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Description

This invention relates to a sine wave power supply circuit usable for powering one or more fluorescent lamps or the like.

Classical, non-electronic current limiting ballasts for powering fluorescent lamps from an AC power supply are of low efficiency. To improve efficiency, electronic ballast circuits are used. Such electronic ballast circuits generally have included a rectifier means including a high value electrolytic capacitor to rectify the AC voltage to produce a smoothed DC voltage, an inverter or converter means connected to receive the DC voltage and to produce therefrom a high frequency alternating output voltage of sufficient amplitude to power one or more fluorescent lamps, and current limiting means to limit the current supplied from the converter means to the lamp. In the present context, "high frequency" means a frequency of at least 20 kHz, whereby the circuit operates substantially silently since the frequency is above the audio range.

These electronic ballast circuits are subject to a number of disadvantages. First, the frequency of the converter means in such circuits is substantially dependent on the amplitude of the DC voltage with which it is supplied, whereby under certain circumstances the frequency could drop below 20 kHz. Second, these circuits have a very poor crest factor since they draw current from the AC supply in short bursts every half cycle of the input voltage, whereby the circuit (particularly if a large number of them are used) can adversely affect the input supply waveform. Third, the reliability of these circuits is not good, in particular due to the presence of the electrolytic capacitor. Fourth, it can be difficult to satisfactorily design these circuits to have a sufficiently high power factor. Fifth, where the converter means comprises a pair of push-pull transistors, the base drive to each is through a resistor, an arrangement which creates an excessive amount of heat under certain conditions. Prior art ballast circuits that have lamp filament heaters, which enable the lamps to turn on more easily, also add inefficiency since such heaters remain powered after the lamp goes on.

Certain electronic ballast circuits have been designed with the electrolytic capacitor omitted and with the circuit driven by the resultant full wave rectified signal generated from the AC source. Use of this pulsed DC voltage overcomes many of the above described disadvantages of earlier circuits, but creates other problems especially where two transistors are configured in a push-pull circuit as part of the converter means. If both transistors are off at the same time, the voltage across each of the transistors goes up until breakdown occurs, damaging the circuit.

In US—A—4051413 there is described a sine wave power supply circuit including a parallel resonant circuit connected between two push-pull switching transistors and producing a high frequency alternating output voltage of sufficient amplitude to power one or more fluorescent lamps; steering means developing an operating current sufficient to render one of said transistors conductive and arranged to provide said operating current alternately to said transistors; and current limiting means connected at the input of said parallel resonant circuit.

In this known circuit the "steering means" comprises resistors serving to provide base currents for the transistors and an inductance means serving to provide base voltages for the transistors, that is the "steering means" simply provides a base drive arrangement for the transistors.

According to this invention such a circuit is characterised in that the input of said parallel resonant circuit is fed from a rectifier serving to convert an alternating input voltage into an unsmoothed direct voltage via said current limiting means; said steering means is controlled by a current source capacitively fed from the current path of said parallel resonant circuit in such a manner that said operating current is generated; and a security means is provided which generates an operating current for both said transistors in response to the detection of excessive voltage across either of said transistors.

Thus, with the circuit of this invention the steering means develops the base drive for the transistors by way of a capacitative coupling to the resonant circuit, this enabling the increased frequency of the resonant circuit at greater loads to create more capacitive current to the base of one or other of the transistors thereby increasing the base drive and vice versa. Such operation provides the advantage of automatic load compensation for the circuit.

Further, with the circuit of the invention, due to the absence of the need to provide smoothing, no electrolytic capacitor is needed across the rectifier means, thereby improving reliability and also reducing cost.

This invention will now be described by way of example with reference to the drawings, in which:-

Figure 1 is a circuit diagram of a power supply circuit according to the invention; and

Figures 2A to 2E shown waveforms present in the circuit of Figure 1.

Referring now to Figure 1, here shown is a power supply circuit 10 according to the present invention. The circuit is preferably powered from a source of unsmoothed or pulsed DC voltage V_1 obtained in a conventional manner. DC voltage V_1 is preferably generated from a rectifier means comprising a full wave diode bridge 12 which has coupled to it an AC input voltage supplied to a pair of input terminals 14 from an AC power source. A conventional EMI filter means 16 may be connected between terminals 14 and rectifier means 12. A fuse 18 and thermal cutout switch 19 may also be added to provide further protection for the components of the ballast circuit 10.

DC voltage V_1 is coupled to, and provides power for, a sine wave converter, which produces a high frequency sine wave output voltage of sufficient amplitude to power one or more fluorescent lamps or the like. The circuit 10 preferably is used to power two lamps connected in parallel to the sine wave converter.

Although the present invention is operable with a smooth or filtered DC voltage source, as described above, it is desirable to operate for efficiency of power consumption from a pulsed DC, i.e., the unfiltered AC full wave rectified voltage source. Consequently, an electrolytic capacitor is not needed on the output of the rectifier means 12 to smooth out the DC voltage.

A capacitor 20 may be added as shown in Figure 1 to operate as a high frequency filter for preventing any signal generated by the sine wave converter from feeding back onto the AC power line. Capacitor 20 is not intended to filter the input DC voltage. Consequently, the value of this capacitor 20 need only be high enough to provide a low impedance path at the high operating frequency of the sine wave converter.

The sine wave converter includes a transformer T1, including two 70-turn windings 22 and 24 and two 1-turn windings 26 and 28. Connected in parallel with windings 22 and 24 is a capacitor 30, windings 22 and 24 and capacitor 30 constituting a tank circuit 32 tuned to resonate at a particular frequency. In the preferred embodiment, the chosen frequency of resonance should be at least 20 kHz to insure operation of the circuit 10 above the audible frequency range. Associated with transformer T1 are two transistors Q1 and Q2, with the collector of Q1 connected to tank circuit 32 at terminal 34 and the collector of transistor Q2 connected to tank circuit 32 at terminal 36. The center tap of transformer T1 between windings 22 and 24, shown at 38, is connected to the DC voltage source through an inductor 40. The other center tap of transformer T1, between windings 26 and 28, is shown at 42. The other end of windings 26 and 28 are connected respectively to the bases of transistors Q1 and Q2.

As will be described in more detail hereinbelow, the bases of transistors Q1 and Q2 are driven from one of four current sources. The main current source comprises capacitor 44, inductor 46, and diode 48, with this network of components providing current during the normal operation of the circuit 10, i.e., when tank circuit 32 is oscillating and the DC voltage V_1 is above a certain minimum voltage level. Two other current sources are provided, and function to start or restart the switching action of transistors Q1 and Q2. Capacitor 50, resistor 52 and diodes 54 and 56 operate as a current source to provide current to transistors Q1 and Q2 whenever the DC voltage V_1 has just begun rising from substantially zero volts. This occurs when the ballast circuit 10 first is started up and thereafter every half cycle of the input 60 Hz waveform generated by the AC voltage source. Resistor 58 and voltage dependent resistor 60 provide two alternate current sources to provide restarting of the switching of transistors Q1 and Q2 at other times when both transistors may have erroneously gone off.

Also connected across transformer T1 at terminals 34 and 36 are preferably two fluorescent lamps 62 and 64. These lamps 62, 64 are connected in parallel rather than in series to enable one of the lamps to remain on even if the other lamp has failed and becomes an open circuit. Connected in series between lamps 62, 64 and terminal 34 is a current limiting means comprising an inductor 66. Also connected in series between terminal 34 and lamps 62 and 64 on the lamp side of inductor 66 is a balancing transformer 68. The operation of these two elements 66 and 68 is described below. Note that these elements could also be connected in series on the other side of transformer T1, between the lamps and terminal 36.

Each lamp 62, 64 also includes a conventional filament at each end of the lamp, shown at 70 and 72. Each filament is preferably connected to filament heater means comprising a winding 74 for each of the filaments 70 and a winding 76 for both filaments 72. These windings provide a heater current for filaments 70 and 72 to facilitate the rapid and non-destructive turning on of lamps 62 and 64. Heating of the filaments prevents dark spots in the lamps created by metal ions stripped from the filaments without filament heating which are deposited around the inside of the lamp, and also prevents the need for a higher voltage to turn on the lamps in the same amount of time.

Once the fluorescent lamps 62, 64 have gone on, the heater current generated by the coil 74, 76 is not needed, and constitutes an unnecessary power drain in the ballast circuit 10. To substantially cancel out this power drain, filament cancellation means are provided to substantially limit this power loss.

The filament cancellation means comprises a plurality of coils, identified as coils 78, 79 and 80, which are inductively coupled to inductor 66. Each coil 78—80 is associated with a corresponding one of said heater coils 74, 76 as shown in Figure 1. Voltage is generated across these windings 78—80 only after the lamps 62 and 64 have gone on, when the high frequency lamp driving current creates a voltage across inductor 66. As can be seen from the dot arrangement of windings 78—80 compared with windings 74 and 76, the voltages generated by 78—80 are 180° out of phase with the voltage generated by coils 74, 76, thereby substantially negating the voltage of the heater current. Consequently, a reduction of over 75% of the power drain from the heater current is obtained, with a corresponding reduction of a number of watts, perhaps 10—15%, of the total power consumption of the circuit 10.

The converter means of the circuit 10 operates in the following manner. During normal operation, with the circuit already started and tank circuit 32 oscillating, the core of transformer T1 is common to windings 22 and 24 and winding 26 and 28. Thus, the sine wave oscillations of windings 22 and 24 and tank circuit 32 also appear as a sine wave across windings 26 and 28. As mentioned above, these windings 26 and 28 are tied to the bases of Q1 and Q2. Thus, for example, if transistor Q1 is on, terminal 34, which is tied to the collector of transistor Q1, is essentially at ground. This produces a voltage drop on the 70 turn winding 22, making the dot end of winding 22 negative with respect to center tap 38. Since the dot on winding 26 is at the center tap 42, this point is negative with respect to the other side of winding 26 at the base of transistor Q1. Thus, a positive voltage is generated at the base of transistor Q1, and is identified as V_3 in Figure 1. With the base of transistor Q1 positive, the current through inductor 46 is steered through winding 26 into the base of transistor Q1, maintaining transistor Q1 on. At the same time, the base of transistor Q2 is held negative because of the same voltage drop occuring across winding 28. When the tank circuit is in its other half cycle, terminal 36 begins to go positive with respect to terminal 34, causing the voltage drop across the steering coils 26 to 28 to steer current to the base of transistor Q2 and away from the base of transistor Q1, turning transistor Q2 on and turning off transistor Q1.

The DC voltage V_1 powers the tank circuit 32 through inductor 40. Inductor 40 acts to isolate the sine wave oscillations of tank circuit 32 from the 60 Hz pulsating DC voltage V_1. Inductor 40 also is a current limiter to protect the transistors Q1 and Q2 from drawing maximum current. This is because without this inductor 40 the voltage at transformer T1 center tap 38 would be limited to a maximum of approximately 100 volts, the voltage of the input DC voltage V_1. This would cause tank circuit 32 to essentially operate as a square wave inverter rather than a sine wave inverter. In addition, without current limiting transformer T1 would stop being a transformer and the impedance of those windings 22 and 24 would disappear. The input voltage V_1 would as a result be directly connected across the collector of these transistors. With too much current, the transistor would probably be rapidly destroyed.

Inductor 46 operates to provide a continuing current through windings 26 and 28 into the bases of the transistors Q1 and Q2 during the crossover point in the operation of tank circuit 32, i.e. wherein the voltage at the tank circuit terminal crosses zero. Without inductor 46, the current would die out, causing both transistors to turn off, with the result that the voltage at the collectors of the transistors would rise very rapidly and perhaps cause their destruction. In other words, inductor 46 insures that at the crossover point when transformer T1 is switching the polarity of its windings, that there is a small amount of current flowing through windings 26 and 28 into the bases of transistors Q1 and Q2. This enables the one transistor that has been already on to remain on for a short, additional length of time, and to enable the transistor about to be on to turn on sooner. At this point, both transistors will be conducting in a so-called variable dissipation mode. The normal mode of operation, when one transistor is on and the other transistor is off, is that the on transistor is in saturation, thereby acting substantially as a closed switch in that state, and the off transistor is essentially an open switch.

Inductor 46 also assists in turning on one of the transistors Q1 or Q2 when the DC voltage V_1 goes to zero 120 times a second. The inductor continues to output current for a short time after V_1 goes to zero, while ringing of the tank circuit 32, which will also generally occur for a short time after power is removed, helps to steer this current to one or the other transistors Q1 or Q2 until the DC voltage V_1 begins again to go up.

As mentioned above, during the normal switching operation of transistors Q1 and Q2, the base current is derived through capacitor 44 from the center point 38 of transformer T1. This capacitor is a current source since the center point of transformer T1 is going from a ground potential up to a high voltage level of an amount depending on the voltage level of the DC voltage V_1, e.g. 250 volts, which varies at tank circuit 32 oscillation rate of over 20 kHz. Consequently, for a small capacitor, you get a fairly large amount of current passing through the capacitor, on the order of 300 milliamps peak, and the current is a square wave. Diode 48 acts as a half-wave rectifier enabling capacitor 44 to conduct current only in the forward direction into inductor 46. In summary, capacitor 42 acts as the source for the primary running current for the bases of transistors Q1 and Q2 during their normal switching operations.

Capacitor 50, resistor 52 and diodes 54 and 56 provide starting current for the bases of transistors Q1 and Q2 via inductor 46 at those times when the DC voltage V_1 is starting at zero volts. Since capacitor 50 is tied to the DC voltage V_1, it generates a positive going current limited by resistor 52 which then flows through diode 56 and into inductor 46. Diode 56 prevents current generated through capacitor 44 from flowing in the opposite direction. Diode 54 allows current to flow only in the forward direction through capacitor 50.

It should be realized that prior to start-up, both transitors Q1 and Q2 are off. The current generated by capacitor 50 and resistor 52 is designed to be sufficient to supply enough current to drive the bases of both transistors, since at start-up, transformer T1 is not oscillating, so that no steering of the current is provided by windings 26 or 28. Since one transistor in the pair will always have a slightly higher gain than the other, that transistor will turn on first. This causes a voltage drop in the corresponding 70 turn winding 22 or 24, which then couples this voltage back to the steering winding 26 and 28. This voltage drop thereby causes steering of the current into the transistor that is on, reinforcing the on state of that transistor. The current to the base of the other transistor is correspondingly reduced. Resistor 58 functions to provide a currrent to the bases of transistors Q1 and Q2 if for some reason the sine wave oscillator stalls at some point other than at the start of half cycle, i.e. at some point when the input DC voltage V_1 is not at zero volts. Normally, the resistance of resistor 58 is high enough so that no current flows through this resistor during normal start-up operation. This current path is needed because, at these higher voltage ranges, insufficient current may be available from the starting means comprising capacitor 50 and resistor 52 to turn on transistors Q1 or Q2 without such assistance.

Another protective device for transistors Q1 and Q2 is the voltage dependent resistor 60. Resistor 60 provides another path for current to flow into the bases of transistors Q1 and Q2. Resistor 60 is designed to operate when current is flowing in inductor 40 and neither transistor Q1 nor Q2 is on. If resistor 60 were not there, this current would cause the voltage at the center point 38 of the transformer to rapidly increase to destructive levels. Consequently, resistor 60 operates to create a current path to the base of transistors Q1 and Q2 whenever center point 38 of transformer T1 goes above a certain voltage, e.g. 300 volts. At this point, the voltage dependent resistor 60 begins to conduct, dumps current into the base windings and forces one or the other of transistors Q1 or Q2 to turn on in the same manner as the starting circuit forces one or the other of the transistors to turn on.

Inductor 66 comprises current limiting means for limiting the current that is enabled to flow across the fluorescent lamps 62 and 64. The inductance of inductor 66 is chosen such that at the predetermined running frequency of the sine wave converter means, inductor 66 will limit the current to the specific level at which lamps 62 and 64 work at their rated output.

The current limiting function of the inductor 66 operates to allow full voltage to appear across lamps 62 and 64 when both lamps are unlit. This voltage is of the order of greater than 300 volts. Once the lamps are lit, however, they only require and desire between 70 and about 85 volts. The balance of this voltage is then carried across inductor 66. It is the variation of this voltage drop across inductor 66 that provides the voltage on filament cancellation coils 78—80 for cancelling of the voltage of the filament heater current.

Transformer 68 acts as a balancing transformer. Transformer 68 includes two windings, winding 81 and winding 82, connected respectively to lamps 62 and 64. In operation, windings 81 and 82 are phased such that if one lamp turns on before the other lamp goes on, the lamp that is on will cause a voltage drop in the associated winding such that the opposite winding will produce a higher voltage across the still unlit lamp. This helps this other lamp to go on and light up more quickly than if transformer 68 was not in the circuit. Subsequently, with both lamps operating, transformer 68 acts to balance the current flow into each of the lamps, keeping them at equal brightness. This operation occurs, since if one lamp starts to carry more current, it will force a higher voltage on the other lamp, which will then draw its corresponding share of the current.

The filament heater coils on transformer T1, and the operation of the filament cancellations means, comprising coils 78—80 inductor 66, were previously described.

Figures 2A—E illustrate certain of the waveforms present in the circuit 10.

Figure 2A and 2B illustrate merely the operation of the rectifier means 12 on the AC input voltage shown in 2A to create a full wave rectified AC voltage, the pulsed or unsmoothed DC voltage V_1 shown in Figure 2B. As is seen in Figure 2B, pointed out above, at every half cycle of the 60 Hz AC wave, the DC voltage V_1 drops substantially to zero volts. At each of these points, the starting circuit comprising resistor 52 and capacitor 50 acts to insure that the sine wave converter means restarts and continues to generate switching of transistors Q1 and Q2.

Figures 2C, 2D and 2E illustrate the operation of the sine wave converter at only a section of time during a given 60 Hz period. Specifically, Figure 2C illustrates the variation in voltage V_2 at terminal 34 of tank circuit 32. As is seen, the voltage is a half wave rectified signal whose amplitude rises up to the then current amplitude of the 60 Hz envelope. The operation of transistor Q1 is such that when transistor Q1 is on, at time period t1, the voltage at terminal 34 is essentially at ground, and when transistor Q1 is off, at time period t2, the voltage at terminal 34 is allowed to reflect the sinusoidal waveform of tank circuit 32. The frequency of this halfwave rectified waveform is the frequency of the tank circuit, which as mentioned above, is on the order of something greater than 30 kHz. Figure 2D illustrates the current I_2 of the tank circuit, and shows that this current waveform is sinusoidal and has an amplitude varying as a function of the 60 Hz envelope of the input voltage V_1. Finally, Figure 2E illustrates the voltage V_3 at the base of transistor Q1, and shows the turning on and turning off of a transistor Q1 also at the greater than 20 kHz rate.

Claims

1. A sine wave power supply circuit including a parallel resonant circuit (22, 24, 30) connected between two push-pull switching transistors (Q1, Q2) and producing a high frequency alternating output voltage of sufficient amplitude to power one or more fluorescent lamps; steering means (26, 28) developing an operating current sufficient to render one of said transistors (Q1, Q2) conductive arranged to provide said operating current alternately to said transistors (Q1, Q2); and current limiting means (40) connected at the input of said parallel resonant circuit, characterised in that the input (38) of said parallel resonant circuit is fed from a rectifier (12) serving to convert an alternating input voltage into an unsmoothed

direct voltage via said current limiting means (40); said steering means (26, 28) is controlled by a current source (46) capacitively fed from the current path of said parallel resonant circuit (22, 24, 30) in such a manner that said operating current is generated; and a security means (60) is provided which generates an operating current for both said transistors (Q1 and Q2) in response to the detection of excessive voltage across either of said transistors (Q1 and Q2).

2. A power supply circuit according to Claim 1, characterised by a starter circuit (50, 52, 56) connected to respond to said direct voltage and to force one of said transistors (Q1 and Q2) conductive whenever said direct voltage increases from zero.

3. A power supply circuit according to Claim 1 or Claim 2, characterised by means (74) for coupling a heater current to a filament (70) of the or each lamp, said means for limiting (66, 79) being arranged to develop a current which is substantially 180° out of phase with said heater current.

4. A power supply circuit according to Claim 3, characterised in that said means for coupling said heater current comprises a first transformer winding (74) coupled to said resonant circuit and another transformer winding (79) in series with said first transformer winding and coupled to a current limiting inductor (66) connected in series between said resonant circuit and the or each lamp, the voltages developed across said transformer windings after the or each lamp has turned on being out of phase with each other.

5. A power supply circuit according to any of Claims 1 to 4, for use with more than one fluorescent lamp (62, 64) characterised by means (68, 81, 82) operative when one lamp is turned on for boosting the voltage supplied to a second lamp not yet turned on.

6. A power supply circuit according to claim 5, characterised in that said means for boosting comprises a transformer (68) having windings (81, 82) each connected in series with a respective lamp and said means (66) for limiting.

7. A power supply circuit according to any preceding claim, characterised in that said parallel resonant circuit includes first and second inductive windings (22, 24) in parallel with a capacitor (30), said steering circuit comprising third and fourth windings (26, 28) which are coupled with said first and second windings and a capacitative connection (44) for supplying said operating current from said parallel resonant circuit to a junction (42) between said third and fourth windings, said transistors (Q1 and Q2) each having a base which is connected to receive said operating current from a respective one of said third and fourth windings.

8. A power supply circuit according to Claim 7, characterised in that said current source (46) maintains current at said junction (42) between said third and fourth windings (26, 28) after a current supplied by way of said capacitative connection (44) diminshes to zero.

9. A power supply circuit according to Claim 7 or Claim 8, characterised in that said security means (60) detects an over-voltage at the junction (38) between said first and second windings and provides in response an operating current to the base of each of said transistors (Q1 and Q2).

10. A power supply circuit according to any preceding claim, characterised in that said starter circuit comprises a series connection of a capacitor (50), a resistor (52) and a diode (56) coupled to bases of both said transistors (Q1 and Q2).

Patentansprüche

1. Sinuswellen-Stromversorgungsschaltung, enthaltend einen Parallelresonanzkreis (22, 24, 30), der zwischen zwei im Gegentakt schaltenden Transistoren (Q1, Q2) angeschlossen ist und eine hochfrequente Ausgangswechselspannung mit ausreichender Amplitude erzeugt, um eine oder mehrere Leuchtstoffröhren mit Strom zu versorgen; eine Steuereinrichtung (26, 28), die einen zum Leitendmachen eines der Transistoren (Q1, Q2) ausreichenden Betriebsstrom erzeugt und angeordnet ist, den Betriebsstrom abwechselnd den Transistoren (Q1, Q2) zu liefern; und eine am Eingang des Parallelresonanzkreises angeschlossene Strombegrenzungseinrichtung (40), dadurch gekennzeichnet, daß der Eingang (38) des Parallelresonanzkreises von einem Gleichrichter (12) gespeist wird, der dazu dient, eine Eingangswechselspannung in eine ungeglättete Gleichspannung über die Strombegrenzungseinrichtung (40) umzuwandeln; die Steuereinrichtung (26, 28) durch eine Stromquelle (46) gesteuert wird, die aus dem Strompfad des Parallelresonanzkreises (22, 24, 30) auf solche Weise kapazitiv gespeist wird, daß der Betriebsstrom erzeugt wird; und eine Sicherheitseinrichtung (60) vorgesehen ist, die für beide Transistoren (Q1 und Q2) einen Betriebsstrom in Reaktion auf die Erfassung einer übermäßigen Spannung über einen der Transistoren (Q1 und Q2) erzeugt.

2. Stromversorgungsschaltung nach Anspruch 1, gekennzeichnet durch einen Starterkreis (50, 52, 56), der angeschlossen ist, um auf die Gleichspannung anzusprechen und einen der Transistoren (Q1 und Q2) zwangsläufig leitend zu machen, immer wenn die Gleichspannung von Null aus zunimmt.

3. Stromversorgungsschaltung nach Anspruch 1 oder Anspruch 2, gekennzeichnet durch eine Einrichtung (74) zum Koppeln eines Heizstroms mit einem Glühfaden (70) der oder jeder Röhre, wobei die Einrichtung zum Begrenzen (66, 79) angeordnet ist, um einen Strom zu erzeugen, der im wesentlichen um 180° außer Phase mit dem Heizstrom ist.

4. Stromversorgungsschaltung nach Anspruch 3, dadurch gekennzeichnet, daß die Einrichtung zum Koppeln des Heizstroms eine mit dem Resonanzkreis gekoppelte erste Transformatorwicklung (74) und eine weitere Transformatorwicklung (79) in Reihe mit der ersten Transformator-

wicklung und gekoppelt mit einer Strombegrenzungsdrossel (66) umfaßt, die in Reihe zwischen dem Resonanzkreis und der oder jeder Röhre angeschlossen ist, wobei die Über die Transformatorwicklungen erzeugten Spannungen außer Phase zueinander sind, nachdem die oder jede Röhre eingeschaltet worden ist.

5. Stromversorgungsschaltung nach einem beliebigen der Ansprüche 1 bis 4, zur Verwendung bei mehr als einer Leuchtstoffröhre (62, 64), gekennzeichnet durch eine Einrichtung (68, 81, 82) die betriebsbereit ist, wenn eine Lampe eingeschaltet worden ist, um die zugeführte Spannung zu einer noch nicht eingeschalteten zweiten Röhre zu verstärken.

6. Stromversorgungsschaltung nach Anspruch 5, dadurch gekennzeichnet, daß die Verstärkungseinrichtung einen Transformator (68) umfaßt, der Wicklungen (81, 82) aufweist, die jeweils in Reihe mit einer entsprechenden Röhre und der Einrichtung (66) zum Begrenzen angeschlossen sind.

7. Stromversorgungsschaltung nach einem beliebigen vorhergehenden Anspruch, dadurch gekennzeichnet, daß der Parallelresonanzkreis erste und zweite induktive Wicklungen (22, 24) parallel zu einem Kondensator (30) enthält, wobei der Steuerkreis dritte und vierte Wicklungen (26, 28), die mit den ersten und zweiten Wicklungen gekoppelt sind, und eine kapazitive Verbindung (44) umfaßt, um den Betriebsstrom von dem Parallelresonanzkreis zu einer Verbindung (42) zwischen der dritten und vierten Wicklung zuzuführen, wobei die Transistoren (Q1 und Q2) jeweils eine Basis aufweisen, die angeschlossen ist, um den Betriebsstrom von einer entsprechenden der dritten und vierten Wicklungen aufzunehmen.

8. Stromversorgungsschaltung nach Anspruch 7, dadurch gekennzeichnet, daß die Stromquelle (46) Strom an der Verbindung (42) zwischen der dritten und vierten Wicklung (26, 28) aufrechterhält, nachdem eine mittels der kapazitiven Verbindung (44) zugeführter Strom auf Null abnimmt.

9. Stromversorgungsschaltung nach Anspruch 7 oder Anspruch 8, dadurch gekennzeichnet, daß die Sicherheitseinrichtung (60) eine Überspannung an der Verbindung (38) zwischen der ersten un zweiten Wicklung erfaßt und in Reaktion einen Betriebsstrom zur Basis eines jeden der Transistoren (Q1 und Q2) liefert.

10. Stromversorgungsschaltung nach einem beliebigen vorhergehenden Anspruch, dadurch gekennzeichnet, daß der Starterkreis einen Reihenanschluß eines Kondensators (50) eines Widerstandes (52) und einer Diode (56) umfaßt, gekoppelt mit den Basen der beiden Transistoren (Q1 und Q2).

Revendications

1. Un circuit d'alimentation en puissance à ondes sinusoïdales comprenant un circuit résonnant parallèle (22, 24, 30) connecté entre deux transistors de commutation en montage symétrique (Q1, Q2), et produisant une tension de sortie alternative de fréquence élevée ayant une amplitude suffisante pour alimenter une ou plusieurs lampes fluorescentes; des moyens d'aiguillage (26, 28) qui produisent un courant de commande suffisant pour provoquer la conduction de l'un des transistors (Q1, Q2), et qui sont conçus de façon à appliquer alternativement ce courant de commande aux transistors (Q1, Q2); et des moyens de limitation de courant (40) connectés à l'entrée du circuit résonnant parallèle, caractérisé en ce que l'entrée (38) du circuit résonnant parallèle est attaquée par un redresseur (12) qui a pour fonction de convertir une tension d'entrée alternative en une tension continue non lissée, par l'intermédiaire des moyens de limitation de courant (40); les moyens d'aiguillage (26, 28) sont commandés par une source de courant (46) qui est alimentée de façon capacitive à partir du chemin de courant du circuit résonnant parallèle (22, 24, 30), de manière à produire le courant de commande; et un moyen de sécurité (60) est prévu pour produire un courant de commande pour les deux transistors (Q1 et Q2) sous l'effet de la détection d'une tension excessive aux bornes de l'un ou l'autre des transistors (Q1 et Q2).

2. Un circuit d'alimentation selon la revendication 1, caractérisé par un circuit de démarrage (50, 52, 56) connecté de façon à réagir à la tension continue, et à imposer la conduction de l'un des transistors (Q1 et Q2) chaque fois que la tension continue augmente à partir de zéro.

3. Un circuit d'alimentation selon la revendication 1 ou la revendication 2, caractérisé par des moyens (74) destinés à appliquer un courant de chauffage à un filament (70) de la lampe ou de chaque lampe, les moyens de limitation (66, 79) étant conçus de façon à produire un courant qui est sensiblement déphasé de 180° par rapport à ce courant de chauffage.

4. Un circuit d'alimentation selon la revendication 3, caractérisé en ce que les moyens destinés à appliquer le courant de chauffage comprennent un premier enroulement de transformateur (74) en couplage avec le circuit résonnant, et une autre enroulement de transformateur (79) en série avec le premier enroulement de transformateur, et en couplage avec une inductance de limitation de courant (66) connectée en série entre le circuit résonnant et la lampe ou chaque lampe, les tensions qui sont développées aux bornes des enroulements de transformateur après l'éclairage de la lampe ou de chaque lampe étant déphasées l'une par rapport à l'autre.

5. Un circuit d'alimentation selon l'une quelconque des revendications 1 à 4, prévu pour l'utilisation avec plus d'une lampe fluorescente (62, 64), caractérisé par des moyens (68, 81, 82) qui fonctionnent au moment de l'éclairage d'une lampe, de façon à augmenter la tension qui est appliquée à une seconde lampe qui ne s'est pas encore éclairée.

6. Un circuit d'alimentation selon la revendication 5, caractérisé en ce que les moyens d'augmentation de tension comprennent un transformateur (68) ayant des enroulements (81, 82)

connectés chacun en série avec une lampe respective, et les moyens de limitation (66).

7. Un circuit d'alimentation selon l'une quelconque des revendications précédentes, caractérisé en ce que le circuit résonnant parallèle comprend des premier et second enroulements inductifs (22, 24) en parallèle avec un condensateur (30), le circuit d'aiguillage comprenant des troisième et quatrième enroulements (26, 28) qui sont en couplage avec les premier et second enroulements, et une connexion capacitive (44) pour appliquer le courant de commande provenant du circuit résonnant parallèle, à un point de connexion (42) entre les troisième et quatrième enroulements, chacun des transistors précités (Q1 et Q2) ayant une base qui est connectée de façon à recevoir le courant de commande provenant de l'un respectif des troisième et quatrième enroulements.

8. Un circuit d'alimentation selon la revendication 7, caractérisé en ce que le source de courant (46) maintient un courant au point de connexion (42) entre les troisième et quatrième enroulements (26, 28), après qu'un courant qui est fourni par l'intermédiaire de la connexion capacitive (44) a diminué jusqu'à zéro.

9. Un circuit d'alimentation selon la revendication 7 ou la revendication 8, caractérisé en ce que le moyens de sécurité (60) détectent une surtension au point de connexion (38) entre les premier et second entroulements, et fournissent en réponse un courant de commande à la base de chacun des transistors (Q1 et Q2).

10. Un circuit d'alimentation selon l'une quelconque des revendications précédentes, caractérisé en ce que le circuit de démarrage comporte un circuit série formé par un condensateur (50), une résistance (52) et une diode (56), connecté aux bases des deux transistors (Q1 et Q2).

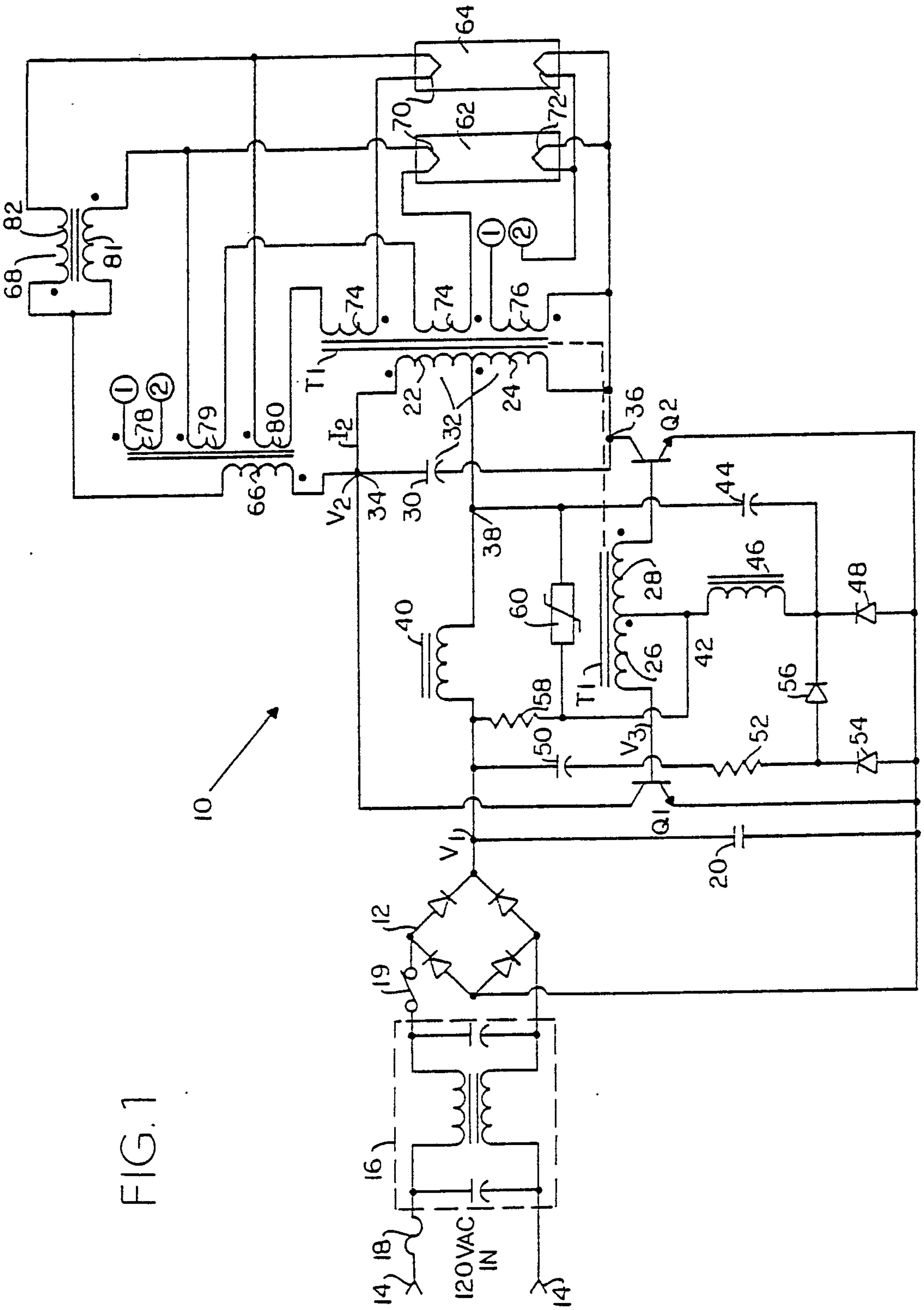

FIG. 1

FIG.2A

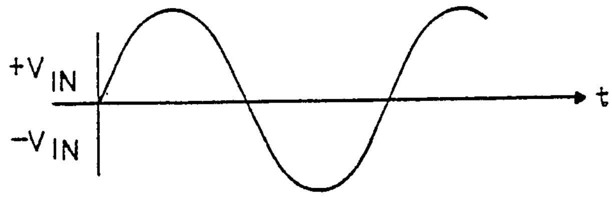

FIG. 2B

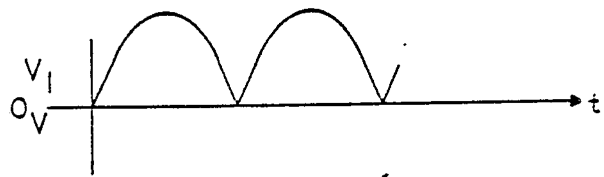

FIG.2C

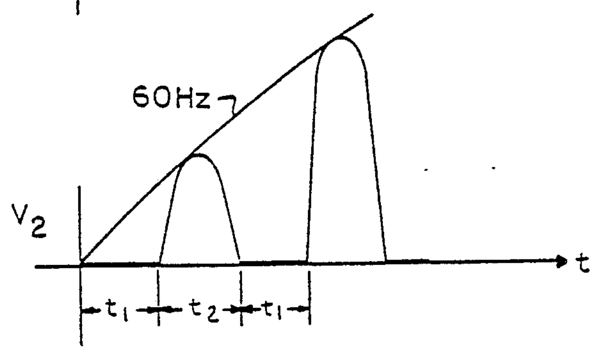

FIG. 2D

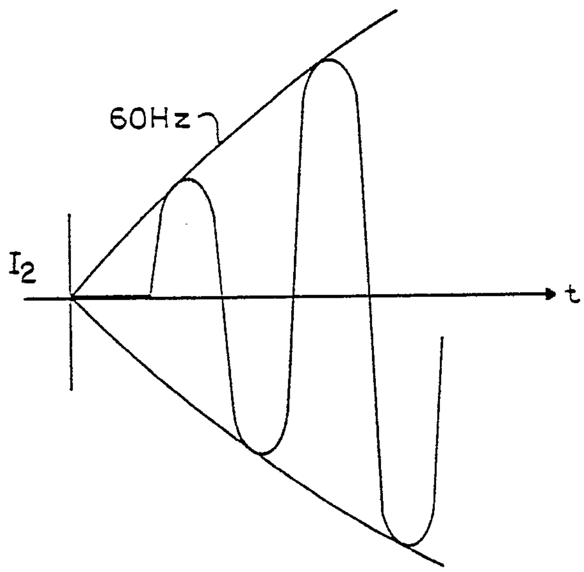

FIG.2E