

May 28, 1940.

G. SANTUCCI

2,202,432

CONTROL MEANS FOR A RADIO RECEIVER

Filed Sept. 21, 1937

3 Sheets-Sheet 1

Fig. 1

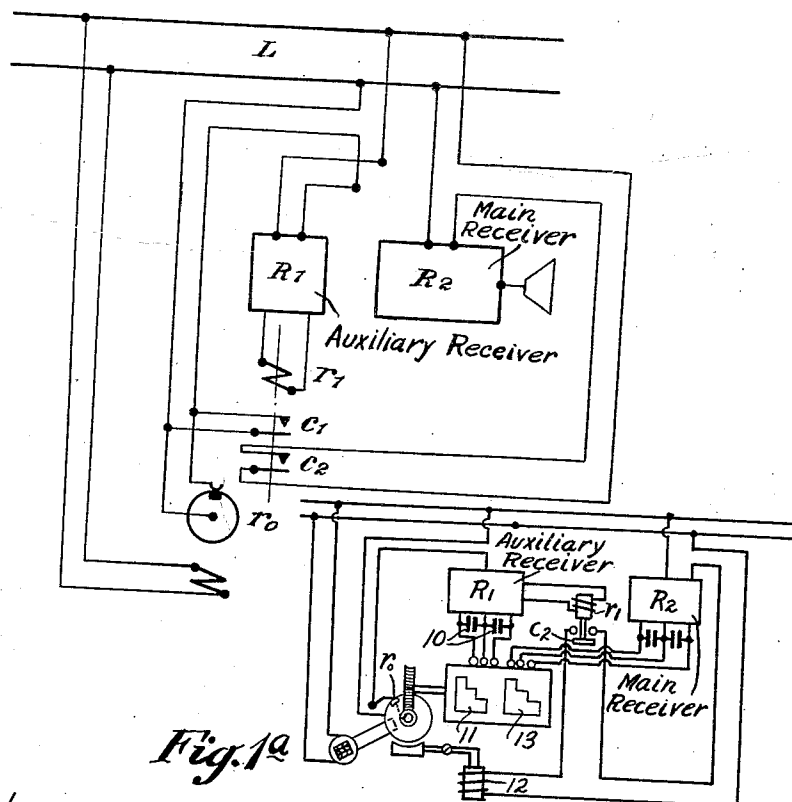


Fig. 1a

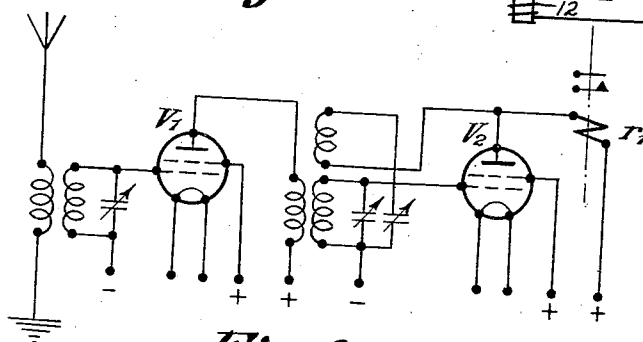


Fig. 2

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Fig. 3

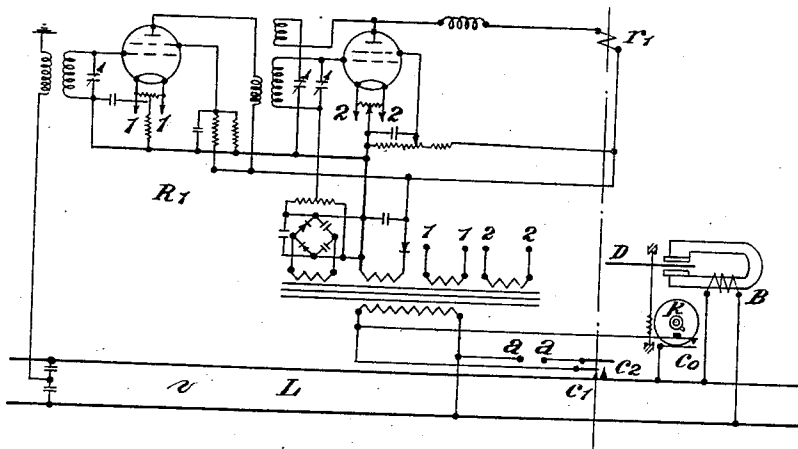
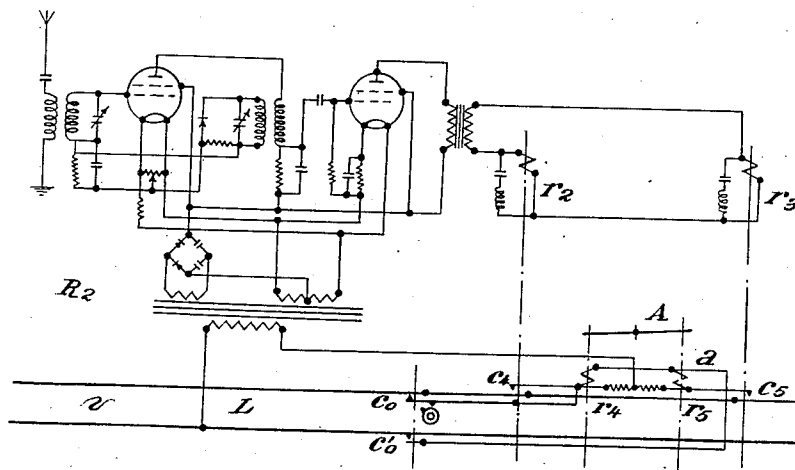


Fig. 4



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Fig. 5

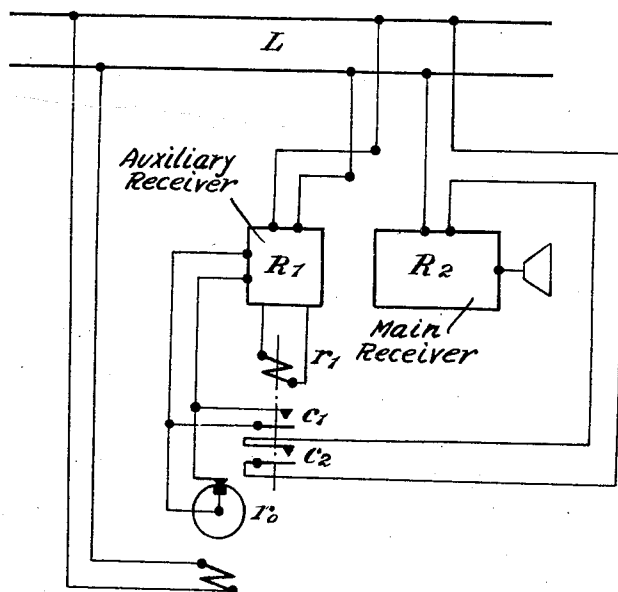
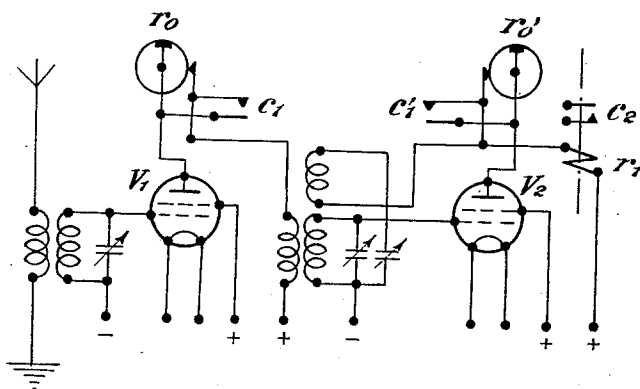


Fig. 6



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CONTROL MEANS FOR A RADIO
RECEIVER

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3 Claims. (Cl. 250—2)

The present invention relates to radio-controlled devices and the primary object is to provide a device by means of which radio receiving apparatus can be rendered operative only when the transmission which is to be received takes place and rendered inoperative as soon as the transmission is completed. The invention is also applicable to the control of other local circuits or devices.

One embodiment of the invention includes a relay actuated by an auxiliary receiver provided with means for periodically rendering it operative for short periods and inoperative for longer periods in between the short periods and the auxiliary receiver is arranged to be operated by the occurrence of modulation at a predetermined frequency in a received signal to maintain the relay in operative condition independently of the periodic operating means and means for effecting the desired control operation dependent upon the uninterrupted reception of the predetermined modulation frequency for a minimum time period which is longer than the normal short operative period of the auxiliary receiver.

According to another embodiment of the present invention a device for effecting a control operation by radio comprises an auxiliary receiver having a power supply circuit thereto controlled by continuously operating timing mechanism whereby the auxiliary receiver is normally rendered intermittently operative for short periods and inoperative for longer periods in between the short periods, including a resonant relay fed by the auxiliary receiver and arranged to be energized during the occurrence of a received signal having modulation at a predetermined frequency to close the power supply circuit independently of the timing mechanism and to prepare a circuit for effecting the desired control operation and switching means operated by the timing mechanism at an instant when the receiver would normally be inoperative to close the last-mentioned circuit to effect the desired control operation only if the resonant relay has been maintained energized by an uninterrupted signal modulated at the predetermined frequency.

According to a further embodiment of the invention a device for effecting a control operation by radio comprises a relay actuated by an auxiliary receiver which is intermittently rendered operative for short periods and inoperative for longer periods in between the short periods, including means for altering the tuning of the auxiliary receiver during each operative period to a number of different incoming wave frequencies

in succession, and means fed by said relay-receiver and adapted to be actuated by the presence of an incoming wave at any of the predetermined wave frequencies to cause the continuous operation of the auxiliary receiver at that particular frequency for the duration of the incoming signal and also to initiate the desired control operation.

In order that the invention may be more readily understood it will now be described by way of example with reference to the accompanying 10 drawings, wherein:

Fig. 1 is an explanatory diagram showing the fundamental principle of intermittent energization and de-energization embodied in devices according to the present invention and shown as applied to the control of a radio receiver.

Fig. 1a is a circuit diagram of a modified control arrangement.

Fig. 2 is a circuit diagram of one form of auxiliary receiver.

Fig. 3 is a more detailed circuit diagram of a suitable auxiliary receiver arrangement for use in arrangements according to the present invention.

Fig. 4 is a circuit diagram of an actual embodiment of the invention; and

Figs. 5 and 6 are views similar to Figs. 1 and 2 of a modified arrangement.

L is the network of electrical energy from which the receiver R_2 is fed when the normally broken contact C_2 is closed, which is controlled by the electromagnet r_1 . The electromagnet r_2 is fed by the anode current of a small auxiliary radio-receiver R_1 tuned to the same wave length as the receiver R_2 , and therefore only excited by the arrival of radio-waves of a determined frequency for the reception of which the receiver R_2 is predisposed.

R_1 therefore is a radio-relay interposed between the feeding network and the receiver R_2 for preventing the latter from being fed at any other time than the one in which the radio transmission occurs.

If it be desired that the reception should be effected at any moment, R_1 must remain permanently inserted on the feeding network L. But if it be allowed that a certain interval of time may intervene between the beginning of transmission and that of reception at R_2 , it is then possible to reduce within large limits the time of ignition, and therefore consumption of the radio-relay R_1 .

To this end, on the feeding circuit of the receiver R_1 a time circuit breaker r_0 is interposed, which is closed periodically at more or less long

intervals by means of a small disk motor, r_0 or in any other suitable way and for a period of time not longer than that necessary for the normal heating of the tubes of R_1 required for the operation of the radio-relay.

If during the period of closure of contact r_0 transmission takes place designed for receiver R_2 the radio-relay R_1 is excited and feeds the electromagnet r_1 which causes the closure, at c_2 , of the feeding circuit of R_2 . At the same time also contact c_1 is closed, in parallel with r_0 on the feeding of R_1 , so that when at the following moment contact at r_0 is broken by rotation of disk, the feeding circuit of R_1 is closed through contact c_1 and remains so for the whole time of transmission, or as long as the electromagnet r_1 remains excited. When transmission is completed contacts c_1 — c_2 are again broken.

If, however, the periodical closure of circuit-breaker r_0 does not occur during the transmission, the radio relay R_1 is not excited, the electromagnet r_1 remains inactive. The tubes of the radio relay then only remain in circuit for the time of closure of circuit breaker r_0 , or for the time required for their ignition which may be very short. This ignition period is followed by a much longer interruption period the length of which will depend from the maximum interval allowed between beginning of transmission and beginning of reception, so that the actual time of action of the radio relay, if there be no radio transmission, is greatly reduced. If, for instance, a maximum interval of 100 seconds is allowed for the listening call of all the radio-receivers R_2 , and 1" for the ignition of the tubes, the utilization of the latter is $\frac{1}{100}$ of total time, and the duration of their action in these conditions will be 1000 times greater than their normal ignition time.

Fig. 2 shows a circuit diagram of one form of the receiver R_1 which includes two stages each utilizing screened-grid tubes one of which is arranged as an amplifier V_1 and the other as a reactively coupled rectifier V_2 . The rectification is such that in the absence of an incoming carrier wave, the anode current flowing through the electromagnet r_1 in the anode circuit of the rectifier V_2 is practically zero. The circuit elements indicated as being variable may of course be fixed if the device is intended permanently for receiving on one wave-length only. The circuit arrangement shown in Fig. 2 for the receiver R_1 , is exemplary and differently constituted circuits may be provided and designed for the direct supply of alternating current to both anodes and filaments.

The periodical closure of the feeding circuit of the radio-relay by means of switch r_0 , in Fig. 1, has the purpose, as stated above, to reduce the consumption of the thermionic tubes and to increase the life of the tubes.

The same purpose may, at least partially be attained if, instead of applying the interval switch r_0 to the circuit connecting the radio-relay to the feeding line, it is inserted in the anode circuit of each tube as indicated in Figs. 5 and 6.

In Fig. 5 the feeding circuit of R_1 is permanently connected to feeding line L, whilst switch r_0 (in parallel with c_1) is applied to the anode circuit of the radio-relay, which thus is only operated during the periodical interval of closure of said switch. If the apparatus includes more than one thermionic tube the switch r_0 will be multiple, as may be seen in the case of the two valves in Fig. 6.

It results from this device that the passage of thermionic current between filament and plate is limited to the very short period (a small fraction of second) of closure of the respective anode circuits, and under these conditions the total duration of utilisation of tubes in the radio-relay happens to be notably increased, as it is known that the working duration of the thermionic tubes is reduced with the increase of emission of thermionic current furnished by them.

In comparison with the system of total interruption of supply to the receiver R_1 —as illustrated in Fig. 1—the system of anode current interruption described with reference to Figs. 5 and 6 and in spite of the disadvantage of a shorter working life of the tubes and a greater current consumption, has the advantage of permitting the use of known types of alternating-current tubes having indirectly heated cathodes which have considerable thermal inertia, and of permitting a reduction of the total time in each open and closed period of the circuit breaker r_0 . In consequence a greater number of listening periods of the receiving apparatus may be made in given time for the same current consumption or tube life.

Fig. 3 is a more complete diagram comprising both the circuit of the radio-relay R_1 and that of the device which controls the intermittent feeding of R_1 , and comprises a coil B with laminated core, permanently branched from the alternate current network L and from a disk D arranged between the poles of said coil, and in permanent rotation. The disk is coupled by helical gearing to a cam K which for each completed revolution causes, during a short time interval, the closure of contact c_0 . The contacts c_1 and c_2 have the same function as in the diagram of Figure 1, and the local radio controlled circuit is connected to terminals a— a .

The radio relay may be adapted for reception on various wave lengths and therefore producing an equal number of distinct local operations, one for every different frequency of received wave.

For this purpose in the radio-relay R_1 during the period in which it happens to be fed various condensers are successively inserted which vary the tuning according to a pre-established wave length as shown in Fig. 1a. The switching of these circuits is effected by a series of consecutive contacts moved by the same rotating circuit-breaker r_0 . It follows therefrom that the electromagnet r_1 is excited at the moment in which the switch closes the tuning circuit which corresponds to the arriving carrier wave.

In this embodiment the contacts C_1 of Fig. 1 are removed while the contacts C_2 remain in use to close the supply circuit to the receiver R_2 and an auxiliary electromagnet 12 is inserted in the latter circuit, the purpose of which magnet is to lock the rotating disc of the circuit breaker r_0 , the disc will be stopped at the instant in which it closes the particular tuning circuit of R_1 which is in tune with the arriving wave, and will thereafter remain in this locked position for the remainder of such transmission. At the same time the radio-receiver R_2 is fed through the contacts C_2 and in order that it may be operable to simultaneously receive on the wave-length transmission then occurring the receiver R_2 is also provided with a series of contacts 13 operated by the rotating member of the circuit breaker r_0 simultaneous switching the receiving circuits of the receiver R_2 so that it is always in tune with the receiver R_1 . In this manner the radio-receiver

R_2 will automatically receive the transmission available on any of the various wave-lengths for which it is predisposed.

A single control of a local circuit other than R_2 is possible and it is possible to obtain plural local controls distinct from each other. As a matter of fact it will be sufficient to substitute to the switching of the various tuned circuits of R_2 the switching of local operating circuits in series with contact c_2 in order that each of them may act in correspondence with a determined length of the wave received by the radio relay R_1 . Thus for every receiving station a series of distinct controls will be realized, each of them characterized by its own radio-frequency of emission.

In the device hitherto described with reference to Fig. 1 and its extension to multiple controls it has been proposed that one or more wave lengths are exclusively used for this purpose. However, with the device shown in Fig. 4 the same carrier wave may be utilized for the control of radio relays for ordinary emissions of any radio station. In the case of radio controlled receptions such wave is emitted for a short period with pre-established modulation from which, with the action of the radio-relay, the automatic connections or disconnections of the feeding circuit of the radio-phonetic receiver is obtained. At every other moment this may be utilized for the reception of ordinary radiograms.

In Fig. 4, there are two relays r_2 and r_3 fed in parallel by the anode current of receiver R_2 and tuned on two different modulation frequencies f_2 and f_3 respectively.

The (intermittent) feeding of R_2 takes place as in the case of Figs. 1, 2, 3 with the periodic closure of contact c_0 due to rotation of cam K, whilst contacts c_1 , C_4 and C_5 remain open. If at the same moment the transmitted wave is modulated on one of the two said frequencies f_2 or f_3 , one of relays r_2 r_3 is excited, which control the closure of the contacts C_4 or C_5 . When this occurs, through the one or the other of these two contacts, feeding of R_2 is kept up as long as the modulation of f_2 or f_3 of the arriving wave lasts, even after break of contact c_0 which takes place as soon as this has been surpassed by the closing cam K.

Continued rotation of the cam K causes the closure after a certain time interval of the contacts C' which connects the common junction a of two electromagnets r_4 and r_5 to one side of the supply line L and the coils r_4 and r_5 are respectively connected to the other side of the line through the two contacts C_4 and C_5 , which are respectively controlled by the coils r_2 and r_3 . Thus the energization of the coils r_4 and r_5 will depend upon the modulation frequency owing to action of the one or the other of the modulation responsive circuits associated with the coils r_2 and r_3 .

A lever of magnetic material A is pivotally mounted adjacent the coils r_4 and r_5 so as to be capable of oscillating to right or left when attracted by one or other of the electromagnets r_5 or r_4 . The movement of the lever A may be employed to operate a local circuit-breaker which may be arranged to control the feeding circuit of a radio-telephone receiver or any other operating or signaling circuit. It will be sufficient therefore to predetermine, in relation to movement of A, which of these two wave modulation frequencies corresponds to the opening, and to the closure of the local radio-controlled switch, in order

to be able to operate the latter at will from the radio transmitting station.

It is to be noted that in order to avoid possible undesired operation of the auxiliary receiver actuated relay such as may be caused for instance by transitory modulations of frequencies of the carrier wave during radio-telephonic emission the action of the lever A is delayed so as not to operate immediately in the presence of the required modulated wave, but only after a certain minimum interval of time, during which the modulation of the transmitted wave must be kept constant and without which the lever is not operated. The closure of the contacts C_0 causes in the presence of the requisite modulated wave, the excitation of one of the two relay coils r_2 and r_3 , and the closure of the respective contacts C_4 or C_5 , but the electromagnet r_4 or r_5 cannot become excited before closure of the contacts C' operated by the cam K. If in the meantime the modulation of the wave has ceased the auxiliary receiver is de-energized before the controlled switch comes into action.

By this arrangement the period of energization of the auxiliary receiver R_1 by closure of the contacts C_0 need only be sufficient to bring the auxiliary receiver into proper operative condition. In this way apart from the saving of energy effected the possibility of accidental operation by a transitory modulation is decreased since in this case the transitory modulation must either commence at the instant of energization or be already present before such energization and must continue uninterruptedly until the subsequent closure of the contacts C' . If one second suffices to bring the auxiliary receiver to its proper operative condition and a further second is sufficient to ensure the required operation of either of the relays r_2 or r_3 , and if a minute is regarded as the required maximum calling interval and a sustained modulation of fifteen seconds the minimum required to effect the desired control operation then a transitory modulation of fourteen seconds cannot in any circumstances effect the control operation even if it commences at the end of the first second of the two second energization period. A fifteen second transitory modulation can only effect the desired control operation if it commences in the one second interval during which the receiver is in proper operative condition. If it occurs before the commencement of this one second interval it will not last long enough to maintain the auxiliary receiver operative until the subsequent closure of the contacts C' while if it occurs after the one second period, the receiver will have already become de-energized. As the chances of the fifteen second modulation commencing during the exact one second of energization of the relay receiver are 60 to 1, it will be clear that the possibilities of accidental operation are very much reduced.

Having now particularly described and ascertained the nature of my invention and in what manner the same is to be performed, I declare that what I claim is:

1. A device for effecting a control operation by radio which comprises, a receiver, means for periodically rendering said receiver operative for short periods and inoperative for longer periods in between said short periods, a relay device fed from said receiver and arranged to be operated by the occurrence of modulation at a predetermined frequency in a received signal to maintain said receiver in an operative condition independently of said periodic operating means, and

means for effecting the desired control operation dependent upon the uninterrupted reception of said predetermined modulation frequency for a minimum time period which is longer than the normal short operative period of said receiver.

- 5 2. A device for effecting a control operation by radio which comprises, a receiver having a power supply circuit thereto controlled by continuously operating timing mechanism whereby said receiver is normally rendered intermittently operative for short periods and inoperative for longer periods in between said short periods, a resonant relay fed by said receiver and arranged to be energized during the occurrence of a received signal having modulation at a predetermined frequency to close said power supply circuit independently of said timing mechanism and to prepare a circuit for effecting the desired control operation, and switching means operated by said timing mechanism at an instant when the receiver would normally be inoperative to close the
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last-mentioned circuit to effect the desired control operation only if said resonant relay has been maintained energized by an uninterrupted signal modulated at the predetermined frequency.

3. A device for effecting a control operation by radio which comprises, an auxiliary receiver which is intermittently rendered operative for short periods and inoperative for longer periods in between said short periods, means for altering the tuning of said auxiliary receiver during each operative period to a number of different incoming wave frequencies in succession, relay means operable by said auxiliary receiver and adapted to be actuated by the presence of an incoming wave at any of the predetermined wave frequencies to cause the continuous operation of the auxiliary receiver at that particular frequency for the duration of said incoming signal, and means associated with said relay means to initiate the desired control operation.
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