Power inverter circuit diagram with battery charging circuit pdf

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16 January 1962 H. R. MALLORY INVERTER-CHARGER CIRCUIT 2 Sheet 1 Filed Jan. 9, 1958 4612;,60/ or daf/u/ INVENTOR Awer flaws/104mm ATTORNEY Jan. 16, 1962 H. R. MALLORY 3,017, INVERTER-CHARGER CIRCUIT I BY g ATTORNEY United States Patent P 3,017,559 INVERTER-CHARGER CIRCUIT Henry Rogers Mallory, Greenwich, Conn., Assignor to P. R. Mallory & Co. Inc., Indianapolis, Ind., a Delaware 1 Filed Jan. (Cl. 321-45) This invention relates to transistor power inverter circuits and in particular combination circuits, which alternately perform the functions of charging a battery and inverting its DC output for alternating current purposes. The circuits of the present invention use transistor inverters to convert low-voltage direct current into alternating current or into higher direct current, wherein the outputs are used for the operation of photoflash devices, radio, television and electronic devices or the like. When secondary batteries are used, they need to be recharged from time to time, and I am considering a novel circuit arrangement that allows the batteries or cells to be charged by the oscillator or inverter transformer, using the transistors in the circuits as rectifiers. A simple switch arrangement is required to switch the circuit from an inverter to a battery charger and vice versa. Since various elements are used in the circuit for both inverting and charging functions, considerable size and weight savings are realized in the construction of different device types. The same circuit arrangement can also be used to rejuvenate certain types of primary batteries as well as secondary batteries. Further objects and advantages of my invention can be seen from the specification. The novelty, which I consider to be characteristic of my invention, is presented here and will be best understood, both in terms of its basic principles and with regard to its particular embodiments, with reference to the specification and the associated drawings in which: BILD 1 is a schematic of the transistor inverter charger circuit of the present invention; 2 is another modification of the transistor inverter charger circuit, which works in conjunction with a schematic of a typical electronic flash for photography; 3 is a schematic diagram of a change in the diagram in ABB. 1, along with additional controls; and Fig. 4 is a switching diagram of an alternative embodiment of the inverter charger circuit, which is considered by the present invention. In relation to the drawings in detail, whereby, as reference digits in the illustrations, refer to equivalent or similar components, the general concept of the inverter circuit of the invention shown in Fig. 1 and comprises a pair of pNP transistors T1 and T2, whose collectors with the respective ends of a suitable load, such as winding W1 of Trl. The bases of these transistors are connected to the respective ends of the winding W2 of the transformer TR1, and this circuit oscillates in the way known in art. Connected between the center'taps or the windings W1 and W2, is a feedback return network consisting of resistor R1. Also connected to the middle tap 3.017.559 Patented r. January 16, 1962 of winding W1 is a secondary battery B1, which contains a suitable number of cells. The positive side of the battery B1 is connected by Denkarm 11 of the switch SW1 1 and contact terminal 12 to a common connection between the emitters of the transistors T1 and T2. Although resistance R1 can be returned to the emitter return side of the battery, it may be preferable that this resistor is connected to the collector return side of the battery, as shown in Fig. 1, so that the oscillator then starts itself under most conditions of the alternating current load. When switch SW1 is connected to contact 12, the previously described circuit works as an invertor or power oscillator, as known in technology, wherein the DC. The current from the battery B1 is turned in by the transistors T1 and T2 and converted into an AC output by transformer TRl and winding W3. The circuit described up to this point can be converted into a full-wave battery battery charger of type center by connecting one end of the charge control resistance R2 between one end of the resistor R1 and the center tap connection of the winding W2. The other end of the resistor R2 is connected to contact 13 of the switch SW1. When arm 11 of the switch SW1 connects the positive side of the battery B1 with contact 13 and an alternating current input is applied to the winding W3 of the transformer TR1, the circuit shown in Fig. 1 becomes a battery charger. In this function, the respective collector and base transwindings for transistors T1 and T2 are additive in phase. In the charging position of the switch SW1, the charging circuit is from the negative side of the battery via the secondary winding W1 of the transformer TR1, through the respective collector base nodes of the transistors T1 and T2, by winding W2, by charging control resistor R2, by contact 13 and contact arm 11 of the switch SW1 back to the positive side of the battery in the more or less conventional center tap, full wave, rectilant circuit well known in the art. Although in Fig. 1 two PNP transistors are shown as grounded base, common emitter circuit, single transistor inverter circuits as well as other circuit combinations such as common collector, common emitter, etc., can be used as inverter circuit, and with a slightly different switching arrangement the same charging results as described can be achieved. Although T1 and T2 are displayed as PNP transistors the circuit works equally well with NPN transistors such as T1 and T2 with a reversal of battery polarity. Image. 2 shows a complete schematic of a photofiash device in a modification of the inverter charger circuit of the present invention is built-in. Essentially, the same transformer TRl with the windings W1, W2 and W3 is used in conjunction with the transistors T1 and T2 in the manner described in conjunction with Fig. 1. A switch consisting of a ganged pair of separate sliding contacts X and Y, which are arranged in such a way that they occupy one of three positions with respect to terminal contacts A, B, C, D, E and F, which are essentially equidistant lyrical from each other. The contacts X and Y move together in the appointment switch functions with respect to the mentioned terminal contacts. In the off-position, no circuits are completed by contact X or Y; Contact X to terminal A does not close a circuit, while contact Y does not close a circuit at terminals C and D, as contact D is a space. When the contacts X and Y are moved to the place at the X-bridge terminal contacts A and B and Y-bridge terminal contacts D and E, the device is in the inverter state, where the battery is powered to operate transformer TR1 for the operation of the electronic flash circuit, which is described below. In this battery position, the circuit is completed from the positive battery terminal to the transistor emitters by terminal conacts'A and B. In this state, contact Y is not functional because terminal contact D is empty. If the contacts X and Y-bridge contacts B, C or E, F respectively and if alternating current p-lug Z has been inserted into a suitable alternating current bushing, the AC consumption is connected to the high voltage winding W3 of the transformer T R1 via the contacts E and F, wherein this winding becomes the transformer primary. In this state, the transformer windings W1 and W2 are connected to the charger secondaries and by correction by the collector-base crossing of the transistors T1 and T2 the battery B2 is charged via the charging rate control resistor R2 and via the terminal contacts B and C bridged by contact X. The type of circuit in this charge position is the known central tap transformer full wave circuit with the modification that the correction effect as carried out by the collector-base crossing of the transistors T1 and T2 takes place along the secondary winding instead of at the end of the winding in the conventional sense. The correction is carried out under loading conditions between the respective bases and collectors of the two transistors T1 and T2. The common link between the issuers of these two transistors has no adverse effect on the rectibal effect of these transistors and it has been established that the emitters can remain connected. In order to control the charging rate of the circuit, the resistance R2 is located between the central tap of the transformer winding W2 and the terminal contact the value of the resistance is selected according to the desired charging properties of the circuit. The loading rate can be varied over considerably wide limits by selecting the correct value of the resistor R2. Is. some embodiments resistance R2 may include a few ohms, while in others there may be dozens of ohms. In the loading position, the transformer windings W1 and W2 are in series and in phase. The additional voltage provided by transformer winding W2 is necessary to provide the required voltage for charging the battery, which would otherwise not be sufficient if it were supplied only by transformer winding W1. In the case of electronic flashes powered by self-contained batteries, rotary circuit fliciency is of great importance because it determines the number of flashes that can be obtained from a range of batteries. The load on the flash circuit is variable from practically a short circuit immediately after the lamp flashes into an open circuit after the energy storage of the tank capacitor C2 has been fully charged. In commercial devices, it is practically necessary that the photoflash tank capacitor is charged with a charging time of about ten seconds or less to about 80% or 90% of the maximum capacitor voltage. When using transistor inverter circuits for electronic flashes, the values of the feedback resistance for a fast charging time should be relatively small. Such a low value of this feedback resistance provides a relatively high idle or charged tank capacitor current from the battery, and under such conditions the circuit cannot be considered sufficiently operational. It is therefore desirable in electronic flashes to vary the value of the said feedback resistance. It should be low for a fast charging time and high resistance for an efficient or low idle current. Lower idle current results in more flashes per charge for secondary batteries or a greater number of flashes when using primary batteries. A transistor inverter circuit requires some kind of feedback return network. In ABB. 2 this feedback return network consists of the resistors R4 and R5, which are connected in series between the respective middle taps of the transformer windings W1 and W2. The ones in ABB. 2 shown circuit achieves this desirable goal of fast charging time and low idle current by an automatically variable feedback resistance. To achieve this purpose, the NPN control transistor T3 is connected via the resistor R5, which is in the order of thousands of ohms compared to resistance R4, whose value lies in the tens or hundreds of claims. The automatic control of this feedback circuit is carried out by an NPN transistor T3, whose collector is connected to one end of the resistor R5 and whose emitter is connected to the other end of the resistor. The automatic control transistor T3 effectively closes the R5 with its shunt capacitor C1 when the main tank capacitor C2 is discharged in the photofiash circuit. This automatic control action is achieved by the base current feed circuit of the resistors R6, R7, capacitor C3 and control rectifier or diode S1. Resistance R6, variable resistance R7 and control rectiverors or diode S1 are in series between one end of the transformer winding W1 and transistor T3 by slider N of the resistor R6 and a part of the resistor R7. Resistor R7 is variable to account for fluctuations in the operating properties of Transistor T3. When starting the device or after a flash, the NPN control transistor T3 is saturated by the base current of the correct size and polarity, as provided by the resistors R6 and a part of R7 by the positive terminal of the battery. If the circuit continues to run and the tank capacitor C2 is charged, more voltage is developed via the primary windings W1, W2 of the inverter transformer. Part of this voltage is corrected by rectiveror S1 in series with resistance R7 and contradicts the current that flows into the base of the transistor T3 from the resistor R6. The electrolytic capacitor C3 smoothes the ripple of the base circuit of the transistor T3. If the resistors R6 and R7 are set correctly, transistor T3 is saturated under start and flash conditions and becomes unsaturated or represents a relatively high impedance under idle conditions. Under start or flash conditions, Transistor T3 effectively shortens the resistance R5. Under idle conditions, transistor T3 has a high impedance, where resistance R5 is switched off without short. In this way, an automatic control of the transistor change circuit is achieved by an incorporation of the variable load transistor T3 in the circuit. When the energy storage or tank capacitor C2 charges, a higher AC voltage appears via transformer winding W1 when the load on the transformer winding W3 decreases. Half of the voltage via transformer winding W1 is corrected by recticate S1 and appears as a current via the part of the resistor R7 adjacent rectivertor S1 in a polarity to counteract the current flowing from the battery B2 by resistance R6 and the part of the resistor R7 adjacent resistance R6. With the correct adjustment of the slider N to resistor R7 and with essentially no load on transformer winding W3, when photoflash capacitor C3 has been charged, the base current in transistor T3 should be a minimum or an opposite polarity, so that the emitter collector impedance of the transistor T3 is very high. Under these conditions, transistor T3 essentially functions as an open circuit, and the feedback return circuit feeds the resistors R4 and R5, the latter having a relatively high value. Different types of batteries can be used in the circuit. In one embodiment for a photoflash device, battery B2 is a hermetically sealed nickel-cadmium battery, which consists of six cells with half an ampere-hour capacity and has a voltage of about 7 volts. YThe Photofiash circuit, which is connected to the is connected, consists of a voltage double circuit, as in ABB. 2, although a singler or single-tripler circuit could be used very well. The voltage double circuit consists of rectiveruator S2 and S3 and a tank capacitor C2. Rectiveror S2 is located between a transformer winding W3 and an electrode of the xenon lamp. Rectiveror S3 is connected between the same end of the transformer winding W3 and the other electrode of the said lamp. The negative terminal of the tank capacitor C2 is connected to the rectifier S3 and the negative electrode of the xenon lamp. The other positive terminal of the tank capacitor C2 is connected to the rectivert S2 and the positive electrode of the xenon lamp. Capacitor C4 is a voltage double capacitor and completes the voltage double circuit as it is known in technology. The negative terminal of the capacitor C4 is connected to the negative terminal of the xenon lamp and to the negative terminal of the rectifier S3, whose positive terminal is connected to one end of the transformer winding W3. The positive terminal of the capacitor C4 is connected to the other end of the transformer winding W3 and to a terminal of the AC. connector Z. One of two camera shutter contacts is connected to a TRIGGER coil TC1 of a Trigger Transformer TRZ. The other of these closure contacts is connected to a trigger capacitor C4. The trigger capacitor C5 is charged by the approx. 300 volts of the voltage double comverder via the resistors R8 and R9, which are connected to the respective sides of the capacitor, wherein the resistors are connected to the rectifier S2 or S3 as well as the tank capacitor C2 and the corresponding electrodes of the xenon lamp. The resistors R8 and R9 have a sufficiently high value to prevent an electric shock to the operator holding the camera assembly, since one side of the shutter contacts is grounded to the camera body without exception. In some embodiments, resistor'R8 and R9 can each have a value of /2 megohm. Resistor R11 is in the shunt with the trigger capacitor C5 and performs two functions: (1) to reduce the voltage appearing via capacitor C5 to about 150 vol-ts or half of the double voltage; and (2) provide a potentiometer for adjusting the voltage to neon display, which serves as a ready light to signal that the capacitor C2 is essentially charged and ready to take photos. Potentiometer slider SL is connected to an electrode of neon indicator tube, the other electrode is connected to one end of the resistance R8. Trigger transformer TR2 provides a high-voltage pulse to initiate the line of the xenon lamp in a manner known in the prior art. The release electrode for this lamp consists of a transparent conductive deposit on the outside of the lamp cover. This triggering mechanism is typical of any number of similar mechanisms that act as capacitor discharge pulse systems. In some embodiments, the inverter circuit of ABB. 1 in the manner shown in Fig. 3 by adding a capacitor R1, which operates as a more resonant feedback return network, are modified, thereby improving the operation of the circuit under inversion conditions, while essentially no effect is achieved on the operation of the circuit under charging conditions. The switching components in ABB. 3 are related to ABB. 2 shown and described. The microfarad value of the capacitor C6 is selected to present to the circuit a time constant in combination with R1 that is approximately equal to the vibration frequency. In addition, the addition of the correct value of the capacitor C6 in the shunt with R1 increases the vibration frequency, which increases the efiiciency of the circuit due to the lower core losses of the transformer TR1 at the higher frequencies. The resonance feedback feedback circuit described above increases the efficiency of the power inversion circuit, regardless of the type of load associated with the power inverter. An alternative embodiment of the inverter charger circuit is in ABB. 4, wherein a single transistor T4 is used instead of the two inv fig. 3 shown transistors. The circuit works similarly as described in Fig. 3 in detail. When switch SW1 is in the inverter position, the positive side of the battery is closed to the emitter of the transistor T4, and the circuit oscillates in a known state of the art. As shown by the illustrations in FIGS. 1 and 3, the collector of the transistor T4 is connected to one end of the winding W1 and its base electrode is connected to one end of the winding W2. The other end of the winding W1 is connected to the negative terminal of the battery, while the other end of the winding W2 is also connected by the feedback network R1, which is pushed with C6 to the negative terminal of the battery. In the charging position of the switch SW1, the battery B1 receives a charge by connecting its negative terminal by winding W1 through the base collector connection of the transistor T4, by winding W2, by charge control resistance R2, back to the positive terminal of the battery after a more or less conventional semi-wave rectictilant circuit, which is known in the prior art. In the context of the present invention, it is considered that the feedback networks described here are some of many possible combinations that could be used just as well. Although the in FIGS. 1, 2, 3 and 4 shown inverters all use magnetic feedback, other types of feedback systems and networks, such as capacitive feedback, are also useful. It is also considered if the use of a battery herein has been shown and described that this equivalent DC is intended. Power supplies can be replaced for this purpose, such as: a battery parallel to a DC current. Generator; a DC generator without a parallel battery; a rectical power supply operated from an alternating current source, which is often found in radio and televsion receivers; a solar power converter; a thermopile and the like. In the specification, I have set out the invention and the best way in which I have described the application of these principles in order to distinguish my invention from other inventions; and I have the part, the mode or the which I claim as my invention or discovery. While I have shown and described certain preferred embodiments of my invention, it is understood that changes and changes can be made without deviating from the function and the scope of application as will be clear to the skilled professionals. An inverter charger circuit consisting of first and second transistors, each with a base electrode, an emitter electrode and a collector electrode, the emitters of the two mentioned transistors are connected to each other, a transformer with a first winding, a second winding and a third winding, the collector of this first transistor is connected to one end of this first winding and the collector of this second transistor is connected to the other end of this second transistor , the base of the first transistor connected to one end of this second winding, and the base of the second transistor connected to the other end of this second winding, a resistance connected between the respective central taps of this first and second winding, a battery that is connected. at one end of the middle tap of the first winding, a switch with a contact arm and two poles, said contact arm connected to the other end of the said battery, the first of the said poles connected to the middle tap of the second winding, the second of the said poles connected to the common connection between these emitters, said contact arm when in contact with this first pole and with an alternating current input into this third winding , which causes this circuit to charge this battery, said contact arm when in contact with this second pole, which is operational to cause this circuit to reverse the direct current of this battery into an alternating current output at this third winding. 2. An inverter charger circuit according to claim 1, and further consisting of a second resistor, which is connected between the middle tap of this second winding and the first switching pole. 3. An inverter charger circuit according to claim 2, and further consisting of a capacitor shunting said first mentioned resistance. 4. An inverter charger circuit according to claim 3 and beyond with a third transistor, the collector of this third transistor, which is connected to one end of the first resistor, wherein the emitter of the third transistor is connected to the other end of the first resistor, a variable resistance connected between one end of this first winding and the common connection between the emitters of the first two transistors. , the slider of this variable resistance connected to the base of this third transistor. 5. An inverter charger circuit according to claim 4 and a second capacitor, which is located between the of the third transistor and one end of the battery-connected battery. 6. An inverter charger circuit according to claim 5 and further a rectiveror, which is connected between one end of the variable resistance and the end of the first winding. 7. A circuit consisting of a direct current. power source, in case of a transistor with three elements, a switch that alternately connects one end of this source to one of the two mentioned three elements, a load and a feedback network, one end of this network being connected to both this load and to the third element of the said transistor, the

other end of the feedback network is connected to one of the two elements mentioned. that the load is connected between the third element of the said transistor and the other end of this source. 8. A circuit according to claim 7, wherein the load comprises a transformer. 9. A circuit consisting of a direct current. Power source, at least one transistor with three elements, a switch that alternately connects one end of this power source to one of the two three elements of this transistor mentioned, a load, a feedback network, one end of this network connected to this load, and the third element of this transistor, the other end of this network is connected to one of the two said elements of that transistor. , and a charge control circuit, one end of this circuit that is connected to this lead and the other end of this circuit is connected by the said switch to the first mentioned end of the aforementioned power source, said load between the third element of the said transistor together. 10. A circuit according to claim 9 consists of a transformer. 11. A circuit consisting of a battery, a load, at least one transistor with three elements, feedback means that one end of this feedback means to be connected to that load and to one of the three elements of the said transistor, which means the other end of this feedback to be connected to one of the other two elements of the said transistor, and a switch that alternately connects one end of that battery to one of the two elements mentioned. Transistor, this load, which is connected between the third element of the said transistor and the other end of the said battery, wherein in the said load a position of the said switch the circuit works as a battery charger and in the other position of the switch the circuit works as a power inverter. 12. A circuit according to claim 11, wherein this load comprises a transformer, wherein this transformer is common with the battery charging circuit and the inverter circuit. 13. A circuit according to claim 12, wherein this transformer is divided into a power part and a feedback part and further comprises a feedback return resistance connected between this feedback part of this transformer and the other end of this battery, and a charge control resistor, which is connected between this feedback part of that transformer and this switch. 14. A circuit consisting of a battery, a transistor with three elements, one load, feedback means that one end of this feedback means to be connected to that load and to one of the three elements of the said transistor, the other end of this feedback means to be connected to one of the others Elements of the said transistor, a switch that alternately connects one end of this battery to one of the two selected elements of these three elements of this transistor, a feedback return resistance connected between this transformer and the other end of this battery, and a charge control resistor connected between that transformer and the connection switch to say one end of that battery, the third element of the said transistor , which is connected to the other end of the said battery by the said transformer. 15. A circuit consisting of a battery, a load, a pair of transistors, each of these transistors having an emitter element, a collector element and a base element, feedback means that one end of this feedback means to be connected to both of these basic elements, the other end of this feedback means to be connected to one of the respective emitters and collectors. , and a switch that alternately connects one end of the said battery to one of the two similar transistor elements mentioned, wherein in one position of the said switch the circuit works as a battery charger and in the other position of the switch the circuit works as an inverter, both of the third similar elements of these transistors, which are connected by this load to the other end of this battery. 16. A circuit according to claim 15, wherein this load comprises a transformer, wherein this transformer is common with the battery charging circuit and the inverter circuit. 17. A circuit according to claim 16, wherein this transformer is divided into a power part and a feedback part and further comprises a feedback return resistance connected between the feedback part of this transformer and the other end of this battery, and a charge control resistor, which is connected between this feedback part of that transformer and this switch. 18. A circuit according to claim 17 and beyond connected to a transfer capacitor shunt capacitor, the shunt capacitor and the feedback return resistance, which forms a resonance return circuit in the same frequency direction as the vibrating frequency of the entire circuit. 19. A circuit according to claim 18 and beyond consisting of a third transistor with three elements, two of the elements of the third transistor connected via this feedback return resistance, and the third element of the third transistor connected to this other end of this battery. 20. A circuit according to claim 19 and further with a variable resistance, which is connected between this third element of the third transistor and the said switch. 21. A circuit according to claim 20, and further com pprising a capacitor connected between this third element third transistorund and said other end of the said battery. 22. A circuit consisting of a direct current. power source, at least one transistor with three elements, a switch that is one end of this source with one of the two three-element elements mentioned, one load and one Network, one end of this network connected to both this load and to the other end of this source, the other end of this network is coupled to the third element of the said transistor, where the load is connected between the third element of the said transistor and the other end of that source. References Quoted in the file of this patent UNITED STATES PATENTS 2,423,646 Flippen et al. 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