United States Patent [19]

Fukata

[11] **3,755,744**

[45] * **Aug. 28, 1973**

[54] **RECEIVING DEVICE FOR AUTOMATICALLY DEMUTING AND REMUTING BY TWO CONTROL SIGNALS SEQUENTIALLY TRANSMITTED FROM TRANSMITTER**

[76] Inventor: **Masayuki Fukata,** 94 Shimorenjaku, Mitaka-Shi, Tokyo, Japan

[*] Notice: The portion of the term of this patent subsequent to Dec. 14, 1988, has been disclaimed.

[22] Filed: **June 25, 1971**

[21] Appl. No.: **156,895**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 885,401, Dec. 16, 1969, Pat. No. 3,628,153.

[52] U.S. Cl. **325/466,** 325/64, 325/325, 325/348, 325/364, 325/392, 325/393, 325/395, 325/478, 340/167, 343/228

[51] Int. Cl. **H04b 1/06**

[58] **Field of Search** 325/17, 64, 304, 325/306, 325, 348, 402, 403, 410, 466, 478, 364, 392, 393, 395; 328/73, 78, 87; 340/167–169; 343/225, 228

[56] **References Cited**

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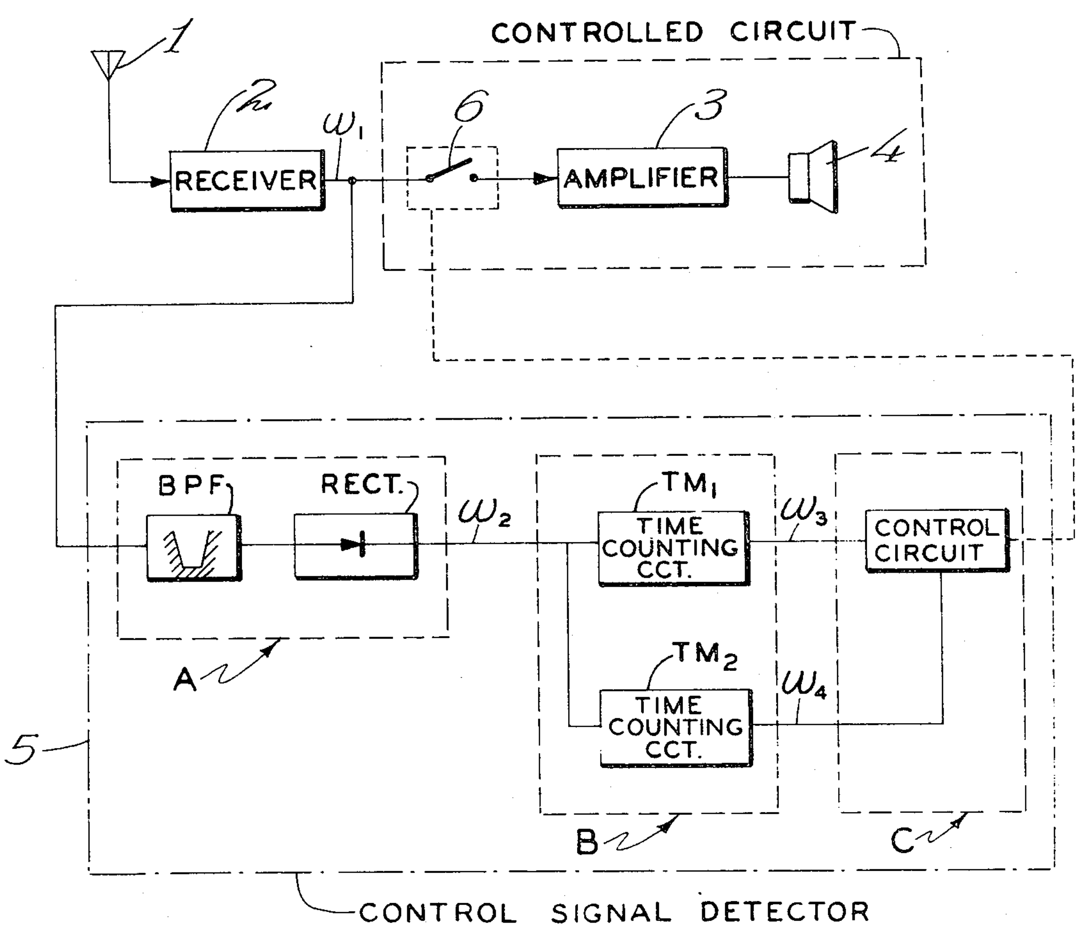
[57] **ABSTRACT**

Apparatus to sense a first control signal and a second control signal transmitted after the first signal and having a duration or repetition rate different than the first signal. A controlled circuit is triggered to and self-held in the switching-in state in response to the first signal and restored in response to the second signal.

4 Claims, 19 Drawing Figures



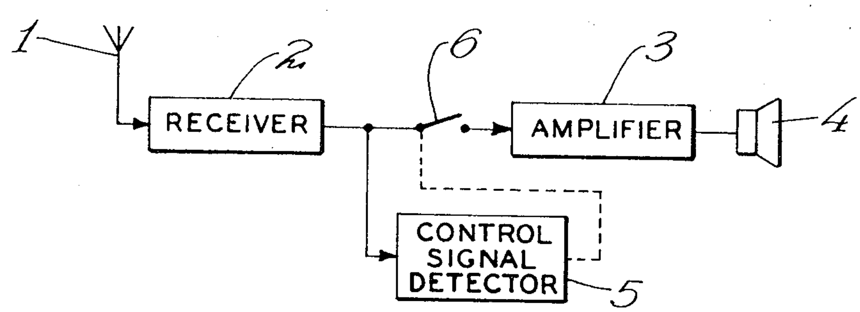


FIG. 1

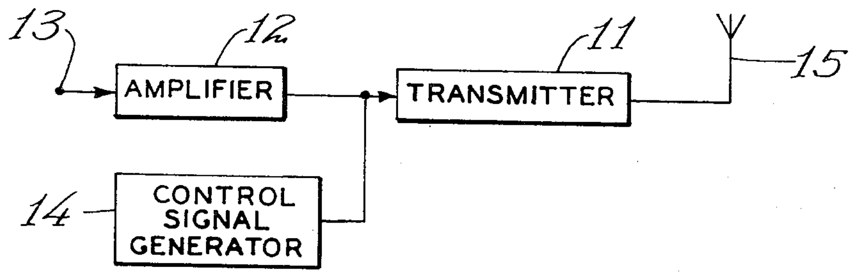


FIG. 2

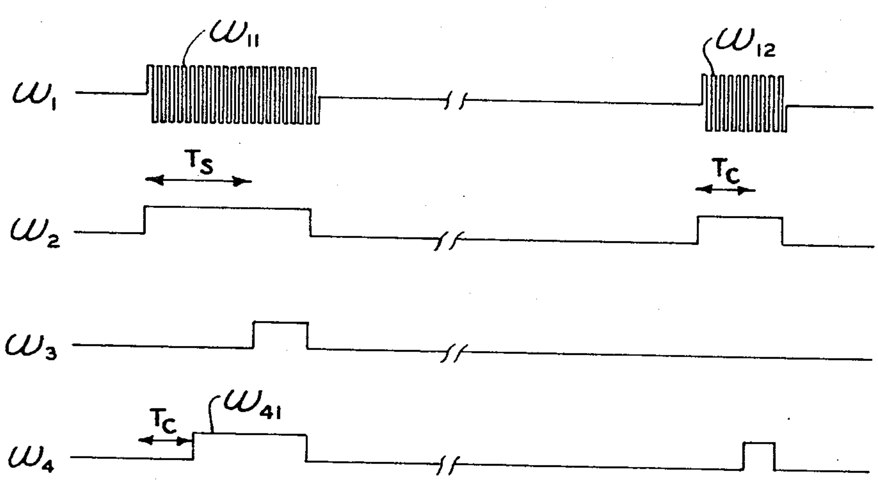


FIG. 4

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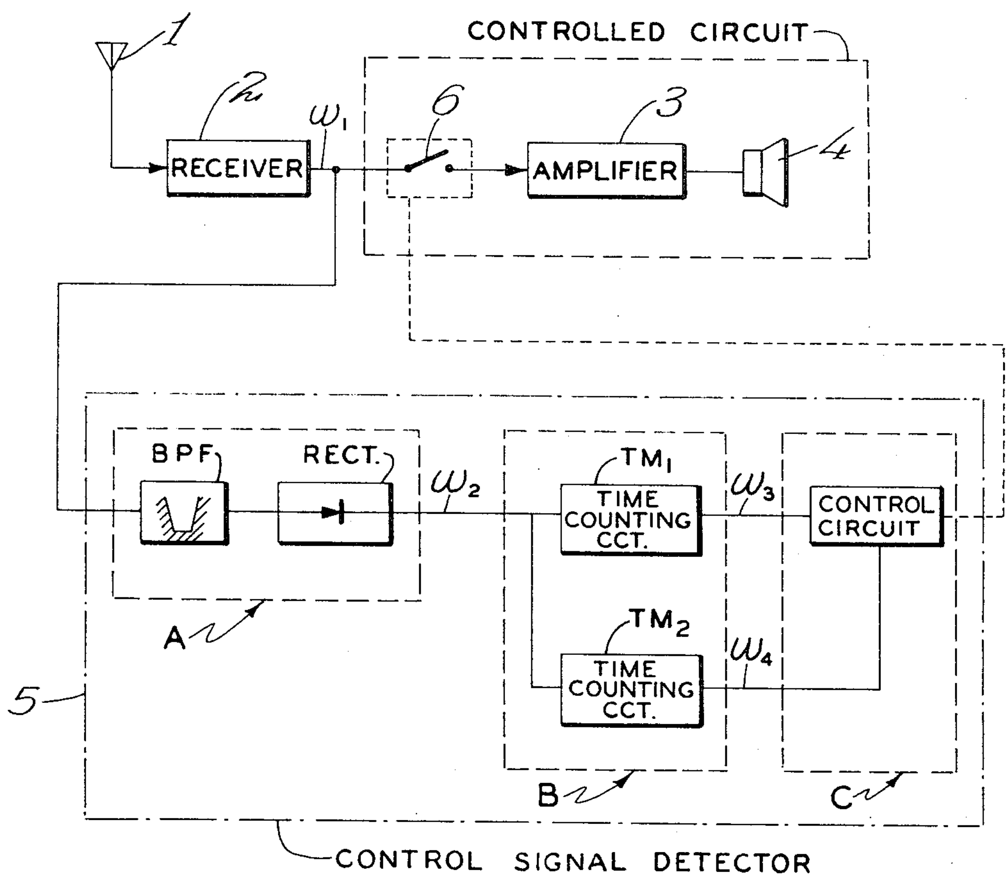

FIG. 3

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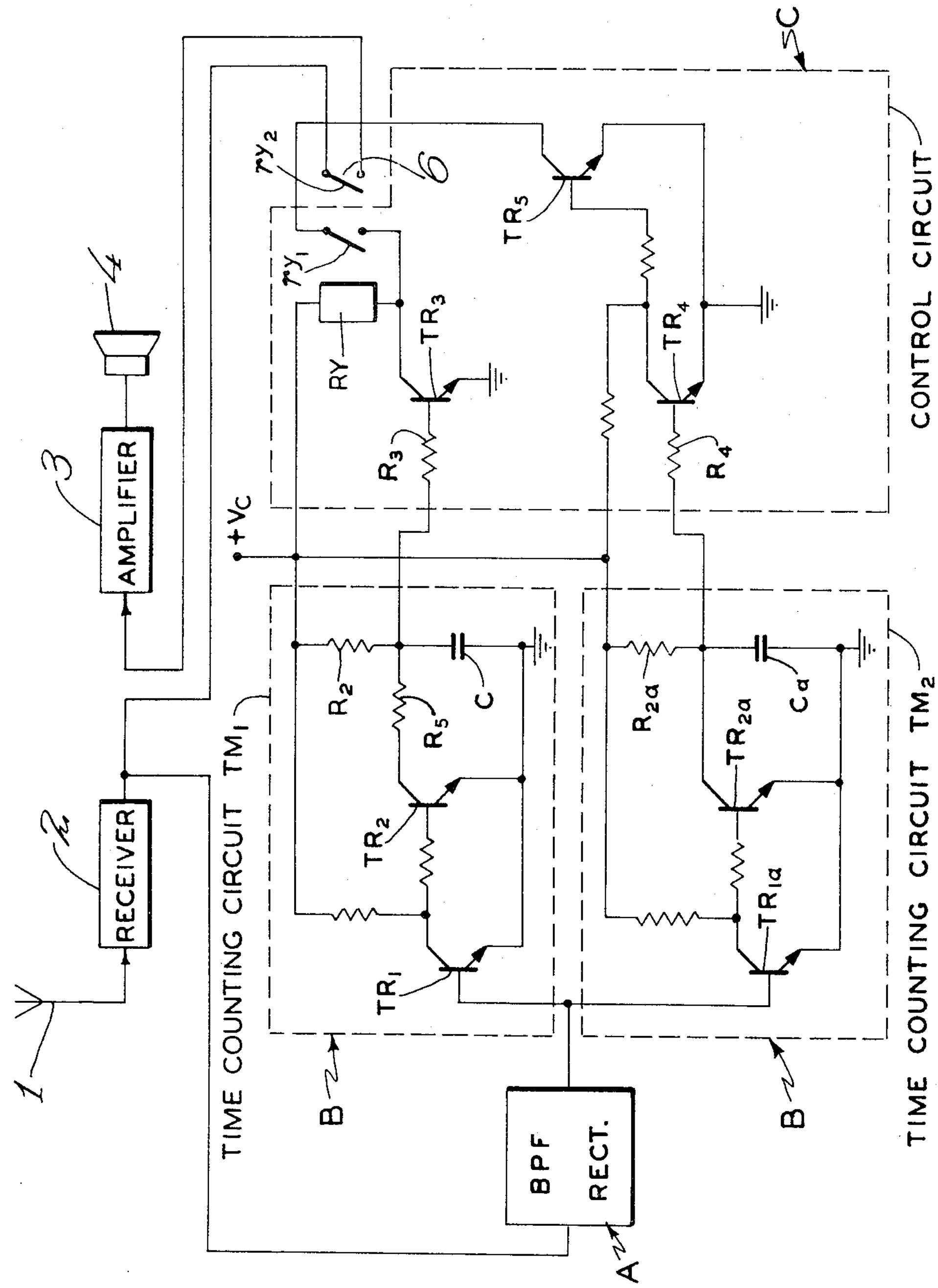

FIG. 5

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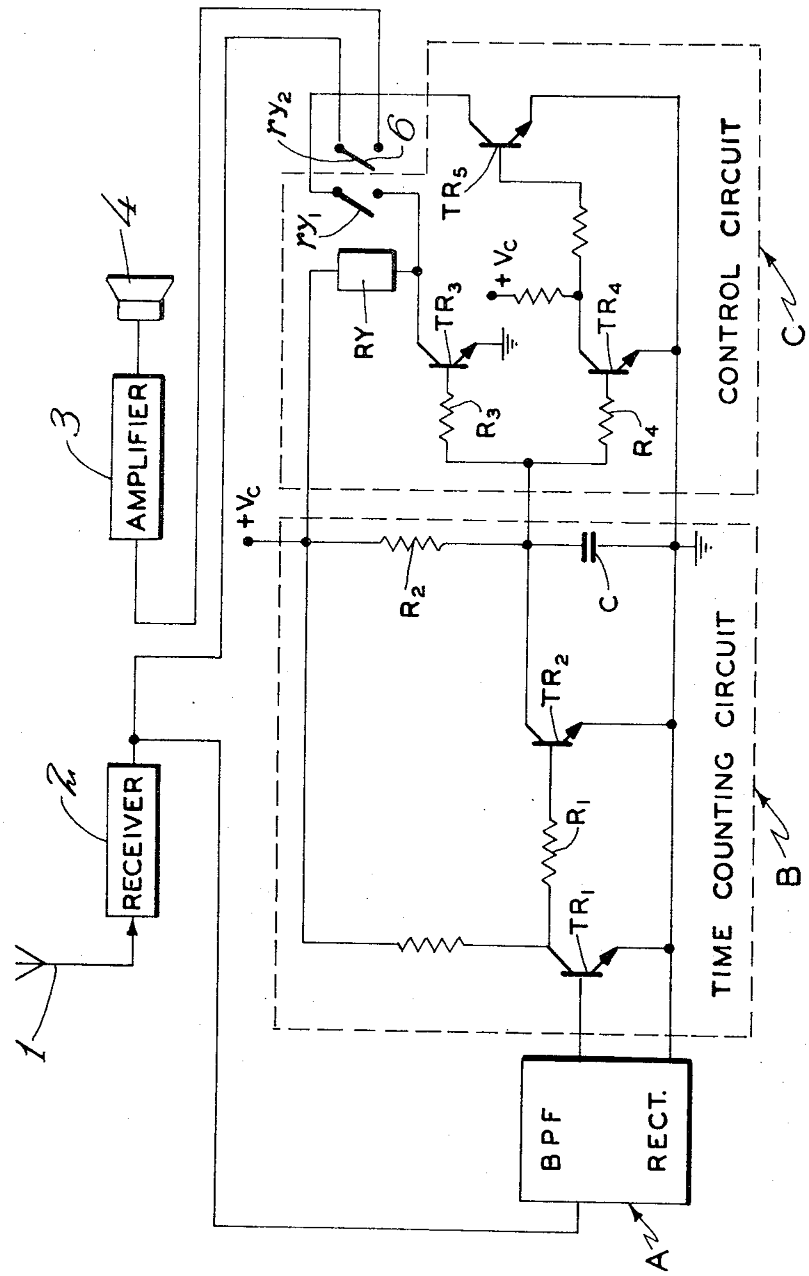

FIG. 6

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Fig. 7a case (a)

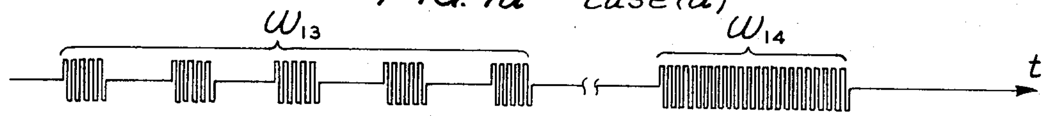


Fig. 7b case (b)

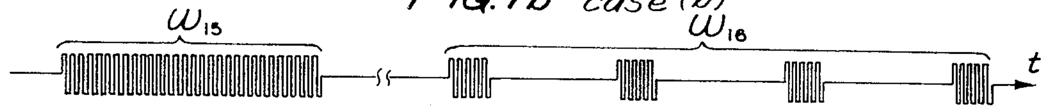
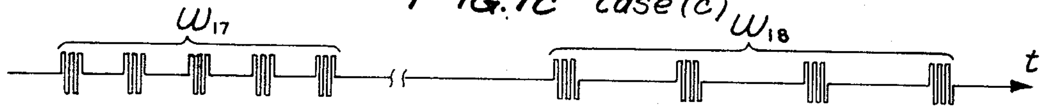


Fig. 7c case (c)



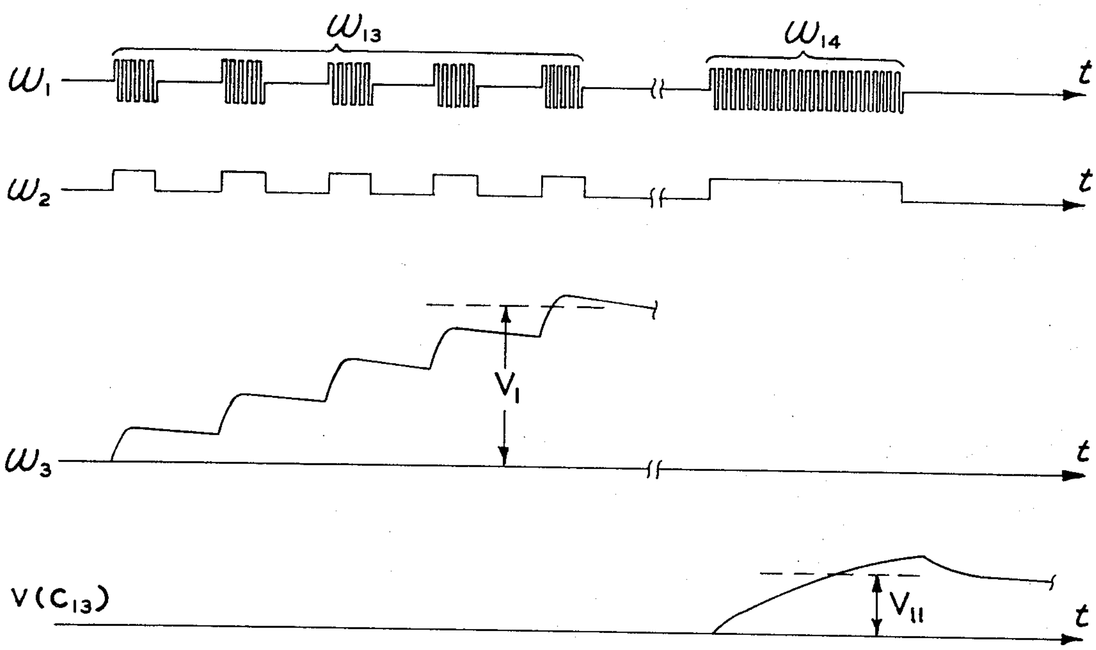


FIG. 9

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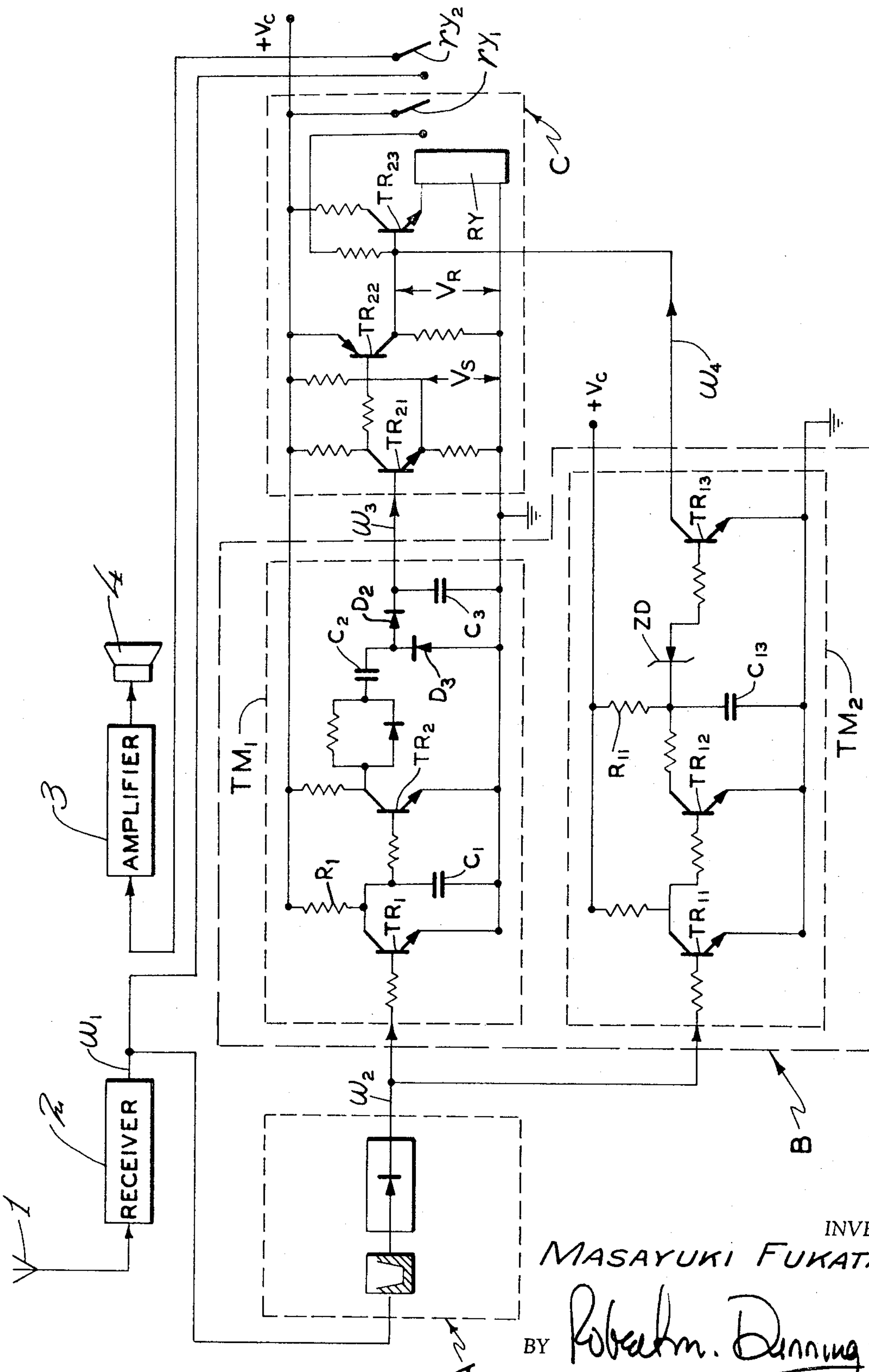

FIG. 8

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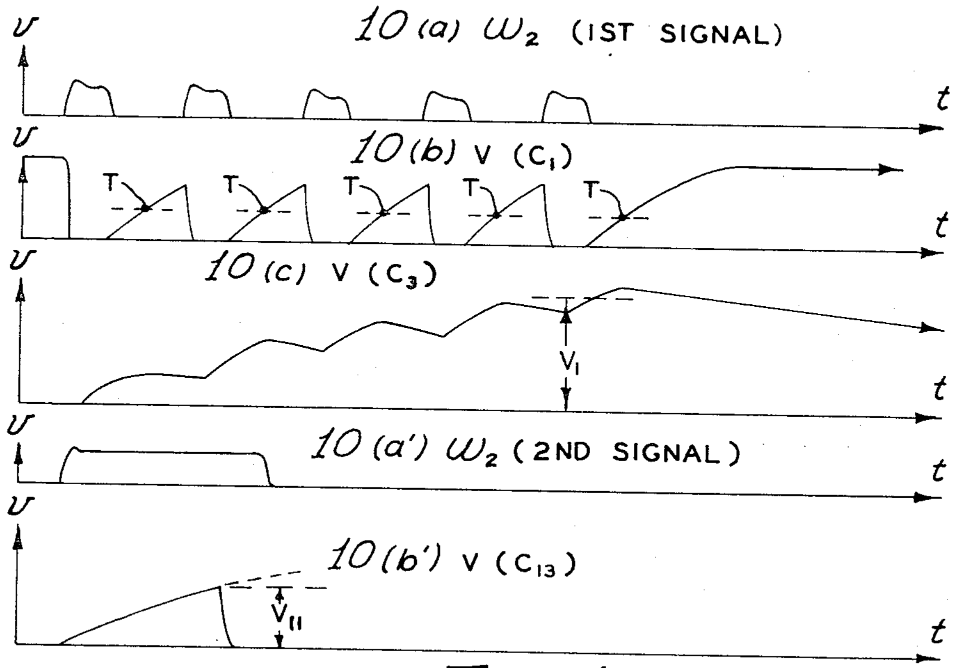

FIG. 10

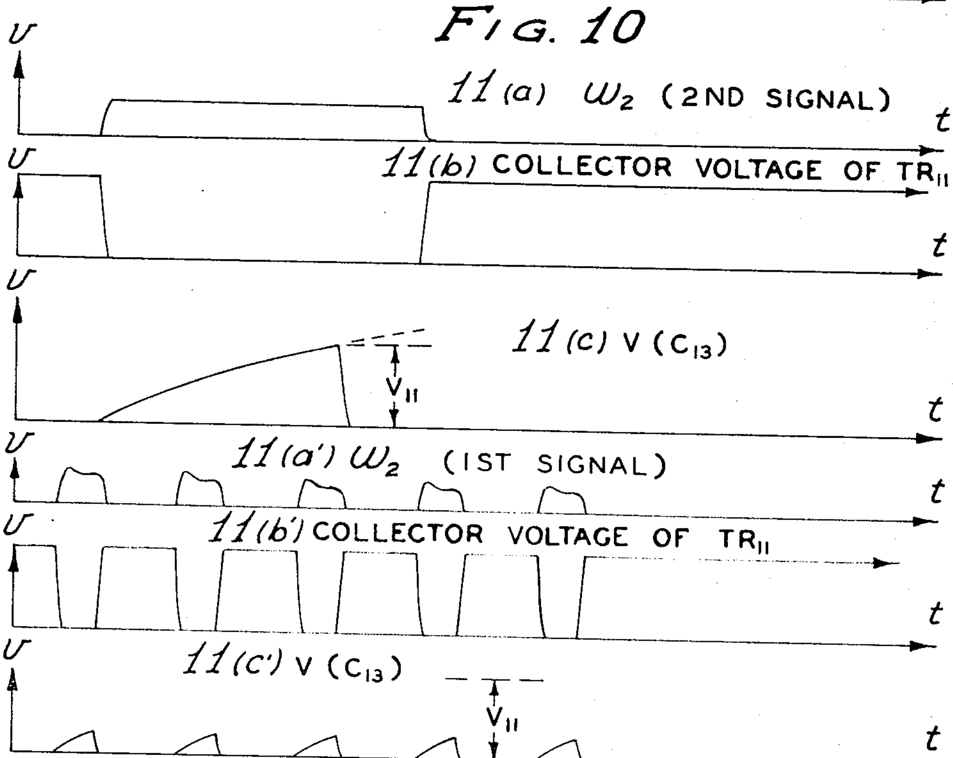

FIG. 11

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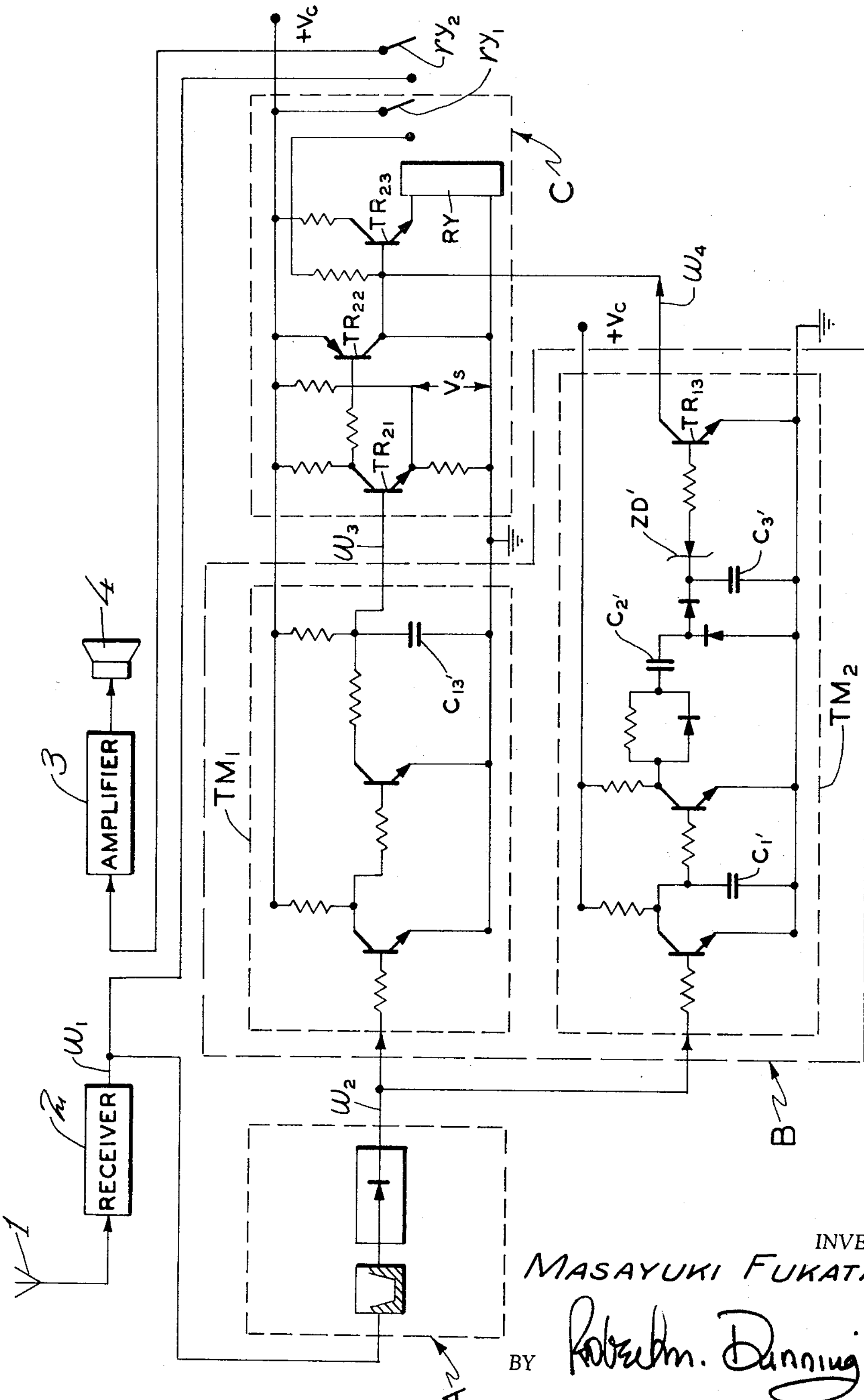

FIG. 12

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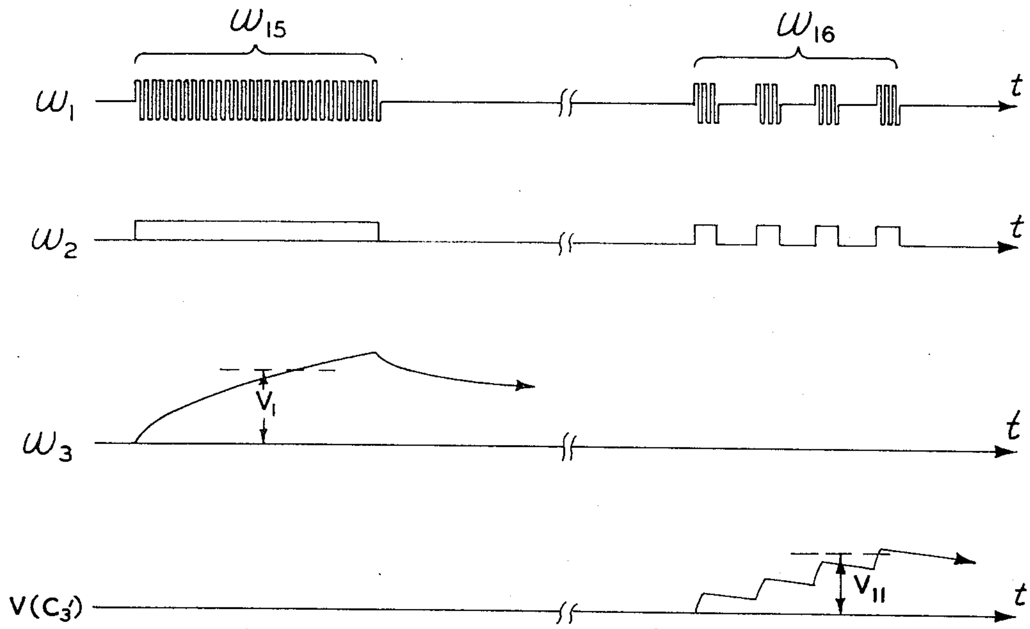

FIG. 13

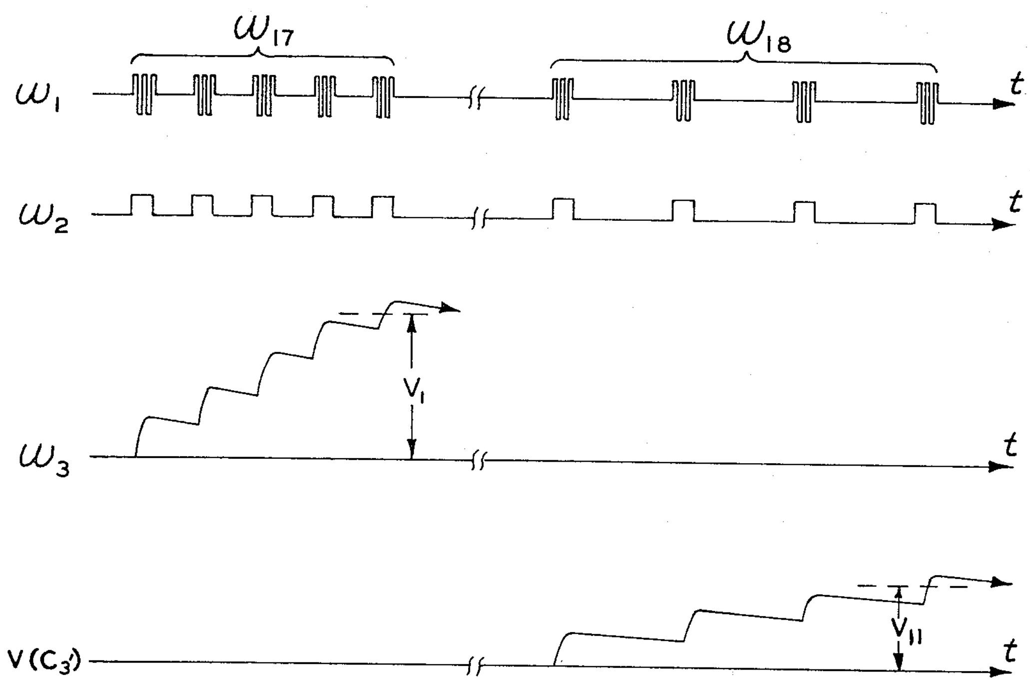

FIG. 15

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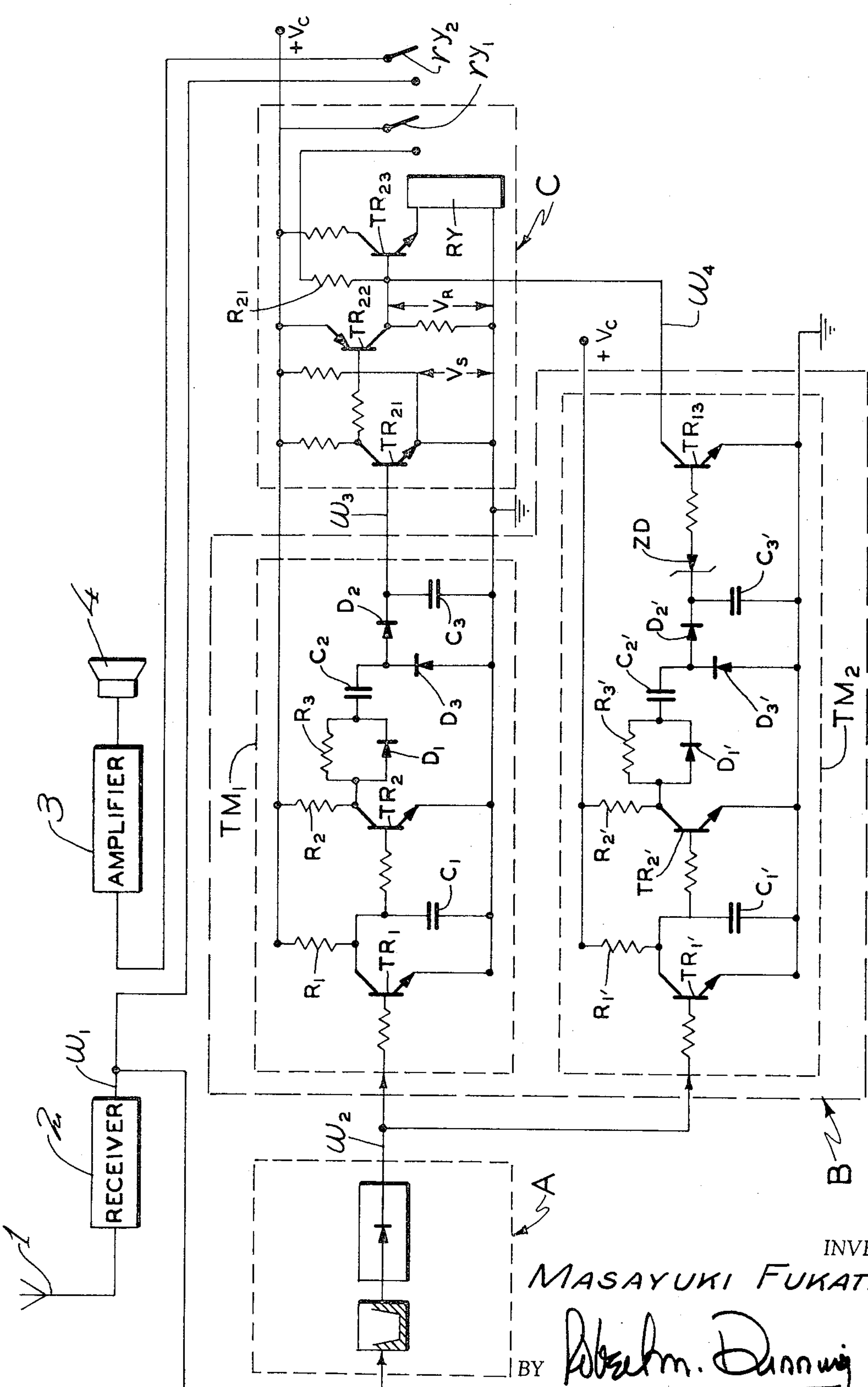

FIG. 14

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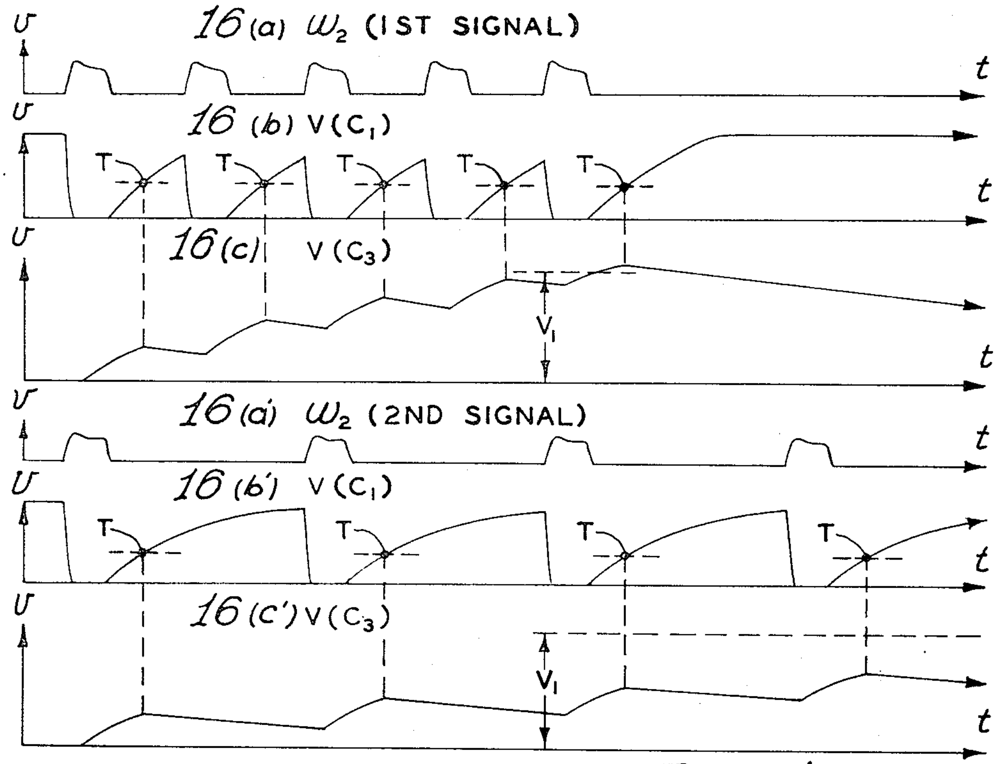

FIG. 16

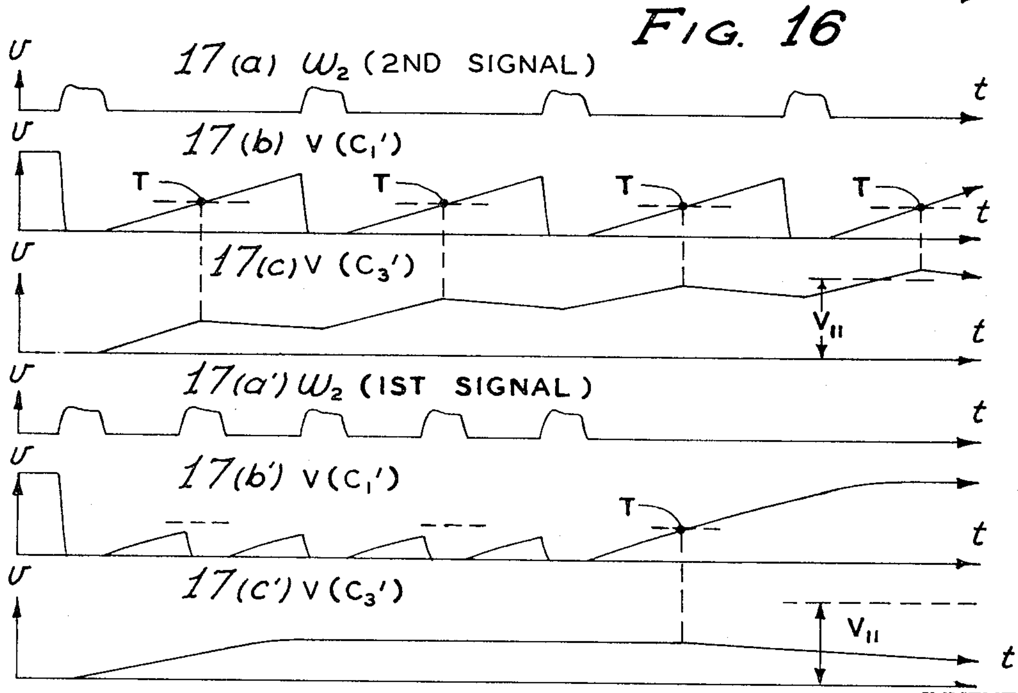

FIG. 17

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RECEIVING DEVICE FOR AUTOMATICALLY DEMUTING AND REMUTING BY TWO CONTROL SIGNALS SEQUENTIALLY TRANSMITTED FROM TRANSMITTER

This application is a continuation-in-part of application Ser. No. 885,401 filed Dec. 16, 1969, titled "Receiving Device for Control Information" and issued as U.S. Pat. No. 3,628,153 on Dec. 14, 1971.

BACKGROUND OF THE INVENTION

The original application and this application relate to receiving devices used in a system for controlling, from the sending side, the receiving side in a broadcast system, such as (1) an emergency broadcast system for transmitting emergency information, such as information of a natural disaster etc., (2) a recorder-control broadcast system for causing recorders such as tape-recorders, to record the broadcast information in accordance with the control of the broadcast station, or (3) a broadcast system for a control signal transmitted to control the switch operation of each of various kinds of apparatus at the receiving side.

In prior art broadcast systems, a device at the receiving side is automatically triggered by a control signal transmitted from the sending side. However, restoration to the stand-by condition of the device on the receiving side is usually performed by manual operation (hereinafter referred as "semi-control system"). If the customer of the receiving set is absent, the receiving set of the semi-control system remains in an unmuted condition after completion of a desired operation. This will cause unnecessary power consumption or unnecessary loud noise from the speaker which is uncomfortable to the neighborhood. This defect prevents popularization of broadcast systems of this type.

To eliminate the above difficulty, another prior art system has been proposed in which the triggered device on the receiving side is automatically restored from the sending side (hereinafter referred as "full-control system"). In this full-control system, two control signals having different frequencies are employed. Two control signals A and B are simultaneously transmitted to the receiving side. The received control signals *a* and *b* are applied to an AND gate, so that a desired control is effected at the output of the AND gate. Thereafter, one of the two control signals *a* and *b* is ceased while the other is further transmitted without interruption to hold the triggered condition of the controlled device. When the other of the two control signals *a* and *b* is ceased, the controlled device is restored to the initial condition. However, if this full-control system is applied to an emergency broadcast system, co-existence of the broadcast program and one of the signals *a* and *b* is offensive to the ear. To avoid such discomfort the modulation rate of the carrier in transmitting the two control signals *a* and *b* is reduced as low as possible. This causes deterioration of the reliability of the control operation of this full-control system. With respect to some of receiving sets, normal triggering and normal restoration in these receiving sets will not be performed at all.

An object of the original application an this application is to provide receiving devices free from the above defects.

Differences of the principles of the original application (now U.S. Pat. No. 3,628,153) and this continuation-in-part application will be understood from the following detailed discussion taken in conjunction with the accompanying drawings, in which the same or equivalent parts are designated by the same reference numerals, characters, and symbols.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram for illustrating an example of conventional receiving devices used in the broadcast system for control information.

FIG. 2 is a block diagram for illustrating an example of conventional sending devices used in the broadcast system for control information.

FIG. 3 is a block diagram for illustrating the theory of operation of this invention.

FIG. 4 shows time charts explanatory of the operation of some embodiments of a control device.

FIG. 5 and 6 are each block diagrams for illustrating an actual embodiment of one control receiving device.

The subject matter shown and described with respect to FIGS. 1 through 6 comprises subject matter shown and claimed in my U.S. Pat. No. 3,628,153 for "Receiving Device for Control Information" issued Dec. 14, 1971. FIGS. 7 through 15 demonstrate the structure of this application.

FIG. 7 shows time charts explanation of the operation of the present invention. Hereinafter, the time charts of FIG. 7(*a*), FIG. 7(*b*) and FIG. 7(*c*) are named the extended case (*a*), the extended case (*b*) and the extended case (*c*), respectively.

FIG. 8 is a block diagram for illustrating an actual embodiment of the extended Case (*a*).

FIG. 9, FIG. 10 and FIG. 11 show the wave form of the control signal of Case (*a*) at several locations in the circuit illustrated in FIG. 8.

FIG. 12 is a block diagram for illustrating an actual embodiment of the extended Case (*b*).

FIG. 13 shows the wave form of the control signal of Case (*b*) at several locations in the circuit illustrated in FIG. 12.

FIG. 14 is a block diagram for illustrating an acutal embodiment of the extended Case (*c*).

FIG. 15, FIG. 16 and FIG. 17 show the wave form of the control signal of Case (*c*) at several locations in the circuit illustrated in FIG. 14.

DESCRIPTION OF THE PRINCIPLES OF THE ORIGINAL APPLICATION

In order to clarify differences of the principles of the original application and the present application, the principles of the former will be described in the first place. To afford a better understanding of the principle of the original application, a conventional broadcast system for control information will first be described.

FIG. 1 is an example of a receiving set which comprises a receiving antenna 1, receiver 2 receiving a transmitted signal from the antenna 1 and amplifying the received signal and further demodulating the received signal, a control signal detector 5 for detecting a transmitted control signal from the received and demodulated signal, a switch 6 controlled by the output of the control signal detector 5, an amplifier 3 amplifying the demodulated signal obtained at the output of the receiver 2, and a speaker connected to the output of the amplifier 3. In this receiving set, the switch 6 is opened in the normal case, so that the speaker 4 is muted. When a control signal is transmitted from the sending side of the broadcast system, it is detected by the control signal detector **5**, so that the switch **6** is closed and the broadcast program transmitted after the control signal can be heard from the speaker **4**.

FIG. **2** is an example of the sending side of the broadcast system to control the receiving sets as shown in FIG. **1**. Broadcast program signals are applied from a terminal **13**. A control signal generator **14** generates a predetermined control signal. The control signal generated from the control signal generator **14** is applied to the transmitter **11**. The output of an amplifier **12** amplifying the broadcast programs supplied from the terminal **13** is also applied to the transmitter **11**. The output of the transmitter **11** is connected to a sending antenna **15**. When a program is to be transmitted to the receiving sets, the control signal is at first transmitted to unmute the receiving sets and then the broadcast program is transmitted.

Means **1, 2, 3, 4** and **6** of FIG. **3** are the same as those in the receiving set shown in FIG. **1**. The control signal detector **5** comprises three means A, B and C. The means A comprises a narrow band-pass filter BPF for selecting a signal of a predetermined single frequency from the output W_1 of the receiver **2** and a rectifying circuit RECT for converting them to a DC pulse signal W_2. The means B comprises a time counting circuit TM_1 and a time counting circuit TM_2. The time counting circuit TM_1 measures the duration of the DC pulse signal W_2 obtained from the means A so that a first output W_3 is present when the duration of the DC pulse signal W_2 exceeds a predetermined time Ts. The time counting circuit TM_2 measures the duration of the DC pulse signal w_2 obtained from the means A so that a second output w_4 is present when the duration of the DC pulse signal w_2 exceeds a predetermined time Tc less than the time Ts. The means C is a control circuit for switching-in the switch **6** in response to the first output w_3 and for switching-off the switch **6** in response to the second output w_4 generated after the termination of the first output w_3. Accordingly, the switch **6** is held in the ON-state in a time from the termination of the first output w_3 to the start of the second output w_4.

The operation of the control signal detector **5** shown in FIG. **3** will be further described with reference to FIG. **4**. A first mark w_{11} of the signal w_1 is transmitted to switch-in the switch **6**, and a second mark w_{12} of the signal w_1 is transmitted to switch-off the switch **6**. The mark w_{11} for switching-on the switch **6** has a duration longer than a predetermined time Ts. The mark w_{12} for switching-off the switch **6** has a duration longer than a predetermined time Tc but shorter than a predetermined time Ts which is longer than the time Tc. As understood from FIG. **4**, when the first mark w_{11} is transmitted, the time counting circuit TM_2 generates the second output w_{41} after the time Tc from the start of the first mark w_{11}. However, the control circuit is designed so that the switch **6** is not switched-off in response to the second output w_{41}. This will be clear from actual embodiment described below.

With reference to FIG. **5**, an example of the control signal detector **5** is described. The above mentioned means A, B and C are designated by dotted enclosures. The operation of this example is as follows. When the first mark w_{11} is transmitted to cut-off a transistor TR_2 and the duration of the output w_2 of the means A exceeds the time Ts determined in accordance with a product of values of a resistor R_2 and a capacitor C, a voltage charged in the capacitor C through the resistor R_2 from a source +Vc is discharged through a path comprising a resistor R_3 and a transistor TR_3. Accordingly, a relay RY is energized so that contacts ry_1 and ry_2 are closed. In response to the close of the contact ry_2, the receiver **2** and the amplifier **3** are connected to each other. Accordingly, program information transmitted after the control signal (w_{11}) can be heard from the speaker **4**. On the other hand, the charging time constant of a capacitor Ca determined in accordance with a product of values of a resistor R_{2a} and the capacitor Ca is smaller than the charging time constant Tc of the capacitor C. Accordingly, transistors TR_4 and TR_5 are respectively turned on and off before the above-mentioned turn-on of the Transistor TR_3. This means that the hold of the relay RY is maintained through the turned-on Transistor TR_3 since the Transistor TR_5 is cut off.

However, when the first mark w_{11} is terminated, the charged voltage of the capacitor Ca is suddenly discharged through a Transistor TR_{2a} so that the hold circuit of the relay RY is maintained by a path through the contact ry_1 and the Transistor TR_5. In this case, the charged voltage of the capacitor C is also discharged through a resistor R_5 and a transistor TR_2. However, since the discharging time constant of the capacitor substantially determined in accordance with a product of values of the capacitor C and the resistor R_5 is larger than the discharging time constant of the capacitor Ca determined in accordance with a product of values of the capacitor Ca and the transistor TR_{2a}, the Transistor TR_5 becomes conductive before turn-off of the Transistor TR_3. Accordingly, the hold of the relay RY are continuously maintained. This hold of the relay RY can be maintained by the use of a slow-releasing relay as the relay RY.

When the second mark w_{12} more than the time Tc and less than the time Ts is transmitted and received, the transistor TR_4 becomes conductive after the time Tc starting from the start of the second mark w_{12} while the Transistor TR_3 is remained in the cut-off state. Therefore, the Transistor TR_5 is turned off so that the self-hold of the relay RY is released. In response to this release of the relay RY, connection between the receiver **2** and the amplifier **3** are cut off. This is the stand-by condition for receiving a next control signal.

With reference to FIG. **6**, another example of the control signal detector **5** is described. In this example, the means B comprises a single time counting circuit. However, the start to turn-on of the Transistor TR_3 is determined so that the turn-on of the Transistor TR_3 starts when the charged voltage of the capacitor C reaches a voltage v_1, while the start to turn-on of the Transistor TR_4 is determined so that the turn-on of the Transistor TR_4 starts when the charged voltage of the capacitor C reaches a voltage v_2. In this case, the voltage v_1 corresponds to a voltage charged in the capacitor C in the time Ts starting from the start of the first mark w_{11}. The voltage v_2 corresponds a voltage charged in the capacitor C in the time Tc starting from the start of the first mark w_{11} or the second mark w_{12}.

In addition to the above mentioned analogue technique, mechanical relays may be adopted to form the means B. Moreover, the relay RY of the means C may be replaced by an electronic circuit, such as Flip-Flop circuit, or by another electronic switching circuit.

The circuits described to this point are the subject of the above referenced copending application.

DESCRIPTION OF THE PRINCIPLES OF THE PRESENT APPLICATION

With reference to FIGS. 7 through FIG. 17 actual examples of an improved set of control signal detectors 5 will be described. The means A, B and C are designated by dotted enclosures. FIG. 7 demonstrates the new control signals that are used. The old control signals i.e. the control signals of the original application and the new control signals i.e. the control signals of the present application can be compared as follows:

Control Signal	Old System	New System Case (a)	Case (b)	Case (c)
first signal	continuous (W_{11})	intermittent (W_{13})	continuous (W_{15})	intermittent (W_{17})
second signal	continuous (W_{12})	continuous (W_{14})	intermittent (W_{16})	intermittent (W_{18})

The response of circuit TM_1 of FIG. 8 to the first control signal W_{13} is as follows. Before the first mark of the first control signal W_{13} is transmitted to circuit TM_1, a transistor TR_1 is cut-off and a condenser C_1 is fully charged up. A transistor TR_2 is short-circuited and condensers C_2 and C_3 remain discharged. When the first mark of the first control signal W_{13} is transmitted to the circuit TM_1, TR_1 is short-circuited, C_1 discharged, TR_2 is cut off. C_2 and C_3 are charged. This condition continues during the existence of the first mark. When the first mark ceases to exist, TR_1 is cut-off and C starts charging through a resistor R_1 as shown in FIG. 10 (*b*). When the voltage across C_1 reaches a predetermined level T in FIG. 10 (b), TR_2 is again short-circuited and C_2 discharges through TR_2. However, the discharge of C_3 is blocked by diodes D_2 and D_3. When the second mark of the first control signal W_{13} arrives at TM_1, the same cycle of response is repeated. That is, TR_1 is short-circuited, C_1 discharges, TR_2 is cut-off and C_2 and C_3 are charged. After this second mark ceases to exist, C_1 starts charging and when the voltage across C_1 reaches T point, C_2 discharges through TR_2. However, C_3 does not discharge but nearly doubles its voltage. C_3 steps up its voltage every time the mark of the first control signal is transmitted as shown in FIG. 10 (*c*). After the fifth mark of the first control signal ceases to exist, the voltage across C_3 reaches V_1 as shown in FIG. 10 (*c*), and a transistor TR_{21} of the control circuit C is short-circuited. Then transistors TR_{22} and TR_{23} are sequentially short-circuited to activate a relay RY. With the activation of the relay RY, contacts ry_1 and ry_2 are closed. The closing of the contacts ry_1 holds RY until the second control signal releases (opens) RY. The closing of the contact ry_2 demutes the receiver.

The predetermined voltage V_1 maintains the following relationship with the preset voltage Vs between the emitter of TR_{21} and the ground (see FIG. 8):

$V_1 = Vs$ +(base-emitter voltage drop of TR_{21})

The response of circuits TM_2 and circuit C of FIG. 8 to the second control signal W_{14} is as follows. Before the second control signal W_{14} is transmitted to a circuit TM_2, a transistor TR_{11} is cut-off, a transistor TR_{12} is short-circuited and a condenser C_{13} discharges completely. When the second control signal W_{14} is transmitted to the circuit TM_2, TR_{11} is short-circuited, TR_{12} is cut-off and C_{13} starts charging as shown in FIG. 11 (*b*) and (*c*). When the voltage across C_{13} reaches V_{11}, a zener diode ZD discharges suddenly and at the same time a transistor, TR_{13}, is short-circuited. Consequently, the transistor TR_{23} of the control circuit C is short-circuited and the self-holding state of the relay RY is released to remute the receiver.

The reason why the circuit TM_1 does not pass the second control signal and the circuit TM_2 does not pass the first control signal can well be understood from FIG. 10 (*b*) (*c*) and FIG. 11 (*b'*), (*c'*).

With reference to FIG. 12 and FIG. 13, another example of the control signal detector 5 will be described.

The response of circuits TM_1 and C of FIG. 12 to the control signal W_{15} (shown in FIG. 13) is as follows: Like the response of the circuit TM_2 of FIG. 8, a voltage across the condenser C_{13} of TM_1 of FIG. 12 reaches V_1. This occurs after the first control signal W_{15} is transmitted to TM_1 as shown in FIG. 13. Then a relay RY is activated and self-held through the operation of transistors TR_{21}, TR_{22}, and TR_{23}. In this case, V_{11} is predetermined as follows:

$V_1 = Vs$ + (base emitter voltage drop of TR_{21})

The response of circuits TM_2 and C of FIG. 12 to the second control signal W_{16} is as follows: Like the response of the circuit TM_1 of FIG. 8, voltage across a condenser C3' of TM_2 of FIG. 12 reaches V_{11}. This occurs after th fourth mark of the second control signal W_{16} ceases to exist as shown in FIG. 13. Then a zener diode suddenly discharges to short-circuit a transistor TR_{13}. Consequently, the transistor TR_{23} of the control circuit C is short-circuited and the self-holding state of the relay RY is released to remute the receiver.

The reason why the circuit TM_1 does not pass the second control signal and the circuit TM_2 does not pass the first control signal can well be understood from the explanation for the Case (*a*).

With reference to FIG. 14, FIG. 15, FIG. 16 and FIG. 17, another example of the control signal detector 5 is described.

The response of circuits TM_1 and C of FIG. 14 to the control signal W_{17} is the same as the operation of Circuits TM_1 and C of FIG. 8 to the first control signal W_{13}. This response is illustrated in FIG. 16 (*a*) (*b*) and (*c*).

The response of circuits TM_2 and C of FIG. 14 to the second control signal W_{18} is the same as the response of circuits TM_2 and C of FIG. 12 to the second control signal W_{16} and is illustrated in FIG. 16 (*a'*), (*b'*) and (*c'*).

Since the first control signal and the second control signal are the same in wave form, there must be some different criteria between these two control signals to permit TM_1 and TM_2 to distinguish between these two signals. In this illustration, the following criteria on control signals are given as an example:

a. The mark duration of the first and the second control signals are the same.

b. The space duration of the first signal is longer than that of the second signal.

c. The necessary number of marks of the first signal for triggering the relay RY is five while the necessary number of mark of the second signal for releasing the relay RY is four.

The discrimination of TM_1 between the first and second signals under the above criteria is illustrated in FIG. 16. In FIG. 16, (*a*), (*b*) and (*c*) show the normal response of TM_1 to the first signal. The voltage across the condenser C_3 reaches the necessary voltage V_1 at the fifth mark of the first signal and triggers the relay RY. In FIG. **16,** (a') (b') the response of TM_1 to the second signal is shown. The voltage across C_3 cannot reach V_2. RY fails to trigger.

The discrimination of TM_2 between the second and first signals with the above criteria is illustrated in FIG. **17.** In FIG. **17,** (a), (b) and (c) show the normal response of TM_2 to the second signal. The voltage across the condenser C3' reaches the necessary voltage V_{11} at the fourth mark of the second signal to release the relay RY. In FIG. **17,** (a'), (b') and (c') the response of TM_2 to the first signal is shown. The voltage across C_3' cannot reach V_{11}. RY fails to release.

The above examples relate to receiving devices used in an emergency broadcast system. However, it will be readily understood that the devices of this invention can be applied to other control systems, such as control of a tape-recorder connected to a receiver or control of a switch or switches of a device provided at the receiving side.

I claim:

1. A receiving device for control information formed by a first intermittent signal and a second continuous signal transmitted after the first signal, comprising:

selection means for selecting the control information from a transmitted signal to convert it to at least one DC signal;

mark-number-counting means coupled to the output of the selection means for generating a first output when the number of mark of DC signal exceeds a predetermined number N;

time-measuring means coupled to the output of the selection means for generating a second output when the duration of the DC signal exceeds a predetermined time T;

first control means coupled to the output of the mark-number-counting means for triggering a control circuit to the switching-in state thereof in response to the first output and for holding the switching-in state of the control circuit;

second control means coupled to the output of the time-measuring means for releasing the hold state of the first control means in response to the second output.

2. A receiving device for control information formed by a first continuous signal and a second intermittent signal, transmitted after the first signal, comprising;

selection means for selecting the control information from a transmitted signal to convert it to at least one DC signal;

time-measuring means coupled to the output of the selection means for generating a first output when the duration of the DC signal exceeds a predetermined time T;

mark-number-counting means coupled to the output of the selection means for generating a second output when the number of mark of DC signal exceeds a predetermined number N;

first control means coupled to the output of the time-measuring means for triggering a control circuit to the switching-in state thereof in response to the first output and for holding the switching-in state of the control circuit,

second control means coupled to the output of the mark-number-counting means for releasing the hold state of the first control means in response to the second output.

3. A receiving device for control information which is formed by a first intermittent signal and a second intermittent signal transmitted after the first signal and in which the first signal and the second signal are different from each other in the number of mark and/or in the space duration and/or in the mark duration, comprising:

selection means for selecting the control information from a transmitted signal to convert it to at least one DC signal;

first mark-number-counting means coupled to the output of the selection means for generating a first output only when the first signal enters said means;

second mark-number-counting means coupled to the output of the selection means for generating a second output only when the second signal enters said means;

first control means coupled to the output of the first mark-number-counting means for triggering a control circuit to the switching-in state thereof in response to the first output and for holding the switching-in state of the control circuit;

second control means coupled to the output of the second mark-number-counting means for releasing the hold state of the first control means in response to the second output.

4. A receiving device for control information including:

a first signal and a second signal;

one of said signals being intermittent and the other being selected from the group consisting of an intermittent signal and a continuous signal;

selection means for selecting the control information from a transmitted signal to convert it to one DC signal;

means for generating a first output;

means for generating a second output;

said generating means being selected from the group consisting of a mark-number-counting means coupled to the selection means generating an output when the number of mark of each intermittent DC signal exceeds a predetermined number N, and a time measuring means coupled to the output of the selection means for generating an output when the output of any continuous DC signal exceeds a predetermined time T;

first control means coupled to said first output for triggering a control circuit to the switching-in state thereof in response to the first output and for holding the switching-in state of the control circuit; and

second control means coupled to the second output for releasing the hold state of the first control means in response to the second output.

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