April 16, 1968 — K. W. SCHMIDT — 3,378,693

IMPULSE SENDER FOR THE DRIVE OF TIMING DEVICES, PREFERABLY AUTOMATIC PERMANENT CALENDARS

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FIG. 1.

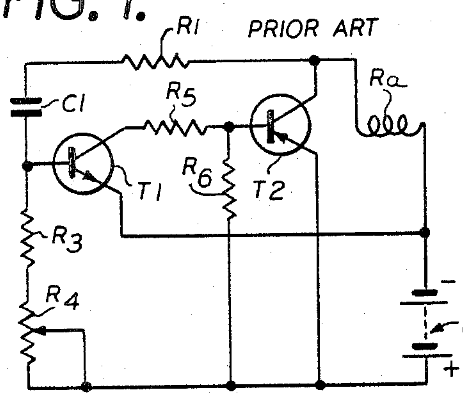


FIG. 2.

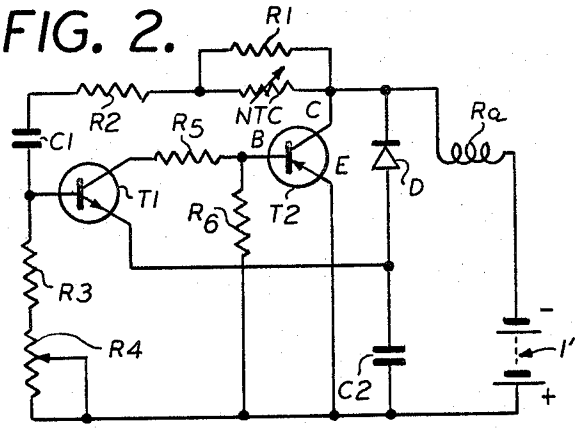


FIG. 3.

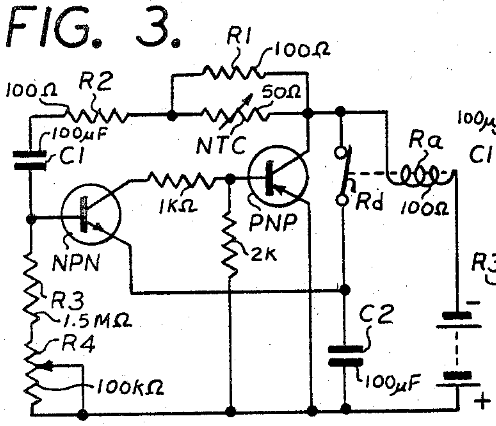


FIG. 4.

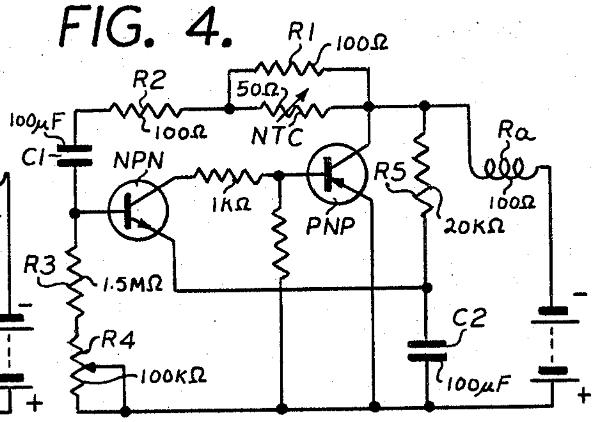


FIG. 6.

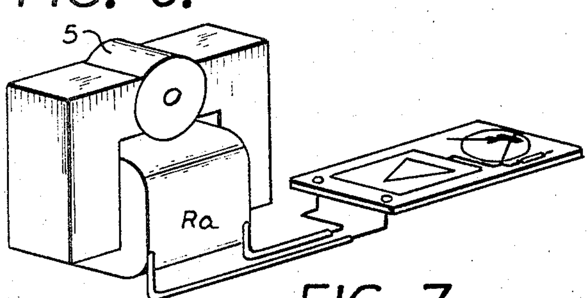


FIG. 5.

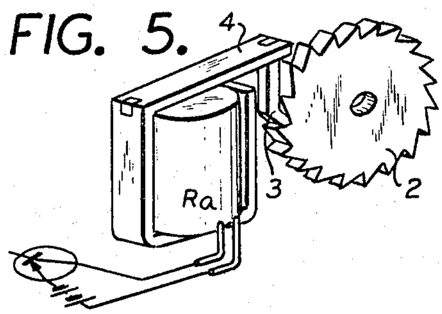
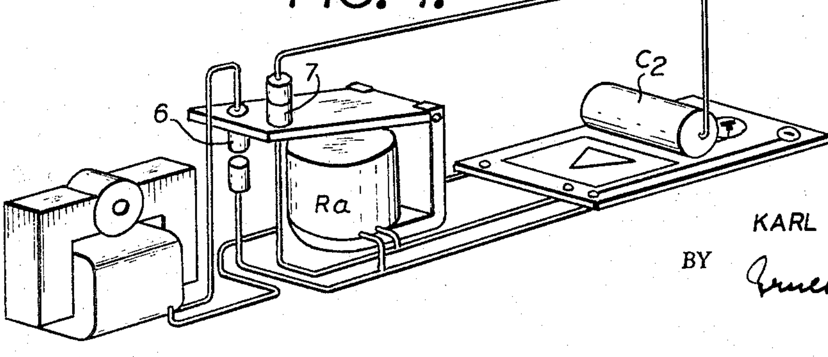


FIG. 7.



INVENTOR.
KARL WILHELM SCHMIDT

BY [signature]

ATTORNEY.

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FIG. 8.

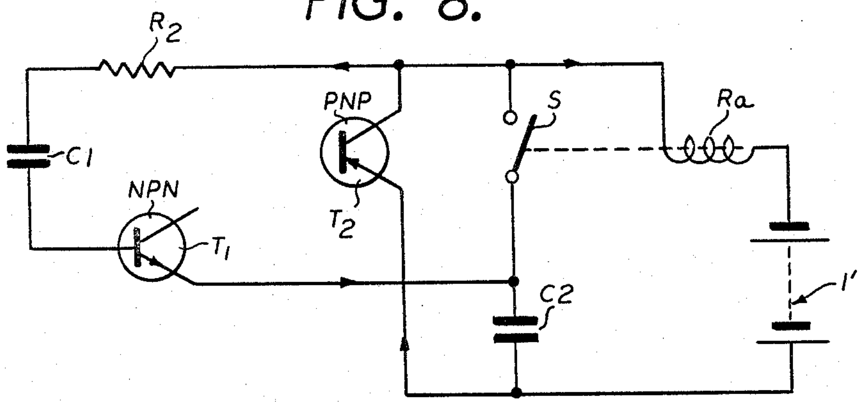
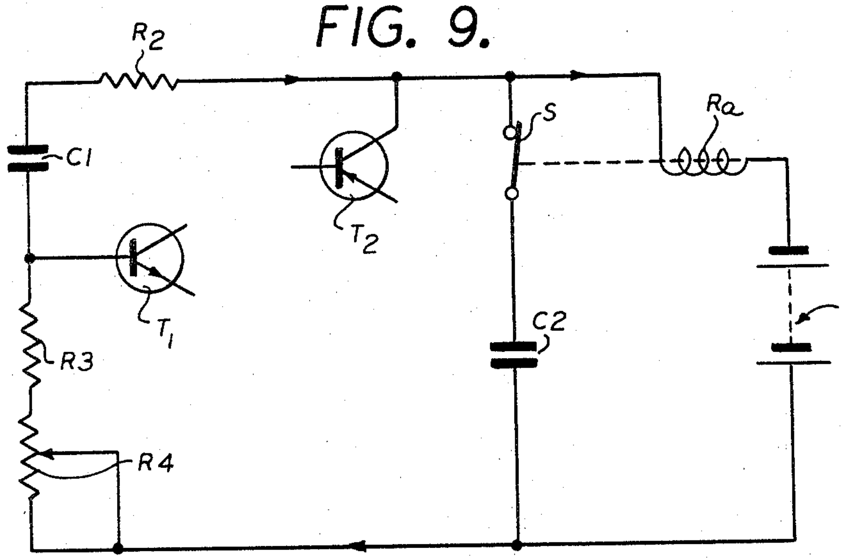


FIG. 9.



INVENTOR.
KARL WILHELM SCHMIDT
BY
ATTORNEY.

United States Patent Office

3,378,693
Patented Apr. 16, 1968

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IMPULSE SENDER FOR THE DRIVE OF TIMING DEVICES, PREFERABLY AUTOMATIC PERMANENT CALENDARS

Karl Wilhelm Schmidt, Idar-Oberstein, Germany, assignor to Firma Gebruder Schmidt Metallwarenfabrik, Idar-Oberstein, Germany, a corporation of Germany

Filed July 21, 1965, Ser. No. 473,799
Claims priority, application Germany, July 25, 1964, Sch 35,527
4 Claims. (Cl. 307—132)

The present invention relates to an impulse sender for the drive of timing devices, preferably automatic permanent calendars and is concerned with the improvement of the known multivibrator circuit with complementary transistors.

It is known that great pulse duty factors can be obtained, for example 1:10,000 with such circuits. It is also known that impulse duration and impulse spacing depend comparatively little upon the supply voltage. For non-stabilized, battery-operated time-indicators the known circuits can hardly be used, nevertheless. Upon lowering of the battery voltage, the impulse spacing is getting shorter and consequently, the time indication is not exact.

This effect is caused by the rising of the inner resistance of an aging battery. A stabilization of the source of current by, for instance, a Zener diode cannot be tolerated, due to the continuous current consumption of such arrangement.

It is, therefore, one object of the present invention to provide an impulse sender for the drive of timing devices, preferably automatic permanent calendars, wherein the battery with its variable inner resistance is separated from the time indicator during the impulse duration and the time indicator is driven by a condenser charged during the impulse spacing. By this arrangement, the time indicator is independent from the inner resistance of the battery.

With this and other objects in view which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is a circuit diagram of a conventional multivibrator circuit;

FIG. 2 is a circuit diagram of a revised multivibrator circuit designed in accordance with the present invention;

FIG. 3 is another embodiment of the circuit diagram disclosed in FIG. 2;

FIG. 4 is still another embodiment of the circuit diagram disclosed in FIG. 2;

FIG. 5 is a schematic perspective view of a mechanical drive of the time indicator;

FIG. 6 is a schematic perspective view of a stepwise operated motor with a switching amplifier;

FIG. 7 is a schematic perspective view of a step-switching device for operation by means of a working contact of a relay;

FIG. 8 is a part of the circuit disclosing the flow of current during the impulse duration; and

FIG. 9 is a part of the circuit disclosing the flow of current during the impulse spacing.

Referring now to the drawings and in particular to FIG. 1, the impulse sender comprises a multivibrator circuit, known in the prior art, wherein a battery 1 charges a resistance R over the emitter-collector conductance of the transistor T_2 and the base-emitter conductance of the transistor T_1 charges the condenser C. Upon enlarging the resistance R, the impulse duration becomes longer, however, the impulse spacing becomes appreciably much shorter. In an aging battery the increasing inner resistance is added to the resistance R during the impulse duration. Due to this fact, the frequency of the impulses increases.

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A stabilization of the source of current by, for instance, a Zener diode, is prohibitive, due to the continuous current consumption of such arrangement.

Referring now again to the drawings and in particular to FIG. 2, a circuit is disclosed in which the battery 1′ with its variable inner resistance is separated from the time indicator during the impulse duration, and the time indicator is driven by the condenser C_2 charged during the impulse spacing.

Thus, the condenser C_2 is charged over the outer resistance R_a and the diode D during the impulse spacing. If now the multivibrator switches over, the transistor T_2 is connected through. The battery voltage is in operative connection with R_a. The collector of the transistor T_2 is rendered positive. By this arrangement the diode D switches off the condenser C_2 from the battery voltage. The charge of the condenser C_1 takes place over the emitter-collector conductance of the transistor T_2 and the resistances NTC, R_1 and R_2, on the one hand, and over the base-emitter conductance of the transistor T_1 by the condenser C_2, on the other hand.

The battery 1′ feeds now merely the outer resistance R_a, while the members R_1, NTC, R_2, C_1, R_3 and R_4 are fed from the condenser C_2.

Such arrangement, if operated, for example, with a frequency of one impulse per minute, as a clock, results in a deviation of less than one minute per day.

Referring now again to the drawings and in particular to FIG. 3, another embodiment of the circuit is disclosed, in which for the purpose of economy the diode D is replaced by a relay R_d, which is formed as a break contact and separates the voltage source from the condenser C_2 during the impulse duration. Thus, the time condenser C_1 can be charged from the condenser C_2 only.

Electronic or mechanical switches can be replaced also by an ohmic resistance, which is to be dimensioned such that the discharge of the feeding condenser C_2 through this ohmic resistance is small during the impulse duration relative to the discharge of the feeding condenser C_2 to the time condenser C_1. Referring now again to the drawings and in particular to FIG. 4, a circuit including such ohmic resistance R_5 is disclosed. In order to maintain as small as possible the influence of the ohmic resistance R_5 and of the condenser C_2 upon the time element, it is required to charge extensively the condenser C_2 during the impulse spacing. For this reason, the time constant for the charge of the condenser C_2 should be shorter than that of the members C_1, R_3 and R_4.

While in the circuit disclosed in FIG. 2 a diode D has been shown as a switch, it is to be understood that the diode D can be replaced by a transistor, in spite of the greater expense, a four-layered diode or a controllable rectifier, as a silicium rectifier. It should be further emphasized that R_a can constitute a relay for the impulses or a particular outer resistance. The transistor T_2 of the time indicator can constitute either a relay for the direct mechanical drive of the step-by-step switch, as indicated in FIG. 3 of the drawings, or an ohmic outer resistance to operate as a switching amplifier for a larger output. In case of the use of a relay with two switching contacts, one of the switching contacts is used as a make contact for a drive of greater output and the other of the switching contacts is used as a break contact for separating the condenser C_2 from the source of current.

NTC is a resistance having a negative temperature coefficient, while the resistance R_1 is a linearizing resistance for the temperature curve of this resistance and serves the adjustment of the temperature condition of the multivibrator. The exact dimensions depend upon the used parts, as transistors and condensers.

FIG. 5 discloses an application of the device, designed in accordance with the present invention, wherein the relay R_a of FIGS. 1 to 4 for the direct mechanical drive of a gear **2** of a time indicator (not shown), meshing with a pawl **3** which is operated by a pivoted armature **4** of the relay R_a, is disclosed.

FIG. 6 discloses another application of the device, wherein a step-by-step motor **5** is operated by the relay R_a over a switch amplifier.

FIG. 7 discloses still another application of the device, wherein a step-by-step switch is operated by a make contact **6** of the relay R_a, while a break contact **7** is used for separation of the condenser C_2.

The adjustable resistance NTC must be dimensioned such that the desired time interval can easily be preset, as an upper limit thereof, and the tolerances of the structural elements can still be balanced, as a lower limit thereof. Any inner resistances of the P and N transistors are balanced out roughly by the corresponding election of the resistance R_3 and finely by the variable resistance R_4.

The dimensions of the respective elements disclosed in FIGS. 1 to 4 are given, by example, for impulse spacing of one minute.

FIG. 8 indicates quite clearly the current flow during the impulse duration showing the charging of the condenser C_1 from the condenser C_2, while FIG. 9 indicates the current flow during the impulse spacing disclosing the discharging of the time condenser C_1 over the resistances R_3 and R_4 and the charging of the condenser C_2 by means of the switch S.

While I have disclosed several embodiments of the present invention, it is to be understood that these embodiments are given by example only and not in a limiting sense, the scope of the present invention being determined by the objects and the claims.

I claim:

1. An impulse sender for the drive of timing devices, comprising
   a multivibrator including
      a voltage source and an outer resistance disposed in series,
      a condenser disposed in parallel with said voltage source and said resistance and charged from said voltage source during the impulse spacing,
      a time condenser disposed in parallel with said voltage source and said outer resistance, and
      switching means disposed in series with said condenser for separating said condenser from said voltage source during the impulse duration, and charging said time condenser from said condenser.

2. The impulse sender, as set forth in claim **1**, wherein said switching means comprises an electronic switch.

3. The impulse sender, as set forth in claim **1**, wherein said switching means comprises a make- and break-contact.

4. The impulse sender, as set forth in claim **1**, wherein said switching means comprises a resistance of predetermined value.

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ORIS L. RADER, *Primary Examiner.*

T. B. JOIKE, *Assistant Examiner.*