

Oct. 5, 1937.

I. F. BYRNES

2,094,733

AUTOMATIC ALARM SELECTOR

Filed May 25, 1933

2 Sheets-Sheet 1

Fig. 1

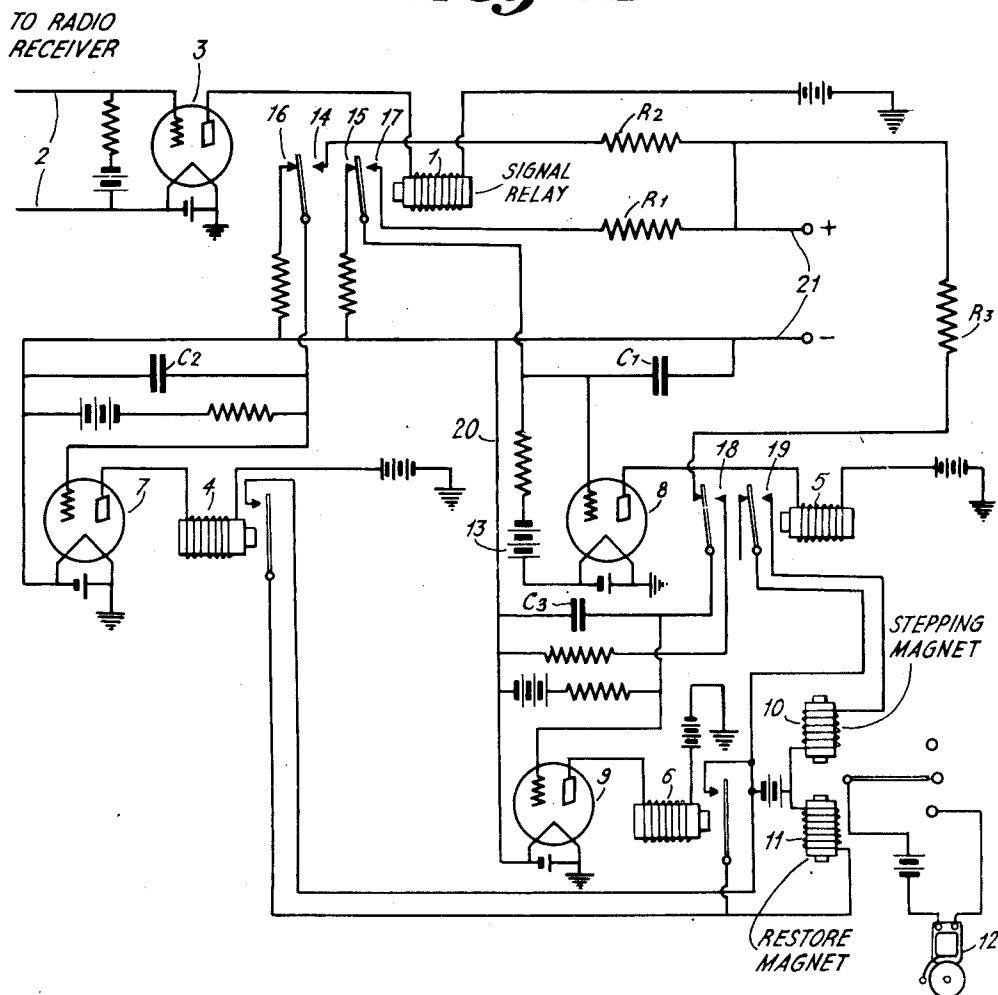
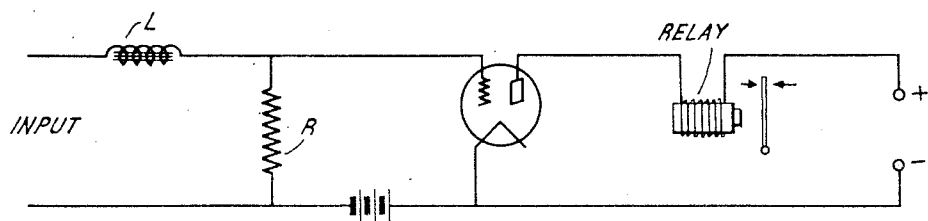


Fig. 3



INVENTOR
I. F. BYRNES
BY *H. S. Swer*
ATTORNEY

Oct. 5, 1937.

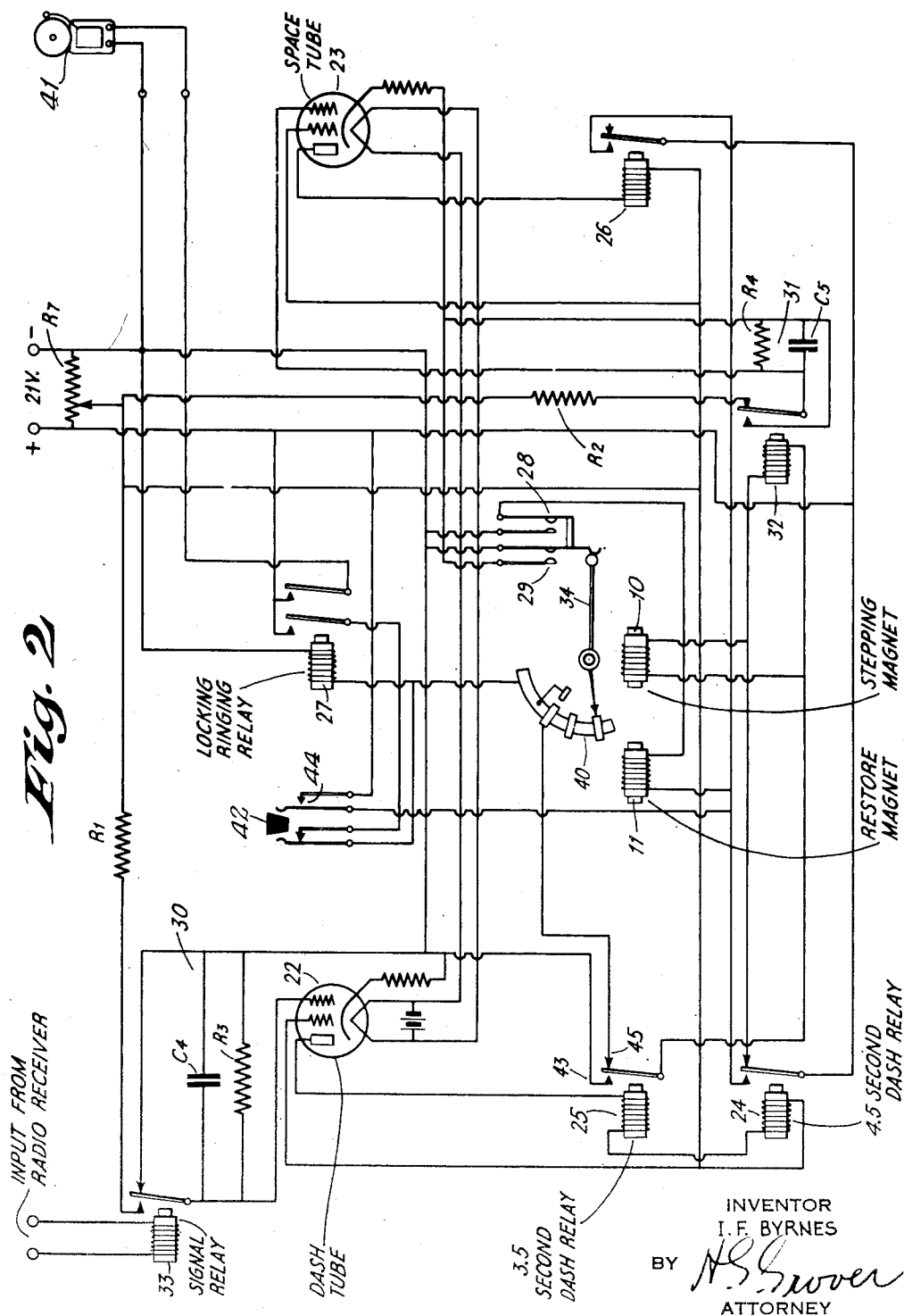
I. F. BYRNES

2,094,733

AUTOMATIC ALARM SELECTOR

Filed May 25, 1933

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,094,733

AUTOMATIC ALARM SELECTOR

Irving Francis Byrnes, Riverdale, N. Y., assignor
to Radio Corporation of America, a corpora-
tion of Delaware

Application May 25, 1933, Serial No. 672,778

10 Claims. (Cl. 177—353)

This invention is concerned with an automatic alarm selector circuit for giving an alarm on the receipt of a predetermined wireless signal composed of a regular series of dashes of definite length and spacing such as is used for requesting aid by ships at sea. In the present case the signal under consideration consists, by international agreement, of a plurality of dashes of four seconds duration separated by spaces of one second each.

Since the signal necessary to operate the alarm is frequently sent by hand, and the timing done by the aid of a watch, it is essential for the effective operation of the system that some tolerance be permitted in the length of the dashes and spaces so as to allow for errors in sending. The present invention is, therefore, designed to respond to dashes of from between three and one-half to four and one-half seconds duration and to spaces of less than one and one-half seconds, and this is accomplished by suitable choice of voltage, resistance and condenser values, together with proper adjustment of spring tension in the relay mechanisms employed. This latitude allows for an error of plus or minus one-half second in the length of each dash, a tolerance which, it has been found in practice, is sufficient for hand operating. Although this particular degree of latitude due to signal variation is preferred, it will be understood, of course, that the permissible amount of deviation from exact signal length may be changed merely by the change in values of the elements indicated above.

Heretofore, the systems which have been proposed have been based largely on the use of mechanically driven cams with clutch mechanisms arranged to be driven at constant speed by motors. Other known systems utilize dash-pot relays consisting of small pistons working in suitable cylinders for securing timing. These prior art arrangements, however, suffer from certain disadvantages such as being difficult to build and, when constructed, difficult to maintain in adjustment. It has been found that the wear and tear on such mechanical alarm systems reduces the life of the parts to a considerable extent.

The present invention, on the other hand, overcomes the aforementioned disadvantages by providing a selector system which has its timing based on an electrostatic arrangement rather than on a mechanical circuit scheme. According to the proposed arrangement, the only moving part during telegraphic reception is the armature of the radio relay.

One feature of this invention is the time-con-

stant resistance reactance circuit which functions to time the operation of various relay devices through the medium of a thermionic electron discharge device. This circuit may comprise the combination of a resistance with either an inductance or a condenser, although the use of the condenser combination is preferred.

Other features and advantages will appear in the following detailed description which is accompanied by drawings wherein Figure 1 illustrates one embodiment of the present invention, Figure 2 the preferred selector arrangement, and Figure 3 a modified time constant resistance inductance circuit which may be used in either of the circuits of Figures 1 and 2.

In Figure 1 there is shown an automatic alarm selector comprising, essentially, a signaling relay 1 which is connected to an input circuit 2 associated with any suitable radio receiving apparatus, not shown, through the medium of an electron discharge device 3. Associated with relay 1 there are a plurality of relays 4, 5 and 6 having individual to themselves thermionic devices 7, 8 and 9, respectively, for causing the actuation of a stepping magnet 10 and a restoring magnet 11, the latter two magnets, in turn, controlling the operation of an alarm device 12. Relays 1, 4, 5 and 6 are of the quick acting type for conditioning the circuit for operation immediately upon the receipt of signal characters.

Electron discharge device 3 is normally biased by grid battery 13 so as not to pass any current which might be sufficient to close relay 5 when no signals are being received, and to pass current only upon the building up of a potential charge on condenser C₁, due to the operation of relay 1, of a value sufficient to overcome the effect of the biasing battery. Relay 5, which is in the anode circuit of device 3, is arranged to operate after a period of three and one-half seconds from the time condenser C₁ starts to charge, during which time it is assumed that the charging current is continuously applied to the condenser. The timing of this relay is affected by several factors which include primarily the capacity of condenser C₁, the value of resistor R₁, and the value of the source of voltage supply 21 in circuit with resistor R₁.

Relay 4 is controlled through thermionic device 7 in a somewhat similar manner to operate in four and one-half seconds after the application of potential to condenser C₂ due to the operation of relay 1 and, similarly, relay 6 is arranged to operate at the end of five seconds after the continuous application of a charge on condenser C₃.

Stepping magnet 10 functions to move its arma-

ture one notch each time upon the operation of relay 5, until after three successive operations of this relay a circuit is closed to energize an indicator of any desired type, such as a bell 12.

5 A restoring relay 11 is provided to return the stepping magnet to its normal position.

In the operation of the circuit, a radio signal, after being detected and amplified at an audio frequency in the usual manner of the receiver, not shown, is impressed on the grid filament circuit of electron discharge device 3 over input circuit 2. This tube is biased to cause the operation of signal relay 1 located in its anode circuit immediately upon receipt of a signal, relay 1, in turn, acting to open the circuits of break contacts 15 and 16 and to close those of make contacts 14 and 17. The circuit shown in the drawings illustrates the normal condition of the selector when no signal is being received.

20 The operation of signal relay 1 closes a circuit to energize condenser C₁ through resistor R₁ and contact 17. The charge on this condenser functions to overcome the bias of battery 13 on relay tube 3 so as to permit the operation of relay 5 in the anode circuit of the tube, a matter which occurs at the end of three and one-half seconds during which time the charge on the condenser C₁ has increased to such a value that the desired amount of anode current flows through the tube. 25 Relay 5, in turn, operates to close its make contacts 18 and 19 and to complete a path for the operation of stepping magnet 10 over its right hand armature and contact 19. The operation of stepping magnet 10 causes its armature to move forward one step or notch. The closure of make contact 18 provides a shunt path around condenser C₃ for the purpose of keeping this condenser discharged.

If at any time the incoming signal ceases, relays 1 and 5 will return to normal and contact 18 will open, thus enabling condensers C₁ and C₂ to discharge and a charge to be built up on condenser C₃. The circuit for C₃ may be traced over a path from the left hand plate of the condenser 45 through lead 20 to the negative side of source 21, and from the right hand plate of the condenser over the left outer normally made break contact of relay 5 through resistance R₃ to the positive terminal of source 21. After five seconds there 50 will be sufficient charge on condenser C₃ to overcome the biasing battery connected to the grid of tube 9 and to enable relay 6 to operate and close an obvious circuit for the energization of restoring magnet 11.

55 If, however, instead of the radio signal ceasing, it should last for more than four and one-half seconds, there will be placed a charge on condenser C₂ by source 21 over a circuit traced through resistance R₂ and make contact 14 of signal relay 1, which will completely overcome the opposing biasing battery of tube 7 and enable relay 4 to operate and thus energize restoring magnet 11 over a very obvious circuit. The receipt of three correct dashes and three correct spaces will cause stepping magnet 10 to move its armature three notches forward and thus close a circuit to operate the alarm 12.

70 From the foregoing, it will be evident that the stepping magnet 10 functions to provide an alarm only when the incoming signal consists of dashes over three and one-half seconds and under four and one-half seconds separated by spaces under one and one-half seconds, otherwise either relays 75 4 or 6 will operate to restore the circuit to nor-

mal. The spaces it will be noted may be any short interval under one and one-half seconds.

Figure 2 shows a preferred arrangement wherein only two electron discharge devices are employed, one indicated as a dash tube 22 which is responsive to dash signals for controlling the stepping magnet 10 and the restoring magnet 11 through the intermediary of relays 25 and 24, respectively, and the other indicated as a space tube 23 which is responsive to spaces of predetermined length for controlling the restoring magnet 11 through a relay 26 in the anode circuit of the space tube.

In addition, a locking relay 27 is provided which is operated through the contacts of stepping magnet 10 upon receipt of the correct signal composed of the regular series of three dashes separated by spaces under one and one-half seconds. This relay is arranged to lock up after actuation in order to give a steady alarm until such time as reset key 42 is manually operated to restore the system to normal. There is thus obtained a continuous alarm indication which functions to attract the attention of the attendant until the circuit is set at rest. Another feature of the circuit of Figure 2 is the contact arrangement 28, 29 which is mechanically connected to the armature 34 of the stepping magnet 10 whereby both the restoring magnet 11 and the space tube 23 do not become effective until after the armature of the stepping magnet has advanced at least one notch or step. This contact device is arranged to be normally open and to prepare the circuits through the restoring magnet coil and the cathode of the space tube for closure only after the actuation of the stepping magnet armature.

In this embodiment, the electrostatic timing circuits include two resistance-capacity circuits 30 and 31 for controlling the action of the tubes 22 and 23.

In the operation of the circuit of Figure 2, signals incoming from the radio receiver actuate signal relay 33 which is preferably connected in the anode circuit of the radio receiver, not shown. The operation of relay 33 will close a circuit to energize the condenser C₄ of resistance capacity circuit 30 over a path which may be traced from the positive side of source 21 through the make contact and armature of relay 33 to one plate of the condenser and from the other plate of the condenser to the negative side of source 21, thus permitting a charge to accumulate on the condenser. Circuit 30 is so arranged that the full charge on condenser C₄ is not obtained until after a lapse of three and one-half seconds, at which time there will be a sufficient charge to permit dash tube 22, which has its control grid connected to the condenser, to pass sufficient current in its anode circuit to operate the three and one-half second dash relay 25. In this connection it should be noted that although dash tube 22 permits current to flow in its anode circuit immediately upon the application of a positive charge from condenser C₄ there will not be sufficient current in its anode circuit to actuate relay 25 until the full charge from condenser C₄ is applied to the control grid, a matter which will not occur until the condenser has been charged for a full three and one-half seconds. The operation of relay 25 in the anode cathode circuit of tube 22 will complete a path to operate stepping magnet 10 and thus move its armature one notch or step, over a circuit which may be traced from the positive side of source 21, the armature 75

and break contact of relay 24, winding of stepping magnet 10, armature and make contact 43 of relay 25 to the negative side of source 21. Although relay 24 is serially connected with relay 25 in the anode cathode circuit of tube 22, this relay does not operate at this time since it is arranged by means of the tension on the spring of its armature not to operate until a dash of four and one-half seconds duration or longer has been received. If the incoming signal persists for four and one-half seconds or longer, relay 24 in the anode circuit of dash tube 22 will operate, thus breaking the circuit for stepping magnet 10 and closing a circuit to energize restore magnet 11 and thus set the stepping magnet 10 and the entire system back at normal or start position. This latter circuit may be traced from the positive terminal of source 21, armature and make contact of the four and one-half seconds dash relay 24, winding of restore magnet 11, contact 28, which will be made since the stepping magnet 10 has already advanced its armature one notch, to the negative terminal of source 21.

If the first dash has a duration between three and one-half and four and one-half seconds and is followed by a space signal, relay 33 will fall back to its normal position, closing an obvious circuit to discharge condenser C₄ of the resistance capacity circuit 30. Relay 25 will then return to normal, opening make contact 43 and closing break contact 45. If the space does not exceed one and one-half seconds and is followed by another dash, relays 33 and 25, together with dash tube 22, will again function in precisely the same manner described above and stepping magnet 10 will move its armature another notch forward.

However, if the space following the dash has a duration of more than one and one-half seconds, then there will be involved a total length of time for the second dash and the first space which will be more than five seconds, i. e., a dash of three and one-half seconds plus a space of at least one and one-half seconds. This length of time is sufficient to enable resistance capacity circuit 31 to build up a charge on its condenser C₅ which is sufficient to cause current to flow in the anode circuit of space tube 23 in which there is serially connected a relay 26 which, when operated, closes a circuit to energize restore magnet 11. More specifically, there is provided a space grid relay 32 which controls the operation of space tube 23 for restoring the system upon the receipt of a space of more than one and one-half seconds duration. This space grid relay is arranged so that in its normal or unenergized position the condenser C₅ in resistance-capacity circuit 31 is closed through the armature and make contact of the relay through resistor R₂ to the positive side of source 21, the other plate of the condenser being connected to the cathode circuit of tube 23. The cathode circuit, it should be remembered, is not closed through to the negative side of source 21 until contact 29 has been closed, which occurs when the stepping magnet has advanced at least one notch. The unenergized position of relay 32 for five seconds or over enables a charge on condenser C₅ to build up to a value which is sufficient to permit current to flow through the space tube 23 for operating relay 26 in the anode circuit of the tube which, in turn, controls the operation of restoring magnet 11. Relay 32, it will be noted, is in parallel relationship with stepping magnet 10 and will operate therewith. The operation of this relay short circuits the condenser of circuit 31 and discharges same, disconnecting the left

hand plate of condenser C₅ from the positive terminal of source 21. From the foregoing, it will be evident that as long as the first space and the second dash are completed before five seconds have elapsed the condenser of resistance-capacity circuit 31 will not have an opportunity to cause the operation of relay 26 in the anode circuit of space tube 23, and stepping magnet 10 will be permitted to move up to the next step.

At the end of three correct dashes the armature of the stepping magnet 10 will have moved up to the third segment, and in this position will connect this segment to the metallic arcuate shaped segment 40 which is in circuit with one side of the locking ringing relay 27. Then if the third dash is followed by any space at all, relay 25 will return to normal and close this side of ringing relay 27 to the positive terminal of source 21, thus completing the path to operate relay 27. This path is traced from the negative terminal of source 21 to one side of relay 27 and from the other side of relay 27 through arcuate element 40 and the third contact segment of the stepping magnet, through normal make contact of relay 25 and the windings of the stepping magnet 10 and space grid relay 32 in parallel and through the normal make contacts of relay 24 to the positive terminal of source 21. Since the current through the ringing relay needed for its operation is very small, the stepping magnet will not actuate its own armature mechanism further even though there is present a small amount of current flowing through its coil. Upon operating, relay 27 closes a circuit through its outer armature and outer make contact to energize alarm 41.

When the locking ringing relay 27 is energized, its inner armature closes a path to hold the coil energized over an obvious circuit. In order to reset the mechanism after an alarm has once been registered there is provided a reset button 42 which, when pushed opens the locking circuit through the contact of the button, and closes another contact 44 for energizing the restoring magnet 11 and setting the circuit at rest.

It will be apparent from what has been said before that ordinary telegraphic dots and dashes do not permit charges to gradually build up on the condenser circuit, since this is prevented by means of the discharge contacts on the signal relay 33 and the space charge relay 32 which provide shunt paths for their respective condensers each time the relays function normally in the ordinary cycle of operations. The use of such an electrostatic time constant circuit permits very fast recycling of the operations of the system merely by the discharging of the condenser.

Another time constant circuit arrangement which may be used for obtaining a time delay instead of the electrostatic resistance condenser combination is the resistance inductance scheme shown in Figure 3. In this case when the current through the resistor R has reached a suitable value after a time delay due to the presence of inductance in the circuit, current of a desired value will flow through the anode circuit of the electron discharge device and actuate the relay.

The embodiments of the invention illustrated and described herein have been selected for the purpose of clearly setting forth the principles involved. It will be understood, however, that the invention is susceptible of being modified to provide various values of timing and to meet different conditions encountered in its use, and it is, therefore, aimed to cover by the appended claims

all modifications within the spirit and scope of the invention.

I claim:

1. An automatic selector circuit arrangement having, in combination, a signal relay responsive to incoming signal impulses, an electron discharge device, input and output circuits for said device, a time constant circuit including a resistor and a reactance in said input circuit, said time constant circuit being arranged upon the application of potential thereto under control of said signal relay to permit said electron discharge device to pass a predetermined amount of current after a certain time delay, a relay in said output circuit responsive to said flow of current through said device, an indicator, an actuating device under control of said last relay for rendering operative said indicator, and a delayed action relay in series with said first relay and operative by the current in said output circuit on the reception of an impulse of a certain duration for rendering said actuating device inoperative.

2. An automatic selector circuit arrangement having, in combination, a signal relay responsive to incoming signal impulses, a thermionic device, input and output circuits for said device, a time constant circuit including a condenser and a resistor in said input circuit, the charge on said condenser being controlled by said signal relay in accordance with received signal impulses, said time constant circuit when charged being arranged to permit said thermionic device to pass current, a relay in said output circuit operative by the current through said device on the reception of an impulse of a certain duration, an indicator, an actuating device under control of said last relay for rendering operative said indicator, and a delayed action relay operative by the current in said output circuit on the reception of an impulse of a different duration for rendering said actuating device inoperative.

3. An automatic selector circuit arrangement having, in combination, a signal relay responsive to incoming signal impulses, an electron discharge device, input and output circuits for said device, a time constant circuit including a resistor and a reactance in said input circuit, said time constant circuit being arranged upon the application of potential thereto under control of said signal relay to permit said electron discharge device to pass a predetermined amount of current only after said signal relay has been operated continuously for a certain interval of time, a relay in said output circuit responsive to said flow of current through said device, an indicator, a step-by-step switch and a motor magnet therefor repeatedly operable in accordance with impulses fed thereto by the last said relay, said indicator being operable only after said magnet has advanced said step-by-step switch a plurality of steps, another electron discharge device having an operating path under control of the last said relay, delay means connected between the last said electron discharge device and the last said relay for causing current to flow through said electron discharge device when said relay remains de-energized for at least a predetermined interval of time and means connected in the output circuit of the last said electron discharge device for rendering said motor magnet inoperative.

4. An automatic selector circuit arrangement having, in combination, a signal relay responsive to incoming signal impulses, an electron discharge device, input and output circuits for said device, a time constant circuit including a re-

sistor and a reactance in said input circuit, said time constant circuit being arranged upon the application of potential thereto under control of said signal relay to permit said electron discharge device to pass a predetermined amount of current after a certain time delay, a relay in said output circuit responsive to said flow of current through said device, an indicator, an actuating device comprising a step-by-step switch and a magnet therefor under control of said last relay for rendering operative said indicator after the switch has been advanced at least three steps by said magnet, and another relay in series with said last relay and responsive to the flow of current in said output circuit for a time interval different than said first time interval for rendering said actuating device inoperative and for restoring said step-by-step switch to normal.

5. An automatic selector circuit arrangement having, in combination, a signal relay, a thermionic device, input and output circuits for said device, a time constant circuit including a condenser and a resistor in said input circuit, the charge on said condenser being controlled by said signal relay in accordance with received signal characters, said time constant circuit when charged being arranged to permit said thermionic device to pass current, a delayed action relay in said output circuit operative by the current through said device on the reception of an impulse of a certain duration, an indicator, an actuating device under control of said last relay for rendering operative said indicator, a second delayed action relay in series with said first delayed action relay and operative by the current through said thermionic device upon reception of an impulse of a different duration for rendering said actuating device inoperative, and a second thermionic device having an input and an output circuit, the operating path of said second device being closed only subsequent to the operation of said actuating device at least once, and a relay in said last output circuit for restoring said actuating device, another time constant circuit connected to the input of said second device, and means for charging said last time constant circuit during spaces of predetermined duration between signal impulses to cause said second thermionic device to pass current whereby the relay in its output circuit is operated and said actuating device restored to normal.

6. In combination, an electron discharge device having an anode, a cathode and a control electrode, means for biasing said control electrode negatively with respect to said cathode, a condenser in circuit with said control electrode, a signal relay responsive to signal impulses for charging said condenser, said condenser being designed when charged to overcome the bias on said control electrode for enabling current to pass through said device, an electromagnetic relay connected to said anode and responsive to a predetermined amount of current flow through said device, a step-by-step switch having at least three position steps and a stepping magnet responsive to each operation of said electromagnetic relay for advancing said switch one step at a time, an indicating arrangement responsive to the movement of said switch at least to the third step for giving an alarm, a restoring magnet for said switch and another electromagnetic relay operable under control of said electron discharge device when the latter remains conductive for a predetermined interval of time, due to the continued operation of said signal relay, for ener-

gizing said restoring magnet to restore said switch to normal.

7. In combination, an electron discharge device having an anode, a cathode and a control electrode, means for biasing said control electrode negatively with respect to said cathode, a condenser in circuit with said control electrode, a signal relay responsive to signal impulses for charging said condenser, said condenser being designed when charged to overcome the bias on said control electrode for enabling current to pass through said device, an electromagnetic relay connected to said anode and responsive to a predetermined amount of current flow through said device, a step-by-step switch having at least three position steps and a stepping magnet responsive to each operation of said electromagnetic relay for advancing said switch one step at a time, an indicating arrangement responsive to the movement of said switch at least to the third step to give an alarm, and a normally opened contacting mechanism mechanically linked to said switch and closing in response to movement of said switch from its normal position, and another relay responsive to the absence of signals for a predetermined interval of time for energizing said restoring magnet to restore said step-by-step switch to normal, the closure of said contacting mechanism functioning to complete the operating path of said last relay.

8. An automatic selector circuit arrangement having, in combination, a signal relay responsive to incoming signal impulses, a thermionic device, input and output circuits for said device, a time constant circuit including a condenser and a resistor in said input circuit, the charge on said condenser being controlled by said signal relay in accordance with received signal impulses, said time constant circuit, when charged, being arranged to permit said thermionic device to pass current, a relay in said output circuit operative by the current through said device on the reception of an impulse of a certain duration, an indicator, an actuating device movable step-by-step from a normal position under control of said last relay for rendering operative said indicator, a second thermionic device, input and output circuits for said last device and a time constant circuit also in said last input circuit, a relay in said last output circuit, said second thermionic device and said last relay constituting means responsive to space signals of predetermined duration between successive time intervals for rendering said actuating device inoperative, and being operative only subsequent to the movement of said actuating device from its normal position.

9. In combination, an electron discharge device having an anode, a cathode and a control electrode, means for biasing said control electrode negatively with respect to said cathode, a condenser in circuit with said control electrode, a signal relay responsive to signal impulses for charging said condenser, said condenser being designed, when charged, to overcome the bias on said control electrode for enabling current to pass through said device, an electromagnetic relay connected to said anode and responsive to a predetermined amount of current flow through said device, a step-by-step switch having at least three position steps and a stepping magnet responsive to each operation of said electromagnetic relay for advancing said switch one step at a time, an indicating arrangement responsive to the movement of said switch at least to the third step to give an alarm, and a normally opened contacting mechanism mechanically linked to said switch and closing in response to movement of said switch from its normal position, and another relay operative by the current through said device on the reception of an impulse of a certain duration for energizing said restoring magnet to restore said step-by-step switch to normal, the closure of said contacting mechanism functioning to complete the operating path of said restoring magnet.

10. An automatic selector circuit arrangement having in combination, a signal-responsive relay, a thermionic device, input and output circuits for said device, said input circuit including a condenser-resistor combination constituting means under control of said signal-responsive relay for producing a retarded response to signals, said response constituting a flow of current in said thermionic device, a second relay in said output circuit adapted to be energized by current through said thermionic device, an indicator, an indicator actuating device operable under control of said second relay, a second thermionic device having an input and an output circuit, said input circuit including a second condenser-resistor combination constituting means under control of said second relay when it de-energizes for producing a retarded response constituting a flow of current in the output circuit of said second thermionic device, and a third relay operable by current flow in the output circuit of said second thermionic device for rendering said actuating device inoperative only upon the occurrence of spacing signals of a predetermined minimum duration.

IRVING F. BYRNES.