected to form a two position circuit device and according to whether the corresponding outlet is or is not in a condition to be seized one or other of said gas discharge tubes is caused to conduct on the conduction of a third gas discharge tube in response to the application thereto of a signal from the preceding or succeeding stage thereby enabling the device to operate in both directions.

According to a further feature of the invention, in a switching device having a plurality of serially-connected stages each corresponding to one outlet of the device, the stages being arranged to operate in succession in response to a signal applied to one of the stages from an external source each stage includes a pair of gas discharge tubes connected to form a two position circuit device and according to whether the corresponding outlet is or is not in a condition to be seized one or other respectively of said gas discharge tubes is caused to conduct on the conduction of a third gas discharge tube to which a signal is applied, the conduction of said other tube serving to repeat the signal to the gas discharge tube of the preceding or succeeding stage corresponding to said third gas discharge tube thereby enabling the device to operate in both directions.

According to a further feature of the invention, in a switching device having a plurality of serially-connected stages each corresponding to one outlet of the device, the stages being arranged to operate in succession in response to a signal applied to one of the stages from an external source, the operation of a stage being

normally effective either to seize the corresponding outlet or to cause the operation of the succeeding stage each stage includes a timing circuit which if the stage fails to operate within a predetermined period becomes operative to transmit a signal to the succeeding stage to enable that stage to operate.

The high speed switching device is such that the number of stages provided therein corresponds with the number of outlets forming the group it is required to test. For example, if the group to be tested has a maximum of ten outlets then the high speed hunt for that group also has ten stages. It follows then that if a group identification were provided a plurality of groups could be connected in common to the high speed switching device.

The invention will be better understood from the following description of one embodiment taken in conjunction with the accompanying drawings which in Fig. 1 shows the circuit of one position of a reversible high speed selecting or hunting arrangement. Fig. 2 shows the method of modifying the arrangement to unidirectional operation with a step-on facility.

Referring now to Fig. 1 of the drawings, when the switching device is to be operated, control equipment (not shown) serves to apply high tension voltage HT1 to the anodes of the cold cathode tubes VKMK, VKBB, VKSZ and the high voltage HT2 to the anodes of the cold cathode tubes VKRO, VKPR, VKSO in each stage of the switching device. It also results in all the idle outlets in the group being identified by a striking voltage applied to the lead 10 of the associated stage, this lead being common to the corresponding stage in all groups.

Assuming the first outlet in the group to be idle, then this firing voltage through resistors R1 and R2 raises the voltage on the trigger electrodes of tubes VKMK and VKBB to a value which is sufficient to ionise the tubes and cause the main gaps to strike. The cathode resistance of tube VKMK is formed by resistors R3 and R4 connected in series to earth and arranged as a potential divider, the required voltage to prime tube VKSZ at its trigger electrode being tapped off through resistor R5. In the case of tube VKBB, the cathode resistance also takes the form of a potential divider by resistors R6 and R7 connected in series to earth. A suitable positive potential is tapped off this divider through resistor R8 and applied to the cathode circuit of tube VKPR, thereby making it insensitive to pulses subsequently applied to its trigger electrode. Although this potential will also be coupled by capacitor C6 to the trigger electrode of tube VKSO its magnitude is not sufficient to ionise it.

A striking voltage is now applied from the control equipment to the lead 11 of the first stage of the switching device to start a hunting action over all the outlets in the selected group. The trigger electrode of tube VKRO is connected to earth through resistors R9 and R10, the lead 11 being connected to the junction of these resistors. The striking voltage applied to lead 11 causes the voltage present on the trigger electrode of tube VKRO to rise to a value which is sufficient to ionise the tube and cause the main gap to strike.

The cathode circuit of tube VKRO is split into two series branches connected to earth and comprises resistors R11 and R12 and resistors R13 and R14 respectively. Capacitors C1 and C2 are connnected across resistors R12 and R13 respectively and the time taken for the cathode potential to reach a steady value is therefore dependent on the time constant of the two series branches. When the tube VKRO conducts the rise in potential at the junction of resistors R13 and R14 is coupled by ca-

pacitor C3 to the trigger electrode of tube VKPR, but does not ionise this tube due to the backing-off potential applied to its cathode from the cathode circuit of tube VKBB.

The other branch of the cathode circuit of tube VKRO, namely resistors R11 and R12 and the coupling capacitor C4, provides a circuit whereby a striking pulse is applied to the trigger electrode of tube VKSZ when tube VKRO conducts.

When tube VKSZ conducts, there is a rise in potential at various points in its cathode circuit, formed by the series resistors R15, R16, R17 to earth, and a potential will therefore be present on lead 12, which could be used externally to the switching device to seize the corresponding outlet in the group. Also a potential on lead 13 from the junction of resistors R16 and R17 could be used to operate an external tube extinguishing circuit. This would effect the removal of the high voltage HT2 from tubes VKRO, VKRP and VKSO. Thus tube VKRO will be extinguished, and the selection or hunting is completed for this group.

Coincident with the application of the striking voltage to lead 11, a timing circuit, with a time duration equal to the time taken to test all outlets in the group, is made operative in the control equipment to ensure that no faulty operations are encountered during the hunting action. If an idle stage is found then the timing circuit is disconnected but if a faulty operation has occurred then the timing cycle is completed and the control circuit arrangements are such that the direction of testing can be reversed. Also suitable alarm and supervisory conditions will be initiated by the control equipment due to the hunt timing circuit completing its operation. For example, if the group has ten stages then the timing circuit will cover the testing of all these stages. However if faulty operation occurs, hunting stops, say at stage three, then the timer completes its cycle and enables the control equipment to arrange for the hunting to recommence from stage ten towards stage one, and the timing cycle to recommence. If still no idle stage is found between stages ten and three, then hunting will again stop at the faulty stage three allowing the timing cycle to be completed, and the appropriate supervisory indication given.

Assume now that in the group to be tested the idle outlet occurs at other than the first stage in the group. As described previously all idle outlets in the group will be indicated by the firing of tubes VKMK and VKBB in the relevant high speed hunt stages. However, as the first outlet in the group is busy, tubes VKMK and VKBB will not be fired and hence no backing off voltage will be applied to tube VKPR.

When the control equipment applies the condition to commence the hunting action, a striking voltage is applied to the trigger electrode of tube VKRO and the main gap strikes, as previously described. When tube VKRO conducts the rise in potential at the junction of resistors R13 and R14 is coupled by capacitor C3 to the trigger electrode of tube VKPR, the trigger being primed through resistor R22. This additional potential causes tube VKPR to fire.

The cathode circuit of tube VKPR is formed by the series resistor R23 and capacitor C5 to earth, with resistors R8 and R7 in series connected across the capacitor C5. When tube VKPR conducts the rise in potential at its cathode is coupled by capacitor C6 to the trigger electrode of tube VKSO, its trigger being primed by being connected to the junction of the series resistors R21 and R18 which are connected between HT2 and earth. The increased potential on the trigger electrode of tube VKSO causes it to strike.

When tube VKSO conducts, a rise in potential occurs in its cathode circuit, which is formed by the earthed series resistors R19 and R20 with capacitor C7 connected across the latter resistor. The cathode of tube VKSO is directly connected to two forward conducting rectifiers MR1 and MR2 in leads 14 and 15 respectively which provide the circuit to enable hunting action to continue from stage to stage as each outlet is tested. Leads 14 and 15 are, in effect, signal repeating leads. Each lead 14 is connected to the lead 11 of the preceding stage while each lead 15 is connected to lead 11 of the succeeding stage. There are slight differences in the first and the last stages of the hunting chain where, in the case of the first stage lead, 14 is not used and, in the case of the last stage, lead 15 is not used. It is to be noted that when hunting in any direction takes place, tube VKSO applies a potential to both leads 14 and 15, only one of which will be effective to continue the hunt in the required direction. The remaining lead will be ineffective as it is connected to the lead 11 of a stage in the hunt that has already been tested and fired.

The tube VKSO having struck in the first hunting stage connects a positive potential to lead 15 which being connected to lead 11 of the second hunting stage, causes the tube VKRO in that stage to fire. This tube behaves as previously described, either firing tube VKSZ if the outlet is idle, or firing tube VKPR if the outlet is busy and in the latter case causing the hunting action to continue.

If however, a faulty operation has occurred within the hunting arrangement, then the timing cycle in the control is completed and in order to enable the outlets after the faulty stage to be tested, the control equipment applies a firing voltage to lead 11 of the last stage of the hunting chain. The tube VKRO functions as previously described, and if the last outlet is busy then tubes VKPR and VKSO will fire and a positive potential will be applied from the cathode circuit of the latter tube through the rectifier MR2 to the lead 15. As this lead is connected to the lead 11 of the preceding stage the positive potential will cause tube VKRO of that stage to function as before described. This process will be repeated until an idle outlet is found, or the fault condition encountered for the second time, which will permit the timing cycle in the control to be completed.

The unidirectional operation of the selecting or hunting arrangement is provided by means of a time delay circuit associated with each stage of the hunting arrangement. The duration of the time delay in any position of the hunt is such as to provide sufficient time for the seizure of the associated outlet if it is idle, or if it is busy sufficient time for that stage to provide an operating condition for the next stage in the hunt. The circuit arrangements are such that the time delay is made ineffective if the operating condition for the next stage in the hunt is established. If this fails to materialise then the time delay completes its operation and provides the alternative operating condition for the next stage in the hunt, thereby enabling the hunting action to continue.

Referring now to Fig. 2, the functions of the tubes VKRO, VKPR and VKSO are substantially the same as those described previously. The trigger electrode of tube VKRO is connected through the series resistors R24, R25 and R26 to earth with a capacitor C8 connected across R26. At the junction of resistors R24 and R25 is connected lead 11, and the series connected resistors R24, R25 and R26 to earth with a capacitor C8 connected across R26. At the junction of resistors R24, R25 is connected lead 11, and the series connected resistor and capacitor R27 and C9 respectively, the capacitor C9 being earthed. The trigger electrode of tube VKTD is connected through resistor R28 to the junction of resistor R27 and capacitor C9, and it will be seen that the delay in the rise of the potential present at trigger electrode of tube VKTD is dependent on the time constant of resistor R27 and capacitor C9. Thus the time constant must be sufficient to cover the normal striking of tubes VKRO and VKSZ if an idle outlet is seized, or if the outlet is busy it must cover the normal striking of tubes VKRO, VKPR and VKSO. If it is required to

speed up the reset time of the timing circuit, a rectifier suitably connected across resistor R27 would provide this facility.

When a striking condition is applied to lead 11, the potential at the trigger electrode tube VKRO causes it to ionise and the main gap to strike, the circuit then functioning as previously described. The firing condition on lead 11 also starts to charge the capacitor C9 through resistor R27. Thus as the trigger electrode of tubes VKTD is connected through resistor R28 to this circuit, there is a time delay before the potential reaches such a value as to ionise tube VKTD. It will be obvious that if the high voltage HT2 were removed from the anode of this tube, or the tube VKSO of the previous position, then the timing is ineffective.

If the outlet associated with the stage is busy then tubes VKRO, VKPR and VKSO will be fired. The lead 16, which is common to both the cathodes of tubes VKTD and VKSO is connected to lead 11 of the next stage in the hunting arrangement. Hence the cathode circuit for tubes VKTD and VKSO of a stage is provided by the next stage in the hunt. When tube VKSO fires, the tube VKTD has a positive potential applied to its cathode and thus is made ineffective, and the next stage in the hunting arrangement is operative. In the event of failure of a stage the tube VKTD is allowed to complete its operation and fire, thereby causing the next stage to become operative.

What is claimed is:

1. In a switching device having a plurality of outlets and a plurality of cascade-connected stages, each corresponding to one of said outlets, each stage comprising first and second gas discharge tubes, means connecting said first and second gas discharge tubes, an input lead connected to said first gas discharge tube, an output lead connected to said first gas discharge tube, a signal repeating lead connected to said second gas discharge tube, means responsive to a signal on said input lead when the corresponding outlet is available for igniting said first gas discharge tube to apply a signal on said input lead when the corresponding outlet is unavailable for igniting said second gas discharge tube to apply a signal to said signal repeating lead.

2. In a switching device having a plurality of outlets and a plurality of cascade-connected stages, each corresponding to one of said outlets, each stage comprising first and second gas discharge tubes, means connecting said first and second gas discharge tubes, an input lead connected to said first gas discharge tube, an output lead connected to said first gas discharge tube, a signal repeating lead connected to said second gas discharge tube, a third gas discharge tube connected to said signal repeating lead, a delay circuit having its input connected to said input lead and its output connected to said third gas discharge tube, means responsive to the application of a signal to said input lead when the corresponding outlet is available for igniting said first gas discharge tube to apply a signal to said output lead, means responsive to the application of a signal to said input lead when the corresponding outlet is unavailable for igniting said second gas discharge tube to apply a signal to said signal repeating lead and for applying a potential to said delay circuit to ignite said third gas discharge tube after a predetermined period to apply a signal to said signal repeating lead, means for preventing the ignition of said third gas discharge tube in response to the ignition of said first gas discharge tube within said predetermined period and means for preventing the ignition of said third gas discharge tube in response to the ignition of said second gas discharge tube within said predetermined period.

3. In a switching device having a plurality of outlets and a plurality of cascade-connected stages, each corresponding to one of said outlets, each stage comprising first and second gas discharge tubes connected to form a two-position circuit element, an input lead connected to said first gas discharge tube, an output lead connected to said first gas discharge tube, a signal repeating lead, connected to said second gas discharge tube, an output lead connected to said first gas discharge tube, means responsive to a signal on said input lead for applying a pulse to said first and second gas discharge tubes, a source of biasing potential permanently connected to said second gas discharge tube whereby said second gas discharge tube ignites on the application of a pulse to said first and second gas discharge tubes at a time when the corresponding outlet is unavailable, means responsive to the outlet corresponding to the stage being available for applying a biasing potential to said first gas discharge tube and for applying a backing off potential to said second gas discharge tube whereby said first gas discharge tube ignites on the application of said pulse to said first and second gas discharge tubes at a time when the corresponding outlet is available, means responsive to the ignition of said second gas discharge tube for applying a signal to said signal repeating lead and means responsive to the ignition of said first gas discharge tube for applying a signal to said output lead.

4. In a switching device having a plurality of outlets and a plurality of cascade-connected stages, each corresponding to one of said outlets, each stage comprising first and second gas discharge tubes connected to form a two-position circuit element, an input lead connected to said first gas discharge tube, an output lead connected to said first gas discharge tube, a first signal repeating lead connected to said second gas discharge tube, a second signal repeating lead connected to said second gas discharge tube, means responsive to a signal on said input lead for applying a pulse to said first and second gas discharge tubes, a source of biasing potential permanently connected to said second gas discharge tube whereby said second gas discharge tube ignites on the application of said pulse to said first and second gas discharge tubes at a time when the corresponding outlet is unavailable, means responsive to the outlet corresponding to the stage being available for applying a biasing potential to said first gas discharge tube and for applying a backing-off potential to said second gas discharge tube whereby said first gas discharge tube ignites on the application of said pulse to said first and second gas discharge tubes at a time when the corresponding outlet is available, means responsive to the ignition of said second gas discharge tube for applying a signal to said first and second signal repeating leads and means responsive to the ignition of said first gas discharge tube for applying a signal to said output lead.

5. In a switching device having a plurality of outlets and a plurality of cascade-connected stages, each corresponding to one of said outlets, each stage comprising first and second gas discharge tubes connected to form a two-position circuit element, an output lead connected to said first gas discharge tube, an input lead connected to said first gas discharge tube, a signal repeating lead connected to said second gas discharge tube, means responsive to a signal on said input lead for applying a pulse to said first and second gas discharge tubes, a source of biasing potential permanently applied to said second gas discharge tube whereby said second gas discharge tube ignites on the application of said pulse to said first and second gas discharge tubes at a time when the corresponding outlet is unavailable, means responsive to the outlet corresponding to the stage being available for applying a biasing potential to said first gas discharge tube and for applying a backing-off potential to said second gas discharge tube whereby said first gas discharge tube ignites on the application of said pulse to said first and second gas discharge tubes at a time when the corresponding outlet is available, means responsive to the ignition of said second gas discharge tube for applying a signal to said signal repeating lead, means responsive to the ignition of said first gas discharge tube

for applying a signal to said output lead, a third gas discharge tube connected to said signal repeating lead, a delay circuit having an input circuit connected to said input lead and an output circuit connected to said third gas discharge tube whereby a signal on said input lead causes a potential to be applied to said delay circuit to ignite said third gas discharge tube after a predetermined period to apply a signal to said signal repeating lead, time delay means connected to said third discharge tube for preventing the ignition of said third gas discharge tube in response to the ignition of said first gas discharge tube within said predetermined period and

means for preventing the ignition of said third gas discharge tube in response to the ignition of said second gas discharge tube, within said predetermined period.

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