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(54) Method and apparatus for transmitting control signals to actuators in television satellite receivers.

(57) The apparatus comprises: at least one receiving antenna (16) having one or more actuators (15); a coaxial transmission cable (13); at least one internal unit (9); first circuit means (1) for transmitting control signals to one end of the cable; second circuit means (17) for receiving and decoding the signals received at the other end of the cable and adapted to operate the actuators. The information for operating the actuators being obtained by modulating the direct tension, powering the external unit, with adapted pulses. The direct power tension normally overlaps the radiofrequency signal in the coaxial transmission cable and the modulation depth is such that it has no effect on the external unit powering. This allows, for transmitting the control signal, to use the same single coaxial cable for transmitting the radiofrequency signals.

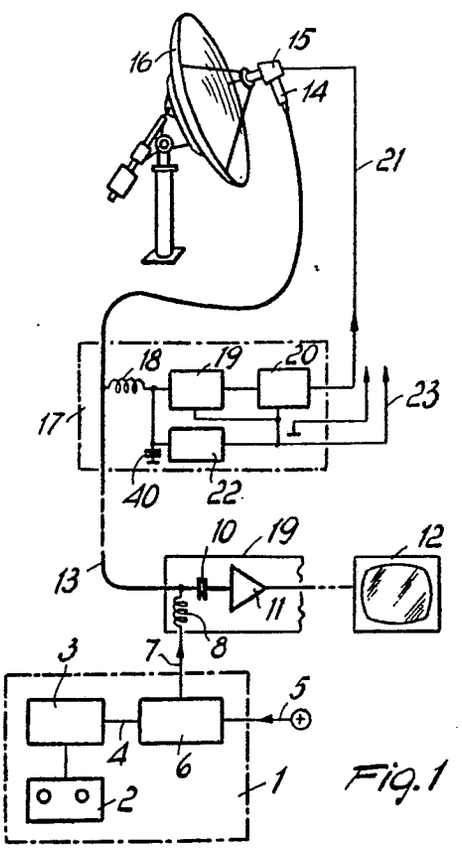

Fig.1

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METHOD AND APPARATUS FOR TRANSMITTING CONTROL SIGNALS TO ACTUATORS IN TELEVISION SATELLITE RECEIVERS

The present invention relates to a method and an apparatus for transmitting control signals to actuators in television satellite receivers.

A television satellite receiver essentially consists of an external unit comprising a parabolic antenna and a low noise converter, located outside a building, and of an internal unit located at or inside, a television set. The external unit output signal, usually in the range of 950-1750 MHz and comprising a plurality of television signals,is transmitted to the internal unit by means of a suitable coaxial cable.

The low noise external amplifier/converter is usually powered by direct current through the radiofrequency signals transmission cable itself.

From now on this powering will be simply called external unit powering.

To avoid interference problems in the satellite television transmission, it is known to transmit adjacent channels with different polarization, i.e. left and right polarization or vertical and horizontal polarizations depending on the satellite having circular or right angled polarizations.

A user who wants to receive signals from both polarizations should therefore set up two low noise converters, one for each polarization, and then make a connection with the corresponding radiofrequency inlets on the internal unit by means of two separate coaxial cables.

The internal unit should also have a first switch system for carrying the direct power current on either cables, according to the selected polarization, and a second system for switching the radiofrequency signal on the single inlet amplifier of the internal unit.

In the above described system, beside using two external converters and a more complex inlet circuit of the internal unit, to receive either polarizations it is necessary to lay two separate coaxial transmission cables; this may be difficult, in installing the system, because of the large diameter of the cables.

To overcome those troubles, polarization shifting devices (for example those known as "polarotor") are becoming more and more common and, employed in a single external converter, allow to adapt it to receive signals of both polarizations and hence to transmit the radio frequency signals through a single coaxial cable, consequently simplifying also the internal unit inlet circuit.

To operate those devices, adapted control signals are required which, for example in the case of devices manufactured by "Chapparal", consist of rectangular waves in TTL (transistor-transistor logic) whose cycle is comprised between 17 and 21 milliseconds and in which the rectangular pulse width of the cycle varies between 0.8 and 2.2 milliseconds. Depending on the width of such pulses a small servomotor, controlled by a PWM (Pulse Width Modulation) detector circuit, suitably places a probe which modifies the polarization of the signals passing through the external converter/amplifier.

In this case too though, the advantage of having one transmission cable is partially nullified by the need of a further three lead cable to transmit the square wave signal, power and ground from the internal unit to the polarotor device.

Thinking of the plurality of satellites which will be received in a near future, there may be other instances such as, for example, the ability of receiving satellites having different orbital position on the equatorial plane.

In this case, if the transmission frequency of the satellites is in the same range, the same antenna can be used as far as it has a polar mounting and an adapted rotating mechanism controlled by means of a multiple lead cable laid beside the radiofrequency transmission coaxial cable.

A further instance may be that of the ability of receiving satellites having different orbital positions and different frequency range thus requiring separate antennas, switch units and transmission cables.

In this case too it is possible to transmit through a single coaxial cable by means of a multiple lead cable controlling a switch device located at the parabolic antennas.

The present invention aims at eliminating the inconveniences of the above described systems by making unnecessary the use of the multiple lead cables controlling the actuators.

The aim of the invention is achieved in a television satellite receiver, by the method and the apparatus outlined in the characterizing part of claims 1 and 3 respectively.

Improvements and developments of the invention are characterized in the sub-claims.

Owing to the fact that the actuator control signals are transmitted by modulating the external unit power direct voltage, which usually overlaps the radiofrequency signals in the transmission coaxial cable, it is possible to use the same transmission coaxial cable to transmit the control signals, thus eliminating the need of additional separate cables to transmit such control signals.

Furthermore, owing to the fact that the power

direct voltage modulation range is kept within values never greater than those of the admissible ripple of the external unit power direct voltage, the external unit operation is in no way affected.

Advantageously, to generate, decode and store the control pulse sequences, integrated devices are used such as those employed in the remote controls of television sets, gates or similar devices.

The signal shape, modulating the external unit power voltage, will be selected depending on the type of actuator to be controlled and it will be generally constituted by rectangular shaped single pulses having a set width, or by square waves with different working cycles, or by coded pulses.

Hence,to control the "polarotor" device manufactured by "Chapparal", the information modulating the external unit power direct voltage, may be constituted by a square wave with a cycle comprised between 17 and 21 milliseconds and having a working cycle varying. at the selected polarization.

Further scopes and advantages of the present invention will be apparent from the following detailed description and included drawings, given as purely explanatory, and not limitative, examples, wherein:

fig. 1 is a block diagram of the apparatus according to the invention;

figs.2 and 3 are detailed diagrams of circuits of two embodiments of the invention.

Fig. 1 schematically shows the connections arrangement according to the present invention in the antenna system for receiving satellite signals.

With reference to fig.1, 1 is the first circuit means, of the arrangement according to the present invention, and substantially comprises a control push-button panel 2 activating a circuit 3 for generating single pulses, or square waves, or coded pulses. Such pulses, on connection 4, modulate the direct tension 5, for powering the external unit 14, by means of the modulator circuit 6. Thus on connection 7 there will be the direct tension modulated by the signals on connecion 4.

Relatively to the direct power tension, of about + 15 Volt, the modulation range is such as to be a ripple overlapping the power tension and being less than 1 Volt, thus having no effect on the powering of the external unit which is always provided with a tension stabilizer.

Such modulated tension, on connection 7, overlaps the radiofrequency signal on the coaxial cable 13, connecting the internal unit 9 to the external unit 14, by means of inductance 8 provided on the inlet circuit of the receiving unit 9.

Condenser 10 picks up the radiofrequency signal for the inlet amplifier 11. The reference number 12 designates the television set on which the received signal is shown.

The modulation of the external unit power tension overlaps the radiofrequency signal on the coaxial cable 13 and constitutes the information for controlling actuator 15.

The second circuit means 17 of the arrangement according to the present invention is at the parabolic antenna 16.

Inductance 18 is at the circuit means 17 inlet and blocks the radiofrequency signals but lets the direct tension in undisturbed; the direct tension modulation, detected by circuit 19 and processed by interface 20, controls actuator 15 by means of connection 21.

The same direct tension, stabilized to the suitable value by circuit 22, also powers the circuit means 17 and actuator 15 by means of connection 23.

Figure 2, provided as a non-limitative example, shows the electric circuit diagram of one of several practical embodiments of the circuit means of the arrangement, according to the present invention, for controlling a "polarotor" actuator device manufactured by "Chapparal".

As above mentioned, this device is controlled by square waves in TTL with a cycle comprised between 17 and 21 milliseconds and a pulse width that has to set on to fixed values, comprised between 0.8 and 2.2 millisecond, according to the selected polarization.

In the present example such square waves are generated in block 3 (fig.1) of the first circuit means 1, inside or at the receiving unit 9, and transmitted to the coaxial cable 13 as a modulation of the direct tension powering the external unit 14.

Fig.2 also shows the wave shapes of the circuit branches and arrows showing the originating point of each wave shape.

With reference to fig. 2, devices 101 and 102 are NAND type gates connected to constitute a bistable circuit such that signals of outlets 103 and 104 are always of opposite logic condition (if 103 is high, 104 is low and viceversa) and, in the present case, will be of +12 Volts and 0 Volts if +12 Volts is the power tension.

The logic condition of outlets 103 and 104 can be switched acting on either of push-buttons 105 and 106.

Integrated circuit 107 is a timer, used as an astable oscillator, generating a square wave having a pulse frequency and width determined by the RC time constants of the circuit. In the present case the time constant is determined by condenser 108, by the resistance 109 and by the series of the resistance 110 and potentiometer 111 connected in parallel to the resistance 112 and potentiometer 113 assembly or to the resistance 112 and potentiometer 114 assembly depending on being high,

i.e. positively connected, outlet 103 or outlet 104 of the bistable circuit. Diodes 115 and 116 keep the potentiometer 113 and 114 circuits open when the corresponding outlets 103 and 104 of gates 101 and 102 are low, i.e. grounded.

In conclusion, at the gate 4 of integrated circuit 107 there will be a square wave having an amplitude approximately equal to the power tension in which the pulse width may assume two distinct values depending on being high the outlet 103 of device 101 or the outlet 104 of device 102; moreover, this situation can be cyclically modified acting on push-buttons 105 and 106.

Potentiometers 113 and 114 control the pulse width obtained in either situations so that the pulse width corresponds to that needed in order for the "polarotor" to let the signal pass in either polarizations.

The square wave, on connection 4, is sent to the base of the NPN transistor 118 by means of the resistive divider 119 or 120.

Transistor 118 will hence be either saturated or locked following the rithm of the base tension, namely transistor 118 will be saturated for the time corresponding to the positive pulse presence on the base and it will be instead locked for the time left of the base square wave cycle.

When transistor 118 is satured, PNP transistor 121 is saturated too and diode 122, connected between its collector and sender, is short circuited and therefore the external unit powers tension, on connection 7, will be approximately equal to the power tension of +15 Volts.

When, on the contrary, transistor 118 is locked, also transistor 121 is locked and therefore the tension on connection 7 will be lowered of about 0.7-0.8 Volts (diode 122 junction tension) relatively to its nominal value.

In conclusion, as an effect of this modulation, a ripple of 0.7-0.8 Volts amplitude, having the same width and timing of that of connection 4, will overlap the direct tension powering the external unit.

This modulated external unit power tension overlaps the radiofrequency signal on coaxial cable 13 by means of inductance 8 of the inlet circuit of internal unit 2.

It should be noted that the ripple overlapping such tension has no effect whatsoever on the external unit powering since the unit is always provided with a tension stabilizer.

At the "polarotor" device the +15 Volts tension, modulated by the square wave, is received from coaxial cable 13 by means of inductance 18 and sent to the tension stabilizer 22 and to a voltage comparator 25 (block 19 in fig. 1).

Tension stabilizer 22 powers the circuit and the "polarotor" by means of connection 23, while the voltage comparator 25, polarized by means of resistances 31, 32, 33 and 34, detects the tension variations at its non reversing inlet and at its outlet there will be a square wave signal similar to the one generated by the integrated circuit 107 and having an amplitude variating between 0 and 15 Volts, if this is the power tension of comparator 25.

Such square wave tension has a pulse width which can assume two different values according to the adjustments operated by means of potentiometers 113 and 114 and this tension controls the "polarotor" which accordingly will let the signals of either polarizations to pass.

Fig. 3 shows an electric circuit diagram, as a non limitative example, of a further possible embodiment of the apparatus, according to the invention, for controlling a "polarotor" device made by "Chapparal". In this apparatus, contrary to the apparatus of fig. 2, the square waves controlling the device are not generated at, or inside, the internal unit.

Said pulses, transmitted in the coaxial cable as power tension modulation for the external unit, are picked up at the "polarotor" device, identified according to their width and then utilized to control the device by means of an adapted interface.

Also in fig. 3, the wave shapes are illustrated, for the various circuit branches, by means of arrows.

Referring again to fig. 3, transistor 201, inserted in a monostable circuit, is normally saturated when at rest.

Transistor 202 is therefore also saturated, diode 203 is shortcircuited and the tension at connection 7 will be about equal to the power tension, in the present case 15 Volts.

By depressing either of push-buttons 205 or 206, transistor 201 is locked with a tension tied to the value of the resistive divider 207, 208 and 209.

The absolute value of this locking tension will be greater if push-button 205 has been depressed because the resistive divider 207, 208 and 209 will find the two resistance series 208 and 209 towards mass and therefore, as an effect of the time constant formed by condenser 210 and resistance 211, transistor 201 will reverse into saturation after a time T2 which is greater than a time T1 given by depressing push-button 206.

During times T1 or T2, also transistor 202 is locked and the power tension at connection 7 finds the diode 203 in series and therefore is lowered of about 0.7 Volts if this is the junction tension of diode 203.

In conclusion, by depressing either of push-buttons 205 or 206, the power tension at connection 7 will be negatively modulated by a single pulse having an amplitude of about 0.7 Volts and a width T1 or T2 >T1 depending on which of push-buttons 206 or 205 in depressed. This tension,

powering the external unit, overlaps the radiofrequency signal on coaxial cable 13 by means of the inductance 8 of the inlet circuit of receiving unit 9.

At the "polarotor" device the external unit power tension of +15 Volts (the external unit is not illustrated here and is connected to the upper end of the AF cable) is picked up by coaxial cable 13 by means of inductance 18, which blocks the radiofrequency signals. The tension then reaches the tension stabilizer 22 and the tension comparator 220 (block 19 of fig.1).

The tension stabilizer 22 powers the circuit and the "polarotor" through connection 23 while the tension comparator 19, polarized by resistances 221, 222, 223 and 224, detects the tension variations as pulses, at its non inverting inlet, every time either of push-button 205 or 206 is depressed.

At its outlet 225 there will be normally a +5 Volt tension which drops to 0 volts for the time corresponding to the pulse generated by depressing push-button 205 or 206, while on connection 226 the same pulse will be inverted by inverter 227.

This inverted pulse reaches the monostable circuit, constituted by the gates 228 and 229 and by the time constant 230 and 231 and which is part of block 20 (fig.1).

This monostable circuit outlet signal, available at connection 232 and sent to the DATA inlet of bistable circuit 233, is a pulse which starts simultaneously with the pulse on connection 226 and having a width determined by the values of resistance 231 and condenser 230. These components are such that this width T3 is greater than width T1, generated by depressing push-button 206, and less than width T2 generated by depressing push-button 205.

The pulse on outlet 225 is sent to the CLOCK inlet of circuit 233.

By means of the particular connection of bistable circuit 233 within the circuit, its outlet Q on connection 234, takes the same logic status of the signal on its DATA inlet every time that the CLOCK signal goes from the logic status 0 to the logic status 1, which happens at the end of the pulse on connection 225.

In conclusion, if the pulse at connection 225 has been generated by depressing push-button 2o6 it is therefore shorter than T3 and the change of status controlled by CLOCK finds the DATA signal having a logic status 1 and therefore signal Q on connection 234 assumes a value approximately equal to that of the power tension.

If the pulse at connection 225 has been generated by depressing push-button 205, it will be longer than T3 and the change of status controlled by CLOCK finds the DATA signal having a logic status 0 and therefore outlet tension Q on connection 234 assumes a value of zero.

The -Q tension on connection 235 will assume the corresponding negative values. The signal at connections 234 and 235, always having opposed logic values, are used in the described interface circuit for inserting two different time constants in the astable circuit provided by timer 236, resistances 237, 238, 239, potentiometers 240, 241, 242 and condenser 243. This circuit is similar to that of fig. 2 and therefore, at its outlet 21, provides a square wave having a pulse width of two different values depending on which of push-button 205 or 206 has been depressed.

Such pulse width is regulated, by means of potentiometers 240, 241 and 242, in order to control the "polarotor" device described for the selected polarizations.

It should be noted that, similarly to the example of fig.2, the control pulses have no influence whatsoever on the powering of the external unit which is always provided with a tension stabilizer 22.

It is apparent that by suitably changing the interface circuit of block 20 a different type of "polarotor" device or any other similar device, can be controlled without departing from the scope of the present invention.

Claims

1. Method for transmitting a plurality of control signals in antenna systems, particularly for receiving television satellite signals directly, said systems comprising: at least one receiving antenna (16) having actuators (15), at least one external unit (14) having a low noise converter/amplifier (14) and a tension stabilizer (70), at least one internal unit (9) for receiving the satellite signals, connection means (13) connecting said external unit (14) to said internal unit (9), power means powering said external and internal units, said method comprising:

- generating a control signal, corresponding to a command for the actuators (15), in first circuit means (1);
- modulating the direct power tension (5), supplied by the powering means, by means of said control signals;
- overlapping the external unit power tension to the radiofrequency signal, transmitted by said connection means (13) and modulated by said control signal, by means of mutual decoupling means (8, 10) between radiofrequency signal and modulated power tension;
- picking up said modulated power tension from said connection means (13) by means of decoupling means (18, 40) between radiofrequency signal

and modulated power tension;
- demodulating the control signal in the power tension and applying said control signal to the selected external unit actuator (15);
said connection means comprising a single transmission cable (13) connecting said internal unit (9) to said external unit (14);
the control signal modulation depth being such that the power tension ripple is in the admissible range in order to be leveled by the tension stabilizer devices provided in the powered units.

2. Method, according to claim 1, characterized in that said tension modulation depth is less than ten percent of said power tension.

3. Apparatus for transmitting a plurality of control signals to actuators in antenna system, particularly for receiving television satellite signals directly, said systems comprising at least one external unit (14), at least one receiving antenna (16) having actuators (15), at least one internal unit (9) for receiving the satellite signals, connection means (13) connecting the external unit (14) to the internal unit (9) and power means powering said external and internal units;
characterized in that said connection means comprises a single radiofrequency transmission cable (13) and characterized in that said apparatus furthermore comprises:
- in first circuit means (1), means (2, 3) for generating a control signal corresponding to a command for said actuators (15) and for modulating the external unit direct power tension (5) by means of the control signal;
- means (8, 10) for overlapping said external unit power tension to the radiofrequency signal transmitted on said radiofrequency transmission cable (13), said external unit power tension being modulated by means of the control signal with mutual decoupling between the radiofrequency signal and the modulated power tension;
- in second circuit means (17), means (18, 40) for picking up said modulated power tension, decoupled from the radiofrequency signal, from said transmission cable;
- means (19, 20) for demodulating the control signal contained in said power tension and for applying it to the selected external unit actuator (15);
- the power tension modulation depth being no greater than the admissible ripple for powering the actuators and the other power units.

4. Apparatus, according to claim 3, characterized in that said external unit furthermore comprises power tension stabilizer means (22, 70), the control signal modulation depth being such that the power tension ripple is in the admissible range in order to be levelled by the stabilizer means of the powered devices.

5. Apparatus, according to either claims 3 or 4, characterized in that the power tension modulation depth is less than ten percent of the power tension.

6. Apparatus, according to one or more of claims 3 to 5, characterized in that the signals modulating the external unit power tension comprise rectangular waves having different width and different working cycles.

7. Apparatus, according to one or more of claims 3 to 6, characterized in that the signals modulating the external unit power tension comprise single pulses having different width or duration.

8. Apparatus, according to one or more of claims 3 to 7, characterized in that it comprises means for codifying the signal pulses modulating the external unit power tension.

9. Apparatus, according to one or more of claims 3 to 8, characterized in that the signals modulating the external unit power tension comprise square waves having different width and different working cycles.

10. Apparatus, according to one or more of claims 3 to 9, characterized in that the direct power tension is modulated by means of codified pulse signals according to a plurality of codes corresponding to the plurality of distinct pieces of information and of distinct commands to be transmitted to said actuators.

11. Apparatus, according to one or more of claims 3 to 10, characterized in that the usual devices utilized in remote controls for television sets, gates and similar are used for codifying the signal pulses.

12. Apparatus, according to one or more of claims 3 to 11, characterized in that the actuators and the interface circuits are powered by the direct tension (5) powering the external unit (14) and normally overlapping the radiofrequency signals in the coaxial cable (13).

13. Apparatus, according to one or more of claims 3 to 12, characterized in that the power tension (5) modulating signals are automatically generated in the first circuit means at determined parameters values of the received radiofrequency signal.

14. Apparatus, according to claim 13, characterized in that said parameters comprise the signal width, said width being detected by a threshold or frequency window detector.

15. Apparatus, according to one or more of claims 3 to 14 ,characterized in that said first circuit means (1) comprises electronic control circuits (2), said electronic control circuits (2) being operated by the remote control provided with said internal unit or television set.

16. Apparatus, according to one or more of claims 3 to 15, characterized in that it comprises memory cells assemblies, each of said assemblies being associated to a respective push-button (2), each of said assemblies being adapted to memorize a situations generated by transmitted commands, said situations being recalled by depressing a selected push-button to read the corresponding memory cell assembly.

17. Apparatus, according to one or more of claims 3 to 16, characterized in that said situations generated by transmitted commands can be memorized in corresponding memory cell assemblies, each of said assemblies being associated to a determined channel such that by recalling said determined channel, a signal corresponding to the selected situation is automatically generated.

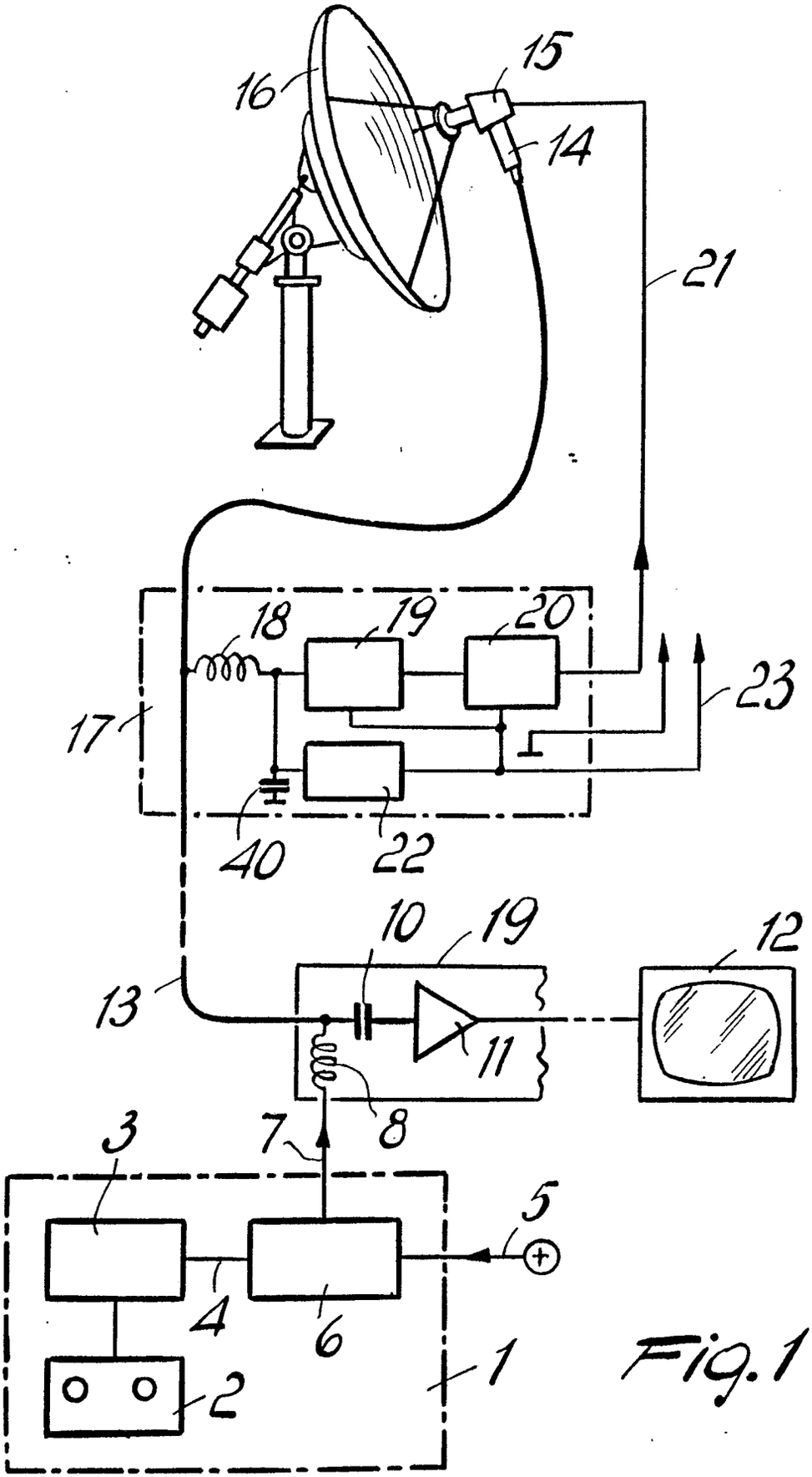

Fig. 1

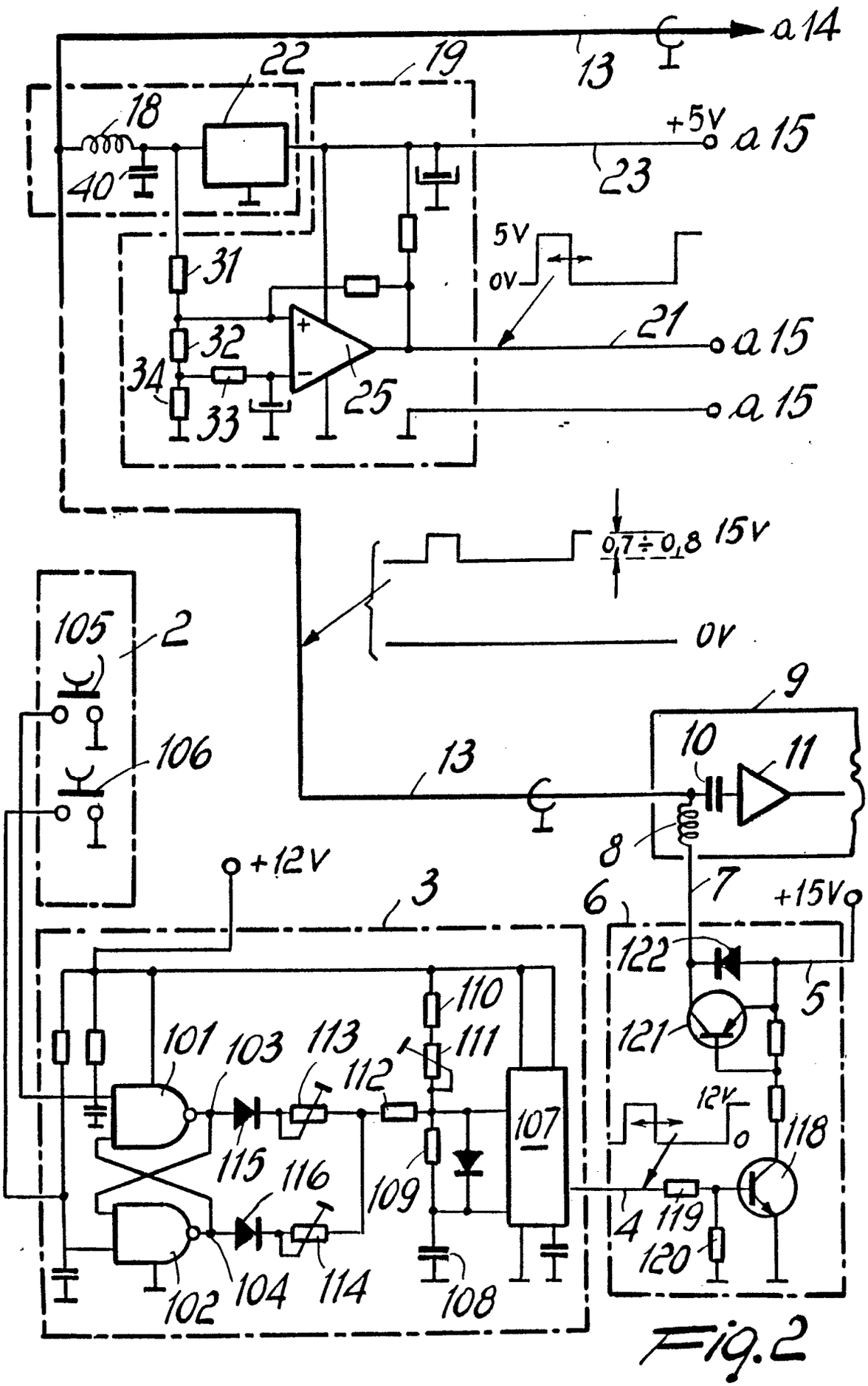
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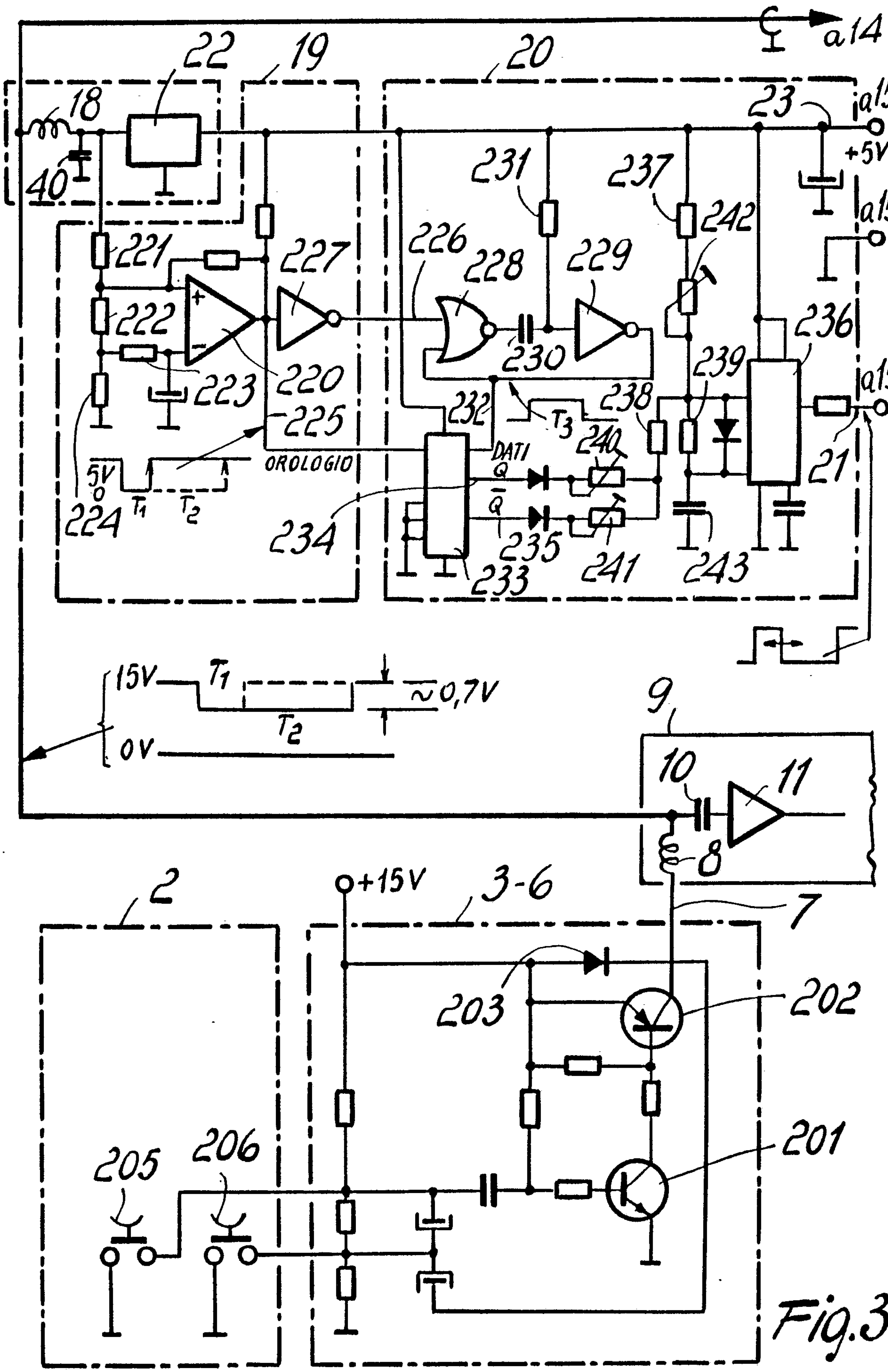
Fig.2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238
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224
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233
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15V
T1
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T2
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8
+15V
2
3-6
7
203
202
205
206
201

Fig.3