

DESCRIPTION

The invention relates to a circuit arrangement in accordance with the definition of the species of claim 1.

Such a circuit arrangement is known from DE-A-3 119 515. There a capacitor in series with the relay is provided as the differentiating circuit. This series connection consisting of capacitor and relay lies between two opposingly controlled operational amplifiers, so that by way of a change of control the polarity of the voltage applied to this series connection can be reversed. This means that the differentiating capacitor at the same time also serves as polarity-reversal capacitor in series with the relay, since it discharges itself by way of the relay in order to switch this off. In circuit technology respects it is disadvantageous that this series connection does not work vis-a-vis a fixed reference potential, but lies between alternating potentials. A relay not working against fixed reference potential is, however, sensitive to electrical interference introductions, and upon malfunctions the fault diagnosis is made correspondingly more difficult.

Known from EP-A-0 033 996 of the same species is a circuit arrangement having a differentiating stage for the control of a bistable relay having monostable switching, which in the working position likewise lies in series with a polarity-reversal capacitor, which is dischargeable for the switching-off by way of the relay, so that in circuit practice approximately the same problems occur as described above.

US-A-4 271 450 likewise discloses a circuit arrangement of the same species with series connection between polarity-reversal capacitor and relay.

In recognition of the factors described at the beginning hereof, the problem underlying the invention is to design a circuit arrangement, of the type in accordance with the species, in such a way that uncritical control and operating conditions lead to a reliable mode of operation of the relay. In this respect it is more especially from safety aspects striven after that the switching back of the relay out of a possibly presently afforded working position into the rest position is ensured even if for some reason the power supply which is supplied from a supply circuit should once fail.

In the case of a circuit arrangement in accordance with the species this problem is solved in accordance with the invention in that it is designed in accordance with the characterising part of claim 1.

In accordance with this solution the relay is placed into a parallel branch of a bridge circuit, and its polarity-reversal capacitor, for ensuring the switch-off procedure, works independently of the differentiating stage for the switching-on of the relay. Thus, with the relay

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switched into the working position, the polarity-reversal capacitor is charged up, which is discharged by a switch-off control signal - or else upon cessation of the supply voltage - contrary to its switch-on current direction by way of the relay. Thus, in this way the relay is mandatorily set back electrically into its switch-off or rest position.

As a result of the separated functions it is readily realisable in circuit technology respects to charge up the polarity-reversal capacitor lying in the bridge diagonal only when the loading of the supply circuit has died away through the setting of the relay in its working position; when thus the relay by reason of its magnetic-mechanical construction stably maintains its once achieved switch-on position until it is switched off again stably by electrically opposed-pole control from the polarity-reversal capacitor.

In the case of the solution in accordance with the invention it is more especially also of practical advantage that the circuit arrangement makes it possible to control a bistable or so-called remanence relay by impulses of alternating polarity, which can have different energy contents. Thus, the impulse durations on the one hand for the switching-on and on the other hand for the switching-off of the relay depending on the operating characteristic values thereof can be optimised independently of one another.

It is particularly advantageous to realise a circuit arrangement in accordance with the invention from discrete components with bipolar transistors as the electrically controllable switches. This is because, for the function of the control circuit, then only a few components are necessary, and this can be operated from the same supply circuit as the relay and the actual control signal transmitter thereof, to which the control circuit can be directly electrically post-connected. The capacitor discharge for the resetting of the relay can be effected by way of a switching transistor which, upon failure of the supply voltage, is self-conductive and thus then too ensures the transition into the rest position of the relay.

Thus it is superfluous to have recourse to a costly realisation in integrated circuit technology and to make available separately the operating voltages which are necessary for this and which as a general rule deviate from the operating voltage of the relay as well as to provide additional matching circuits between an integrated control circuit and the control-signal transmitter on the one hand as well as the relay on the other hand. Moreover, the static-current requirement of a control circuit, built up in an optimised manner from discrete components, of the type necessary here is distinctly lower than in the case of the realisation with integrated components, all the more so if it is taken into account that these, as has been said, require a supply of their own for the provision of matched operating voltages.

Additional alternatives and further developments as well as further features and advantages of the invention will become apparent from the further claims and from the following description of a preferred example of realisation regarding the solution in accordance with the invention which is shown as a block wiring diagram in the drawing along with a restriction to that which is essential. The sole figure of the drawing shows a control circuit in accordance with the invention which is built up from discrete components.

From a direct-voltage supply circuit 8 a bistable relay 9, namely equipped with magnetic and/or mechanical devices for the maintenance of an electrically initiated switching position, is operated by way of a control circuit 10 from a control signal transmitter 11 in such a way that it displays monostable working behaviour, thus switches out of the working or switch-on position upon cessation of a switch-on control signal 7 (or even of the voltage of the supply circuit 8) despite its internally bistable function back into the switch-off or rest position.

For this provision is made for charging up, during the occurrence of the switch-on position of the relay 9, by way of this a polarity-reversal capacitor 12 which lies in series therewith by way of a bridge diagonal and which, upon termination of the switch-on control signal 7, is connected in parallel with the relay 9, thus discharges itself along with reversal of the polarities occurring at the relay 9 by way of this and thus the relay 9 mandatorily switches back into the monostable-stationary switch-off or rest position.

In detail the mode of operation of the control circuit 10 shown in the drawing as a preferred example of realisation is as follows:

The control signal transmitter 11 supplies as switch-on information a control signal 7 which (in the exemplified instance shown) has H-potential and thus switches through a switch 13, designed as a transistor and responding in a polarity-dependent manner, to a differentiating stage 14. At the same time, by way of a transistor switch 15 which lies in series with the aforesaid transistor but which is complementary the differentiating stage 14 is separated from the L-potential.

The differentiating stage 14 (built-up for example from the series connection of a resistor 14 with a capacitor 17) supplies a decaying switch-on impulse 18 to an inverting amplifier 19 for the switching through of a power switch 20 lying in series with the relay 9 at the supply circuit 8. In the circuit realisation shown the amplifier 19 is a transistor which co-operates with the base of the transistor switch 20 by way of a series resistor 21 in the manner of a Darlington circuit.

With the transistor amplifier 19 switched off, the further discharge of the capacitor 17 is affected by way of a resistor 22. By means of this resistor 22 at the input of

the amplifier 19, thus in the depicted simplest exemplified instance at the base of a transistor, furthermore by influencing the working point the level can be preset below which, with a decaying switch-on impulse 18, the switch 20 opens again; thus the differentiating time constant of the RC-stage 14 determines the length of the switch-on current impulse 23, triggered by way of the switch 20, for the control of the relay 9. The capacitor 12 still experiences no charging-up, so long as practically identical potential occurs at its two connections, because both switches 13/20 are (still) switched through. If then, however, the current impulse 23 is finished, because the switch 20 opens again, whilst on account of the still occurring switch-on control signal 7 the switch 13 is still closed (switched for passage), the capacitor 12 is charged up by way of the switch 13, a protective resistor 24 lying in series therewith for the limitation of the switch-on current and the relay 9, to the potential difference supplied by the supply circuit 3. Since in this respect the current-flow polarity by way of the relay 9 does not change, the switch-on position of the relay 9 previously brought about by the current impulse 23 and now maintained in a constructionally bistable manner experiences no change.

If, of course, in the case of the control signal 7 the switch-on (1) control signal 7 disappears, thus in the exemplified instance shown assumes L-potential (whether because from the control-signal transmitter 11 an item of switch-off item is supplied; or whether because the power supply from the supply circuit 3 fails and therefore the relay 9 is to switch back into the operationally safe switch-off position), then the switch 13 is opened (highly resistive) and instead thereof the complementarily acting switch 15 is now switched through.

In this way the polarity-reversal capacitor 12 previously charged up into its ready-for-use state is, whilst maintaining its direct connection to the relay 9, connected in parallel with this, whereby the capacitor 12 discharges itself, along with polarity reversal of the current-flow direction effective in the relay 9, by way of this, thus the relay 9 switches back into its bistable rest or switch-off position.

Thus, through the control circuit 10 with the polarity-reversal capacitor 12 it is ensured that, both generally upon failure of the supply voltage and specifically upon termination of the switch-on control signal 7, the relay 9, despite an internally bistable mode of operation, is at all times transferred into the switch-off position, thus that the mode of operation of the relay 9 as a whole (namely taking into account the mode of operation of the control circuit 10) is a monostable mode of operation with the switch-off switching position as the rest preferred switching position. More especially it is in this respect of practical advantage that the circuit arrangement makes it possible to control a bistable or remanence relay by impulses of alternating polarity, which can have a different energy

content, so that the impulse durations for the switching-on and for the switching-off depending on the given relay 9 can be optimised independently of one another, as is taken into account in the drawing by the adjusting symbols in the case of the threshold resistor 22, in the case of the capacitor 12 and in the case of the differentiating stage 14. Between two consecutive switch-over procedures the circuit arrangement has only a minimum current consumption, namely dictated by the leakage currents of the circuit components, which can, however, on account of simple realisability in discrete circuit technology be kept very low. Through the not very complex discrete circuit technology also a practically arbitrary adaptation of the mode of operation of the circuit arrangement to given voltage conditions is made possible; more especially a heavy-current relay can be operated in a functionally reliable manner from a supply voltage in the order of magnitude of only 5 volts direct voltage, without the automatic switching back into the rest position of the relay upon failure of the supply voltage being jeopardised.



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CLAIMS

1. A circuit arrangement (10) having a differentiating stage (14) for the control of a bistable relay (9) which has a monostable switching characteristic and which in the working position lies in series with a polarity-reversal capacitor (12), which for the switching-off of the relay (9) is dischargeable by way of this, in which respect the polarity-reversal capacitor (12) lies in the bridge diagonal of a bridge circuit which is connected to a direct-voltage supply circuit (3), characterised in that the bridge circuit has in its parallel branches on the one hand a series connection of the relay (9) with a relay switch (20) and on the other hand a series connection of a working switch (13) with a switch-off switch (15) working complementarily to this, and a control signal transmitter (11) connected in parallel with the bridge circuit to the supply circuit (3) is provided, from which the working switch (13) or respectively the switch-off switch (15) are controllable and the relay switch (20) can be switched through transiently by way of the differentiating stage (14).
2. A circuit arrangement (10) according to claim 1, characterised in that the differentiating stage (14) is designed as an A-C-circuit (16-17), which is arranged between an amplifier (19) for the control of the relay switch (20) and a working switch (13) which is controllable from the control signal transmitter (11).
3. A circuit arrangement (10) according to claim 2, characterised in that a discharging and working-point resistor (22) is connected in parallel with the input of the amplifier (19).
4. A circuit arrangement (10) according to one of the preceding claims, characterised in that it is built up from discrete electrical components with switching transistors as the switches (13, 15, 20).
5. A circuit arrangement (10) according to claim 4, characterised in that provided as working switch (13) is a transistor, the collector of which is applied to H-potential of the supply circuit (3) and the emitter of which leads by way of the differentiating stage (14) onto the base of a transistor amplifier (19), in the collector circuit of which lies the base-emitter section of the relay switch (20), in the collector circuit of which the relay (9) lies, with adjustment of the working point of the transistor amplifier (19) by the discharging resistor (22) for a capacitor (17) of the differentiating stage (14).
6. A circuit arrangement (10) according to claim 3, characterised in that the polarity-reversal capacitor (12) lies in series between on the one hand the relay (9) and on the other hand a current-limitation resistor (24) as well as the working switch (13), in which respect the polarity-reversal capacitor (12) is switchable by way of a



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complementary transistor as switch-off switch (15) in parallel with the relay (9).

7. A circuit arrangement (10) according to claim 6, characterised in that the switch-off switch (15) is connected by its emitter to the polarity-reversal capacitor (12) as well as by way of the current-limitation resistor (24) to the emitter of the working switch (13), whilst its base is controlled by the control signal transmitter (11) and its collector is connected in parallel with the relay (9) to the supply circuit (8).

8. A circuit arrangement (10) according to one of the preceding claims, characterised in that the controlled relay switch (20) is provided for the supply of a switch-on current impulse (23) to the relay (9), in which respect the length of the switch-on current impulses (23) is adjustable by way of a working-point resistor (22) and by way of the differentiating time constant of the differentiating stage (14) in the control of the relay switch (20).