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FREQUENCY STABILIZED MULTIVIBRATOR

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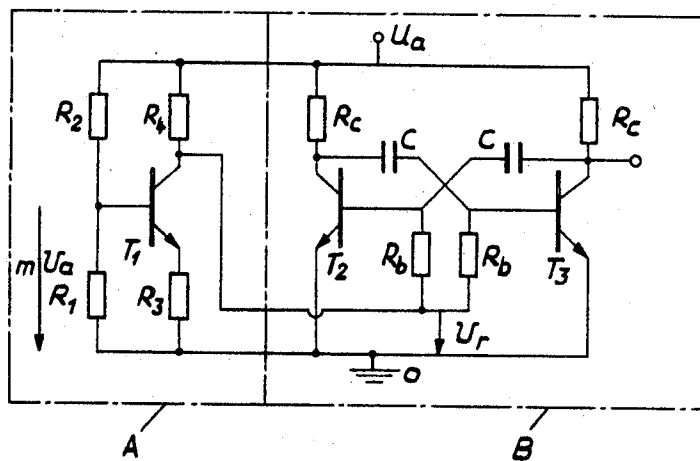


Fig. 1

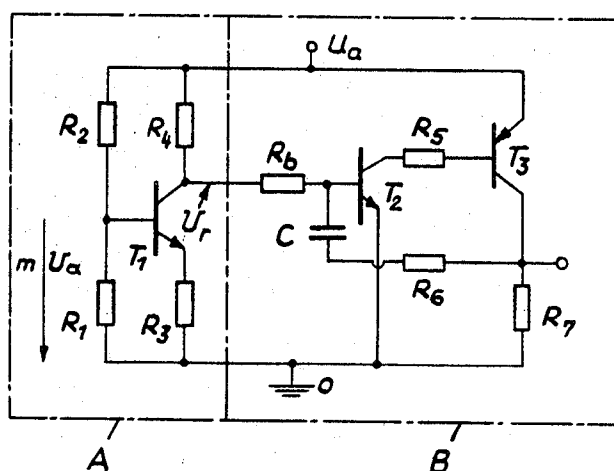


Fig. 2

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FREQUENCY STABILIZED MULTIVIBRATOR
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3 Claims

ABSTRACT OF THE DISCLOSURE

A transistor circuit provides a compensating voltage to an astable multivibrator in order to stabilize its frequency, at least for variations due to temperature.

The present invention concerns a frequency stabilized multivibrator, comprising an astable circuit provided with at least two transistors interconnected by means of at least one R-C circuit.

It is known that if the feed voltage of multivibrators of this type is low, their frequency depends on the variations of this feed voltage as well as on temperature variations. This is due to the presence of the base-emitter junctions of the transistors in which the voltages at the terminals are not negligible in relation to the feed voltage.

In order to avoid these effects, it has already been proposed to utilize resistances with a suitably chosen temperature coefficient; this solution however has the disadvantage that it only allows the temperature effect to be compensated and that it necessitates the use of special components.

It has also been proposed to utilize diodes; this solution has the disadvantage that it cannot be used for voltages as low as 1.3 v. and that it does not afford sufficient freedom to allow a perfect compensation to be achieved.

The purpose of the invention is to avoid these disadvantages.

The multivibrator according to the invention is characterized in that it comprises a compensating circuit provided with a transistor and applying a compensating voltage to the astable circuit, in order to stabilize its frequency, at least for variations in temperature.

The drawing illustrates, by way of examples, two embodiments.

FIG. 1 shows the diagram of a first embodiment, relating to a multivibrator having two transistors interconnected by means of two R-C circuits.

FIG. 2 illustrates the diagram of a second embodiment relating to a short pulse multivibrator.

A multivibrator is an essentially non-linear oscillator the operation of which is characterized by relaxation periods (for instance the discharge of a capacity through a resistance) separated by commutation periods. The well known circuit shown in B in FIG. 1 belongs to this category.

It comprises two transistors T_2 , T_3 with a common emitter hook-up, and interconnected by means of two R_b -C circuits. The feed voltage U_a is applied to the collectors, through collector resistances R_c .

If the feed voltage U_a of this circuit is high, its variations have very little influence on the frequency of the oscillation; the influence of temperature only makes itself felt through the variations of the relaxation time constant R_b -C.

When the feed voltage is reduced, an ever increasing influence of this voltage on the frequency is observed,

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as well as an increasing supplementary temperature effect.

This is due to the presence of the base-emitter junctions of the transistors T_2 , T_3 the terminal voltages of which are no longer negligible in relation to U_a .

It is known that the repeating frequency may be modified by varying the ratio U_r/U_a . In other words, the frequency f of the multivibrator depends on the feed voltage U_a , the temperature T and the regulating voltage U_r . This dependence may be characterized by sensibility factors S_a , S_t and S_r defined by the equation

$$df = S_a \cdot dU_a + S_t \cdot dT + S_r \cdot dU_r$$

In the embodiment illustrated in FIG. 1, the astable circuit is combined with a compensating circuit applying a regulating voltage U_r the variations of which with the temperature and the feed voltage are such that they correct the frequency variations of the astable circuit (by annulling the second member of the above equation).

The compensating circuit illustrated in A in FIG. 1 comprises a control transistor T_1 with a common emitter hook-up having a resistance R_3 in the emitter circuit and a resistance R_4 in the collector circuit. Its base is fed by a fraction m of the feed voltage which is the same as that of the oscillating circuit. The compensating voltage U_r is derived at the collector of T_1 and applied to the common point of the resistances R_b .

When the temperature increases, the voltage at the terminals of the base-emitter junction of T_1 decreases by $-\mu$ volts per degree; the emitter and collector currents of the transistor T_1 increase and U_r decreases. This reduction allows the compensation of the decrease of the voltage at the terminals of the base-emitter junctions of the transistors T_2 , T_3 of the oscillating circuit. The correction may be adjusted by acting on the ratio $p = R_4/R_3$.

By utilizing the second degree of freedom afforded by the factor m , it is also possible to compensate the effect of the variations of U_a . The two effects will be compensated if

$$p = \frac{S_T}{(\mu) S_r}$$

and

$$m = \frac{(-\mu)}{S_T} (S_a + S_r)$$

The second embodiment illustrated in FIG. 2 comprises an astable circuit B comprising two transistors T_2 , T_3 interconnected by means of three resistances R_5 , R_6 and R_7 and a condenser C. This astable circuit, which is destined to generate short pulses, is compensated by a compensating circuit A, of the same type as that of the preceding embodiment, and applying the regulating voltage U_r to the base of the transistor T_2 , by means of a resistance R_b .

In certain cases it may be necessary to add one or several diodes in series in the base of the transistor T_1 in order to obtain a higher value of $-\mu$; this naturally also causes an increase of the value of the voltage at the terminals of the base-emitter junction.

I claim:

1. A frequency stabilized multivibrator, comprising an astable circuit provided with at least two transistors interconnected by means of at least one R-C circuit; and a compensating circuit comprising four resistances, and a control transistor, two of said resistances being connected in series as voltage dividers between the poles of a feed current source, their common point being connected to the base of said control transistor, a third of said resistances being connected between a collector

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and one of the poles of said current source, and the fourth resistance being connected between the emitter and the other pole of said current source; variations in temperature producing changes in the operation of said control transistor, thereby causing a compensating voltage derived at the collector of said control transistor to be applied to the base electrode of at least one transistor of said astable circuit, in order to stabilize its frequency.

2. A multivibrator according to claim 1, in which the two transistors of the astable circuit have a common emitter hook-up with the emitters connected to one of the poles of the current source, each collector being connected to the other pole through a resistance and to the base of the other transistor by means of a condenser, each one of the said bases being connected, through a resistance, to the said collector of the transistor of the compensating circuit.

3. A multivibrator according to claim 1, in which the two transistors of the astable circuit are of opposite types, the emitter of a first one of these transistors being connected to one of the poles of the said source and its

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collector to the base of the second transistor through a resistance, the collector of this second transistor being connected to the said pole of the source by means of a resistance and its emitter being connected to the other pole of this source, the base of the said first transistor and the collector of the second transistor being connected through a series of R-C circuit and the collector of the transistor of the compensating circuit and the base of the said first transistor of the astable circuit being interconnected by means of a resistance.

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