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(56) Documents cited
GB 0814330 EP A1 0111153 US 4232200
GB 0766378 US 3547629 US 3599073
GB 0752055 US 4492876
G. N. Patchett "Electronic Power Supplier" 1970, Pitman, pp 66–67, Fig. 6. 7

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(54) Power supply circuit for telephone apparatus

(57) A microprocessor 1A, display 2A and pushbutton board 3A of a telephone apparatus M are normally supplied with power from the telephone lines A, B via a rectifier bridge 8A and a diode D1, the supplied voltage being stabilized by means of a transistor TR1 and a battery 11A, such as a lithium battery, having a stable voltage characteristic. The battery 11A also acts as a backup supply when the supply on lines A,B, is absent. In a modification, the rectifier bridge (8A), (Fig. 8), is connected to the transistor (TR2) via a first diode D3 when a switch (9B) is in a first position, obtained when the telephone unit M is off-hook, and via a second diode (D2) and series resistor (R2) is a second position of the switch (9B). The resistor (R2) has a value limiting the on-hook current level to the maximum value allowed by the telephone company regulations.

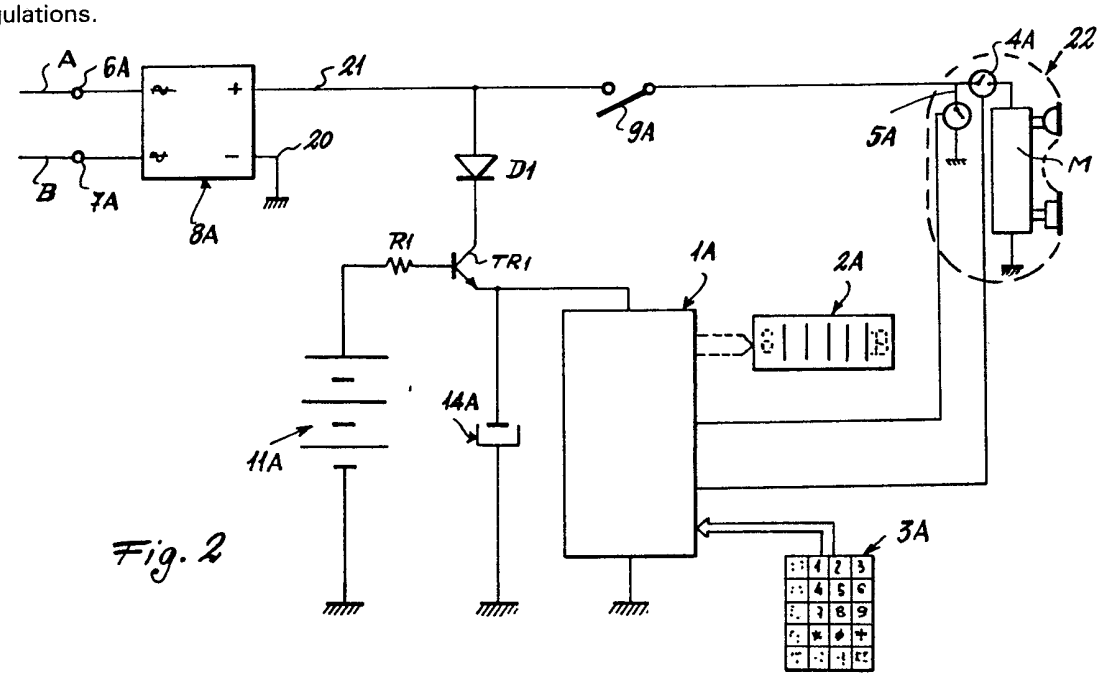

Fig. 2

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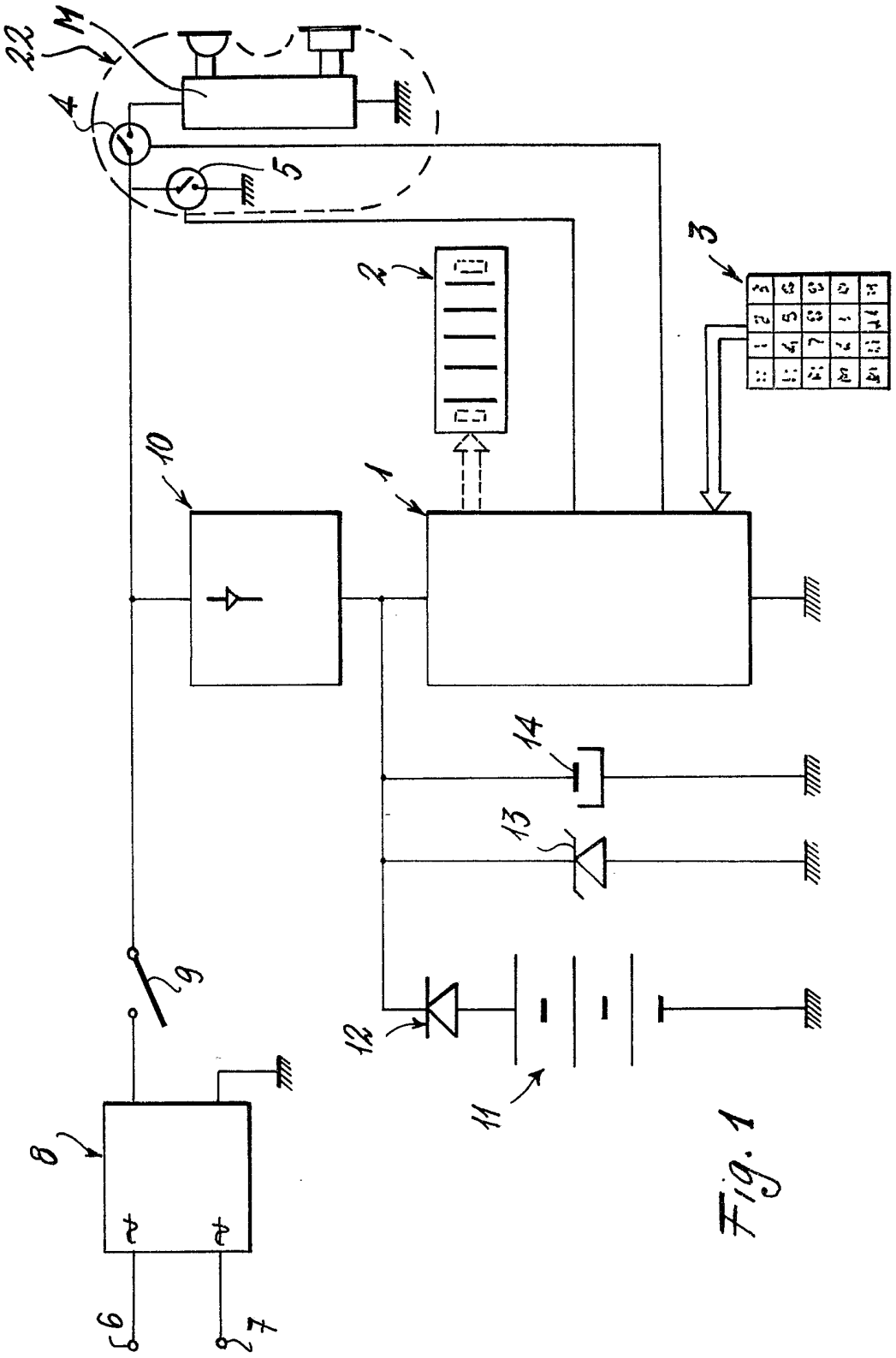

Fig. 1

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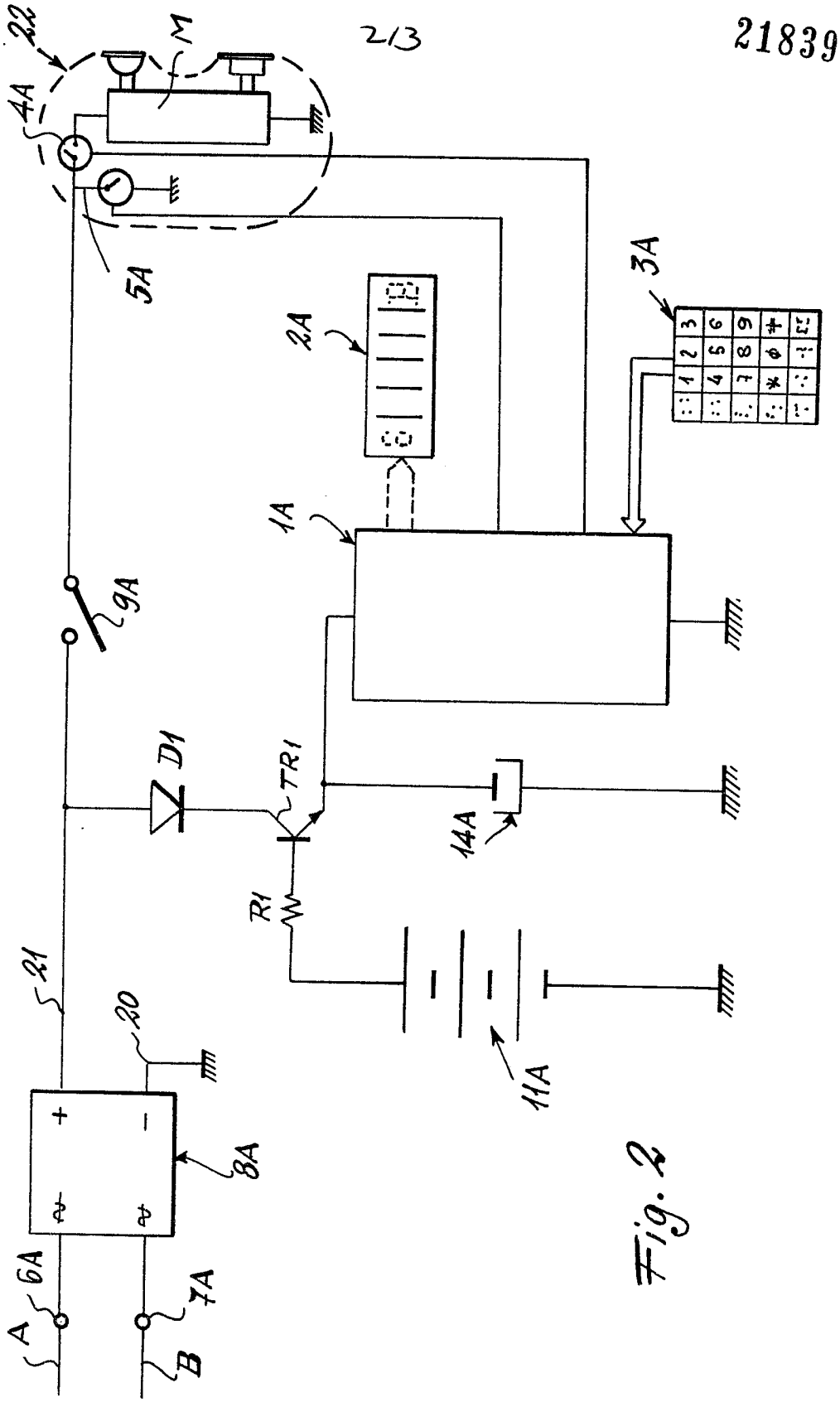

Fig. 2

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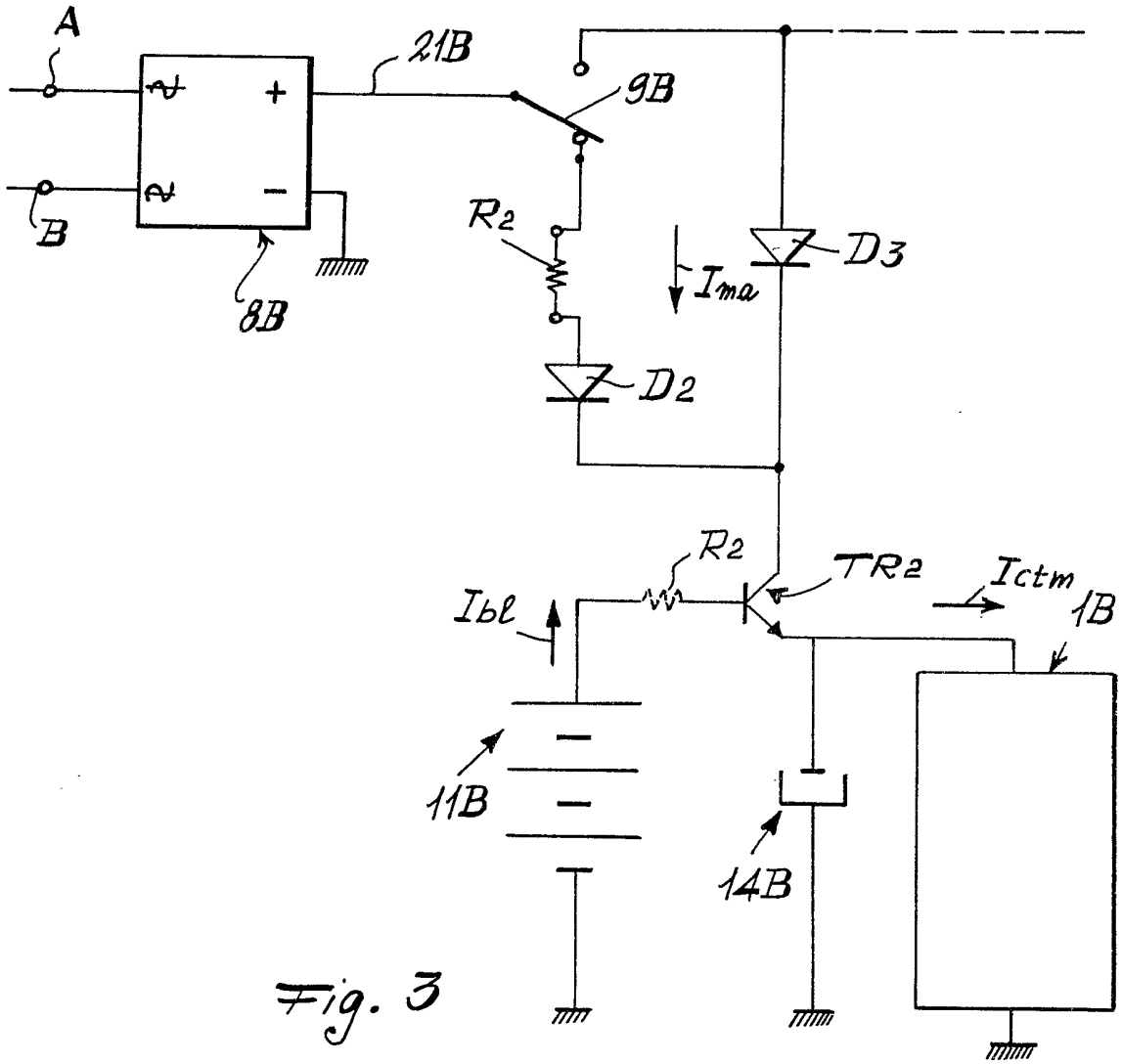

Fig. 3

SPECIFICATION

Power supply circuit for telephone apparatus

This invention relates to a power supply circuit for telephone apparatus, comprising at least one current rectifier means and at least one back-up battery.

Multifunction telephone apparatus is becoming increasingly widespread, and the greater the number of services or functions which they are able to perform the more popular they become. One of the basic services required is to be able to memorise, say, ten telephone numbers, and additional services, which improve the desirability of the telephone apparatus and more completely satisfy the requirements of the user, can, for example, consist of visual display of the telephone numbers or of the operations fed in, vocal synthesis for automatic reply, and data exchange with terminals through an integral modem. These services obviously result in an ever increasing energy consumption because of their nature. Where the magnitude of this energy consumption permits it, multifunction telephones are exclusively supplied from the telephone line itself. This is of benefit to the user, in that he is not compelled to install the telephone in proximity to a power supply socket, and can be an economical advantage for the telephone manufacturer as it enables him to save the cost of a power supply unit for connection to the electricity supply mains. The constraints placed on such a method are on the one hand the circuit energy consumption of the telephone apparatus, and on the other hand the maximum current which can be drawn from the telephone line, with the result that there is a limitation on the number of the services offered by the telephone apparatus.

It should also be noted that it is very important to ensure extremely stable voltage when a dedicated microprocessor or liquid crystal display units are used. Moreover, the information present in the memory must be retained for a certain time even when telephone line voltage is absent (for example when in a socket system the main telephone is plugged into the line with the exclusion of the secondary telephone, or when the user unplugs the telephone to move it from one point to another). In such cases it is common practice to provide in the telephone apparatus a direct current supply circuit comprising a back-up accumulator or battery.

One example of this known circuit configuration is described in the MOSTEK manual "MICROELECTRONIC DATA BOOK 1984/5" XIV-19, or in the ITT manual SAA 6020 A MICROCOMPUTER FOR AN INTELLIGENT PUSHBUTTON TELEPHONE SUBSET", page 5.

This known method is represented diagrammatically in Figure 1, in which the multifunction telephone circuit to be electrically supplied comprises a microprocessor indicated by the block 1. With the block 1 there are associated for read-out purposes a liquid crystal display unit 2, and for data feed-in purposes a pushbutton board 3, and in addition the reference numerals 4 and 5 respectively indicate the conventional muting contacts and line contacts of the voice circuit 22. The microprocessor 1 and associated devices are supplied electrically by the telephone line by way of two input terminals 6 and 7, a block 8 representing a rectifier bridge, a switch 9 (if closed), controlled for example by the telephone unit M, and a power unit 10 (for example a current source power supply unit) disposed downstream of the switch 9. The back-up battery 11 is connected to the microprocessor 1 in the same manner as the power unit 10, and by way of a diode 12. A zener diode 13 and a capacitor 14 are connected in parallel with the diode 12 and battery 11. This system has, however, three disadvantages:

1) when the switch 9 is open, the memory retention current for the microprocessor 1 is supplied by the battery 11 alone. However, as the battery has necessarily to also supply the other circuit parts (including the zener diode 13), it is apparent that only a part of the battery charge is used for safeguarding the memory of the microprocessor 1;

2) the zener diode 13, used to ensure the stability and thus the precision of the supply voltage, is a supplementary source of energy consumption, because even if low-current zener diodes are used, a current of several tenths of a microamp is still required for operation in proximity to the bend in their characteristic curve, this current being high relative to the consumption of the microprocesor 1 and relative to the maximum current which can be absorbed from the telephone line as governed by the regulations in various countries;

3) circuits which tend to as least partly obviate the aforesaid two drawbacks use a large number of components and are therefore economically of little advantage.

According to the present invention, there is provided a power circuit for telephone apparatus, to which power is normally supplied from an external source and including stabilising means including a battery having a stable voltage characteristic.

With the present invention, therefore, it is possible for the battery consumption to be substantially limited, preferably by means of a mixed supply from the telephone line and battery, and for an improvement in supply voltage stability to be attained without the need to use a component such as a zener diode, which is an intrinsic source of energy consumption besides representing a cost.

The present invention is also simple and en-

ables a multifunction telephone circuit to be supplied by the telephone line itself, even in the case of very low line voltages, i.e. in the case of lines of considerable length.

Preferably, current rectifier means are connected in series with a transistor to which the battery is connected and the battery may be connected to the base of the transistor. The rectifier means may be connected to the telephone line upstream of a switch cntrolled by the telephone unit.

A second current rectifier means may be provided in series with a resistor and with the transistor, the switch being a change-over switch which when in a first state activates said second rectifier means and when in its second state activates the other rectifier means.

The present invention will be further described by way of non-limitative example with reference to the accompanying drawing, in which:

Figure 1 shows the schematic diagram of a conventional power supply circuit associated with a multifunction telephone circuit; this figure has already been described;

Figure 2 shows in an analogous manner the schematic diagram of a first embodiment of the power supply circuit according to the invention; and

Figure 3 shows the schematic diagram of a second embodiment of the power supply circuit according to the invention, with certain parts omitted for descriptive simplicity.

With reference to Figure 2, the telephone line A, B is connected by way of the terminals 6A, 7A to a conventional rectifier bridge 8A, one output 20 of which is connected to earth, whereas its other output 21 is connected as power supply to a conventional voice circuit 22 included in a conventional telephone unit M. In this connection line there is disposed a conventional switch in the form of an exclusion switch 9A, which when the telephone is inoperative, i.e. with the telephone unit M on-hook, is in the open position as shown in the figure under discussion. Connected to the switch 9A are a conventional muting switch 4A and a likewise conventional line switch 5A, which are connected in series with each other and in parallel with the voice circuit 22.

The two switches 4A and 5A are conventionally controlled by the conventional multifunction telephone circuit, which is constituted in this case by a microprocessor, and serve respectively to prevent the user hearing the clicking of the numbers dialled on the conventional pushbutton board 3A, and to feed the data relative to the numbers into the line.

The multifunction telephone circuit 1A is associated with the pushbutton board 3A and with the display unit 2A, which displays the number dialled by the user on the pushbutton board.

According to the invention, the multifunction telephone circuit 1A and the loads dependent on it, such as the display unit 2A, are supplied by an electrical supply circuit comprising a diode D1 connected to the output 21 and to the collector of a transistor TR1. The emitter of this latter is connected to the supply input of the circuit 1A. The positive pole of a lithium battery 11A is connected to the base of the transistor TR1 through a resistor R1. The only purpose of this latter is to limit the base current of the transistor TR1 on connecting the battery 11A, and is of low value which can be ignored in the comparative calculations given hereinafter. A filter capacitor 14A is connected to the emitter of the transistor TR1 in parallel with the circuit 1A.

From the operational aspect, the following three operating conditions are significant:

1. telephone unit M on-hook, with the telephone line A, B supplied with power;
2. telephone unit M on-hook, but without power supply to the telephone line A, B;
3. telephone unit off-hook.

In the first of these three cases, the switch 9A is open and the telephone circuit 1A is supplied in mixed form by the line A, B and by the lithium battery 11A, with considerable advantage for the battery itself in that the current which it delivers is only 1/Hfe times the current absorbed by the circuit 1A. Hfe indicates the direct current gain of the transistor TR1.

In the second case, the circuit 1A is supplied only by the lithium battery 11A.

Finally, in the third case the circuit 1A is supplied by the line A, B whereas the lithium battery 11A functions as a stabiliser for the voltage across the circuit 1A, and feeds a small current equal to 1/Hfe of the current required by this circuit.

By way of example, it will be assumed that the circuits 1 and 1A are identically formed from the microprocessor SAA 6020 of the ITT Company. Then for the aforesaid operational situation (1), which is that which results in the maximum long-term current consumption, and ignoring the other two operational situations because the behaviour is identical, the transitional circuit illustrated in Figure 1 consumes the following current from the lithium battery:

1 microprocessor SAA 6020 + 1 display unit model LC 382080 of the VIDELEC Company + 1 zener diode = 50 + 50 microamps = 100 microamps.

In this respect, the microprocessor and display unit together consume 50 microamps and the zener diode consumes the other 50 microamps.

However, in the case of the invention, the consumption is: 1 microprocessor SAA 6020 + 1 display unit model LC 382080 of the VIDELEC Company/Hfe = 50/Hfe = 1 microamp (having used a transistor in which Hfe =

50).

This absorption is even less than the self-discharge current of a typically used lithium battery (model LSL 6 of the firm SAFT), which is about 4 microamps.

Figure 3 shows a different embodiment of the invention used for power supply to a multifunction telephone circiut.

For simplicity of illustration, this figure omits certain conventional parts which are shown in the preceding figures. For example, the display unit, telephone unit with its voice circuit, and the pushbutton board are not shown.

In this embodiment, the switch operated by the telephone unit is replaced by a two-position switch 9B. This position shown in the figure corresponds to the position which it assumes when the telephone unit is on-hook, the other position being that assumed when the telephone unit is off-hook. When the switch 9B is in the position shown in Figure 3, the multifunction telephone circuit is connected to the output 21B of the rectifier bridge 8B by way of a diode D2, a resistor R2, which can be fixed or variable (trimmer), and the transistor TR2, to the base of which there is connected to the positive pole of a lithium battery 11B by way of a low-value resistor R3. When the hook switch 9B is in its other position, the circuit 1B is connected to the output 21B by way of the transistor TR2 and a different diode D3. The reference numerals 14B indicates a capacitor corresponding to the capacitor 14A of Figure 2.

The operation of this embodiment is as follows:

When the telephone unit is off-hook the power supply circuit illustrated operates exactly as that shown in Figure 2. However, when the telephone unit is on-hook the current supplying the circuit 1B is absorbed partly from the output 21B of the block 8B, i.e. from the telephone line A, B by way of the resistor R2 and the diode D2, and partly from the lithium battery 11B. By sizing or adjusting the resistor R2 in such a manner as to obtain, with the telephone unit on-hook a current absorption from the output 21B (and thus from the telephone network) equal to the maximum value allowed by the regulations of the specific country, and indicated hereinafter as Ima, the current Ib1 required from the lithium battery is

$$Ib1 = Ictm - Imo$$

where Ictm is the current required by the circuit 1b. In other words, the current absorbed from the lithium battery 11B is only the difference between the current required for operating the circuit 1B and that allowed by the regulations.

CLAIMS

1. A power circuit for telephone apparatus, to which power is normally supplied from an external source and including stabilising means including a battery having a stable voltage characteristic.

2. A power circuit according to claim 1 wherein the battery also acts as a power source for the apparatus.

3. A power circuit according to claim 1 or 2 wherein the battery is connected to and controls means for controlling the supply of electricity from an external source to the telephone apparatus.

4. A power circuit according to claim 3 wherein the means for controlling the supply of power is a transistor to which is connected said battery and a current rectifier.

5. A circuit as claimed in claim 4 wherein the battery is connected to the base of the transistor.

6. A circuit as claimed in claim 4 wherein the battery is connected to the base of the transistor through a resistor.

7. A circuit as claimed in claim 4, 5 or 6 wherein said current rectifier and a switch controlled by a telephone unit are also connected to the external source.

8. A circuit as claimed in claim 7 further comprising a second current rectifier in series with a resistor and with said transistor, the switch being a change-over switch which when in the first state connects said second current rectifier to the external source and when in its second state connects the first mentioned current rectifier to the external source.

9. A circuit as claimed in claim 8, wherein resistance of the resistor is fixed.

10. A circuit as claimed in claim 8, wherein the resistance of the resistor is variable.

11. A circuit as claimed in any one of the preceding claims wherein the battery is a lithium battery.

12. A circuit as claimed in any one of claims 4 to 11 wherein the or each current rectifier is a diode.

13. A power circuit for telephone apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

14. Telephone apparatus including a power circuit according to any one of the preceding claims.

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