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VARIABLE DELAY CONTROL CIRCUIT FOR MOTOR-DRIVEN SIGNAL SEEKING RECEIVERS

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Fig. 1.

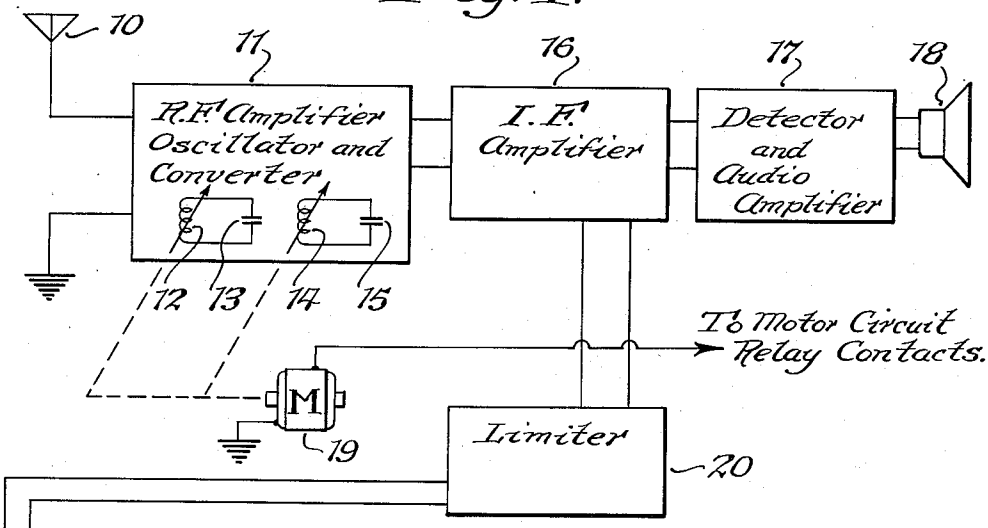
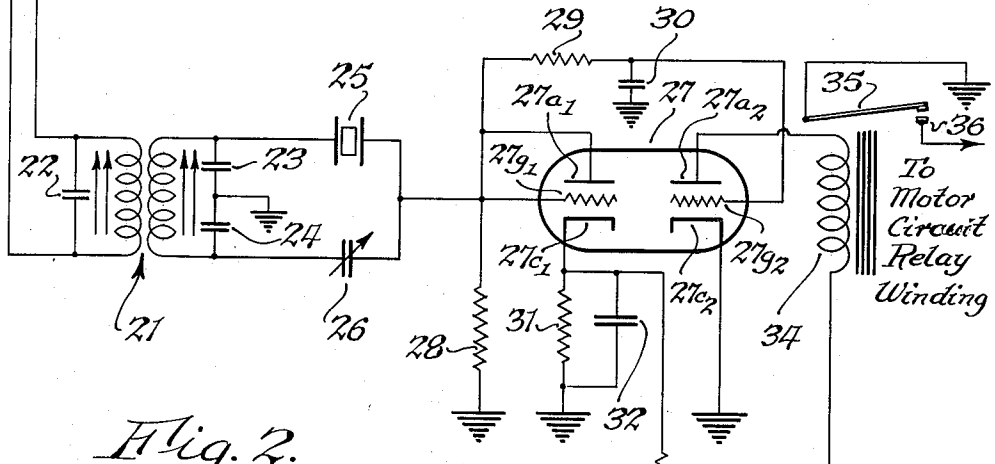
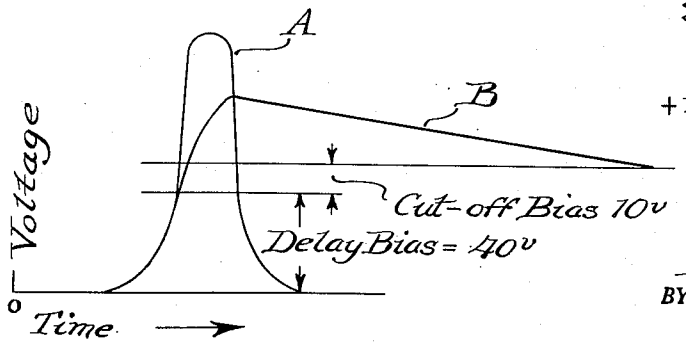


Fig. 2.





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VARIABLE DELAY CONTROL CIRCUIT FOR MOTOR-DRIVEN SIGNAL SEEKING RECEIVERS

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3 Claims. (Cl. 250—40)

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This invention relates to an improved control circuit for signal seeking receivers.

In signal seeking receivers, so-called, the tuner is driven by a motor and is arranged to scan the spectrum of the receiver repeatedly and control apparatus is provided whereby when a signal of predetermined strength is tuned in, the motor driving the tuner is disconnected, permitting the receiver to remain tuned to the incoming signal.

In such receivers usually a vacuum tube is used as the control element, the incoming signal being rectified and applied to the grid of the control tube in a manner to reduce or cut off the plate current of the control tube, thereby permitting a relay to open the motor circuit. In normal signal seeking receivers using a hard control tube, with a very selective piezo-electric crystal or when using a high scanning speed, the control tube may be cut off for only such a very short length of time that the relay does not have time to release and the receiver may tune through a signal instead of stopping as it should. To overcome this difficulty in the past, it has been necessary to use a relatively low scanning speed. This, in turn requires an excessive length of time for the receiver to scan from one end of the spectrum to the other. Alternatively, less selective crystals have been used giving a broader frequency response. Neither of these expedients is satisfactory from the scanning speed standpoint.

It is an object of this invention, to provide a system which permits the scanning speed of a signal seeking receiver to be greatly increased or, alternatively, permits the use of a fixed scanning speed with a very much more selective piezo-electric crystal than heretofore, thus permitting better noise rejection.

It is a further object of this invention to provide an improved control system for signal seeking receivers whereby the scanning speed may be considerably increased without the danger of the receiver passing over an incoming signal instead of stopping.

It is still a further object of this invention to provide an improved control circuit in which vairous adjustments may be made to control the action of the crystal in stopping the receiver.

It is a further object of this invention to provide a system of the class described in which the

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plate current of the control tube remains at a value sufficiently low for a time long enough to permit the motor control relay to drop out, even though the length of time a signal is tuned in is much less than this value.

Still other objects and advantages of my invention will be apparent from the specification.

The features of novelty which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its fundamental principles, and as to its particular embodiments, will best be understood by reference to the specification and the accompanying drawings in which:

Figure 1 is a circuit diagram of a signal seeking receiver embodying my invention,

Figure 2 is a set of curves explaining the operation of the circuit according to my invention.

Turning now to Figure 1, 10 designates any suitable antenna supplying incoming signals to radio frequency amplifier, oscillator and converter unit 11 which may comprise tuned circuits formed by inductance 12 and condenser 13 and inductance 14 and condenser 15. Still other tuned circuits may be employed but are omitted for the sake of simplicity. The tuned circuits may be tuned by driving motor 19 which may for example, move permeability tuning cores into inductances 12 and 14, although variable condensers may be used if desired.

The output from the amplifier, oscillator and converter unit 11 is supplied to the intermediate frequency amplifier 16 and thence through detector and audio amplifier unit 17 to loud speaker 18. To provide the desired control, a portion of the output from intermediate frequency amplifier 16 is supplied to limiter 20. The limiter 20 may be in the form of a vacuum tube amplifier arranged to deliver an output which never exceeds a predetermined fixed value no matter how great the input. The output of the limiter may then be supplied to the crystal bridge circuit comprising transformer 21, the primary coil being shunted by trimmer condenser 22 and the secondary coil being shunted by condensers 23 and 24 in series with their common terminal connected to ground. The arrows in Figure 1 indicate permeability cores, that is, cores formed of iron dust mixed with a binder.

One side of the secondary of the bridge transformer 21 supplies one terminal of a piezo-electric crystal 25, the other side of which is connected through adjustable condenser 26 to the opposite terminal of the secondary of the bridge transformer 21. The crystal 25 is made resonant to the center of the intermediate frequency band and preferably has a band width of only about 1/10 or less of that of the preceding circuits; for example, if the intermediate frequency amplifier passes a band width of 5,000 cycles, the crystal will pass a band width of only 500 cycles or less.

This particular feature is not, per se, a part of this invention and is included only for the purpose of completing the disclosure of the present invention. The feature referred to is described and claimed in a co-pending application of Verlis H. Wiley, Serial No. 554,470, now United States Letters Patent No. 2,491,942, granted December 20, 1949.

The common terminal of crystal 25 and condenser 26 is connected to the rectifier tube. In the present instance, I have shown the rectifier and control tube as a twin triode with the rectifier section made up of the first half with grid and plate connected together. The tube 27 may comprise cathode $27c_1$, control electrode $27g_1$, and anode $27a_1$ in the first triode section and cathode $27c_2$, control electrode $27g_2$ and anode $27a_2$ in the second triode section, all within the same envelope. However, separate tubes may be used if desired.

Cathode $27c_1$ may be connected to ground through resistance 31, bypassed by condenser 32, control electrode $27g_1$ may be connected to ground through resistance 28 and is also connected to anode $27a_1$ and through resistance 29 to control electrode $27g_2$. A connection to ground between resistance 29 and control electrode $27g_2$ is provided by condenser 30. The cathode $27c_2$ may be connected directly to ground.

The anode $27a_2$ is connected through the energizing winding of relay 34 to the source plus B, the negative side of which is usually grounded. Cathode $27c_1$ may be connected through resistance 33 to plus B. The relay 34 controls armature 35 which engages fixed contact 36. Armature 35 may be grounded and fixed contact 36 may control the motor circuit through apparatus omitted for the sake of simplicity, in such a manner that when relay 34 opens, the motor circuit is opened.

Generally a sensitive relay of the type of relay 34 has not sufficient current carrying capacity to be placed in the motor circuit directly and usually operates through relays capable of carrying heavier current and it will be understood that from contact 36, there may be a connection through an additional relay which is connected in the motor circuit in such a manner as to interrupt the flow of power to the motor circuit when relay 34 opens.

The operation of this system will now be described.

When during the normal scanning process, a signal is tuned in, it appears in the loud speaker 18, but a portion of it is passed through limiter 20, crystal bridge transformer 21 and through the crystal tuning circuit or narrow band selector and appears at the grid $27g_1$ of tube 27. It is there rectified and the negative voltage resulting therefrom is applied to grid $27g_2$ through resistance 29. This negative voltage applied to the grid $27g_2$ charges condenser 30. When the signal is no longer delivered by the output of the crystal selector through continuation of the scanning process, the condenser 30 tends to maintain the negative charge on the grid $27g_2$ until the charge on condenser 30 leaks off to ground through resistances 29 and 28. By controlling the discharge time of the condenser 30, the length of time for which the tube 27 is cut off may be greatly increased to allow plenty of time for the sensitive relay 34 to open even with crystals of narrow band width and high scanning speeds.

Suppose that the receiver scans at the rate of 400 cycles per millisecond and that the maximum crystal output voltage is 100 volts, and that the crystal has a band width of 100 cycles at one-half output or 50 volts on the selectivity curve. Let us further suppose that 40 volts of noise delay bias is introduced by the resistance 31, 33 voltage divider network and that 10 volts are necessary to cut off the control tube, and condenser 30 is omitted. With such a combination, the control tube will be cut off for .250 millisecond as the receiver scans through a signal. This condition is indicated by curve A of Figure 2. This time is far too short to allow most commercial sensitive relays to drop out.

Next, consider what takes place with condenser 30 in place as shown in Figure 1. Let us suppose that resistance 29 is 470,000 ohms and that resistance 28 is 15 megohms and condenser 30 is 265 micro-micro-farads. Now the condition existing as the receiver tunes in a signal is shown graphically by curve B of Figure 2. In this case, the tube is held cut off for in excess of 4.0 milliseconds, or over 16 times as long as before. This cut off time can be regulated or controlled through suitable choice of the values of resistance 28, resistance 29, and condenser 30. Thus the control tube can be held cut off for a period of time entirely sufficient to assure satisfactory sensitive relay operation.

In the condition just described we have assumed a not unnecessarily sharp crystal with a given rate of scan but it will be apparent that the same principles apply when a much sharper crystal is used and that although the time would be even less with a sharper crystal than .250 millisecond, by application of the principles herein disclosed, the time during which the control tube is held cut off may be made entirely sufficient to permit and assure satisfactory operation of the relays.

In the specification I have explained the principles of my invention and the best mode in which I have contemplated applying those principles, so as to distinguish my invention from other inventions, and I have particularly pointed out and distinctly claimed the part, improvement, or combination which I claim as my invention or discovery.

While I have shown and described certain preferred embodiments of my invention, it will be understood that modifications and changes may be made without departing from the spirit and scope thereof, as will be clear to those skilled in the art.

I claim:

1. In a signal-seeking receiver, in combination, tuning means for effecting tuning of said receiver continuously with a scanning action over a predetermined range of wave signal frequencies, means for deriving from received wave signals having an intensity exceeding a predetermined value a control potential, the rapidity of said tuning causing said control potential to have a cycle of amplitude change occurring during a

predetermined interval, means including a control circuit responsive to the amplitude of said derived potential for controlling said tuning means to terminate the scanning action thereof, said last-mentioned means including a relay which effects said control of said tuning means consequent upon a change from a first to a second operating condition of said relay but which requires a minimum interval of change of relay excitation longer than said predetermined interval to effect said change from said first to said second operating condition thereof, and an electrical energy-storage element included with resistors in a charge time-constant circuit and a discharge time-constant circuit in said control circuit for receiving and storing energy supplied to said element by said control potential, the time constant of said charge circuit being substantially equal to said predetermined interval and the time constant of said discharge circuit being long in comparison to said charge time constant thereby to prolong the amplitude of said control potential over a time interval longer than said predetermined interval.

2. In a signal-seeking receiver, in combination, tuning means for effecting tuning of said receiver continuously with a scanning action over a predetermined range of wave signal frequencies, means for deriving from received wave signals having an intensity exceeding a predetermined value a control potential, the rapidity of said tuning causing said control potential to have a cycle of amplitude change occurring during an interval of the order of 1 millisecond, means including a control circuit responsive to the amplitude of said derived potential for controlling said tuning means to terminate the scanning action thereof, said last-mentioned means including a relay which effects said control of said tuning means consequent upon a change from a first to a second operating condition of said relay but which requires a minimum interval of change of relay excitation substantially longer than 1 millisecond to effect said change from said first to said second operating condition thereof, and an electrical energy-storage element included with resistors in a charge time-constant circuit and a discharge time-constant circuit in said control circuit, the time constant of said charge circuit being substantially equal to one millisecond and the time constant of said discharge circuit being in excess of two milliseconds thereby to prolong the amplitude of said control potential for a time interval in excess of 2 milliseconds.

3. In a signal-seeking receiver, in combination, a tuner, means for causing said tuner rapidly to scan over its tuning range, a control tube having a cathode, an anode, and control electrode and having in its anode-cathode circuit a relay for controlling said means, means including a first resistor for deriving a potential from incoming signals of predetermined strength and for impressing said potential between said cathode and control electrode of said tube to change the position of said relay and thereby to terminate the scanning action effected by said tuner, the rapidity of said scanning causing said derived potential to vary through a cycle of amplitude change of duration normally too short to permit said change of position of said relay, and a condenser connected between said control electrode and said cathode and coupled through a second resistor to said potential deriving means, said condenser and said second resistor being included in a condenser charge circuit and having values selected to provide a time constant substantially equal to the duration of said cycle of amplitude change and said first resistor being included with said condenser in a condenser discharge circuit having a time constant long in comparison to said charge time constant thereby to maintain the value of said impressed potential over a time interval long as compared to the interval during which said impressed potential has substantial amplitude in the absence of said condenser.

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