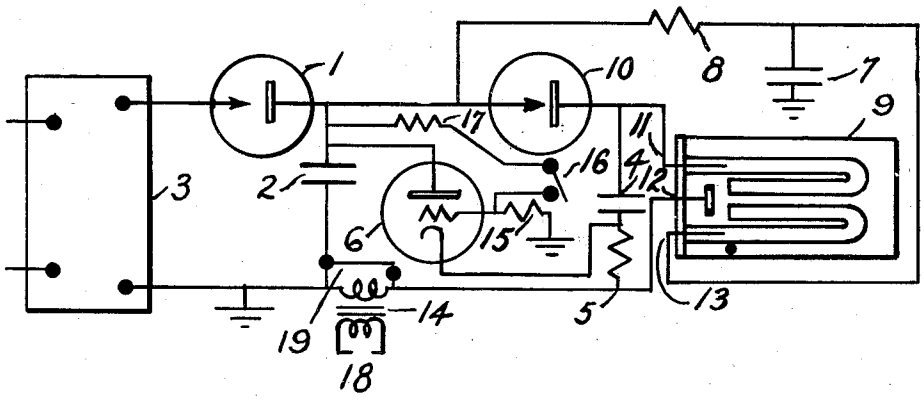
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HIGH-INTENSITY ELECTRON FLASH TUBE CIRCUITS

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HIGH-INTENSITY ELECTRON FLASH TUBE CIRCUITS

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The present invention has for its purpose the provision of a flash discharge circuit such as required for photo-flash illumination of articles, or flash welding of objects, especially for use where very high peak currents of short duration and predetermined value are to be employed.

One object of the present invention is to provide a circuit employing condenser charge and discharge cycles in which heavy discharges can be had at relatively rapid rates.

Another object is to provide a simple circuit that will give visual indication of ready-to-discharge condition, without requiring extra parts to give such an indication.

Still another object is to provide high-powered flash type circuits in which a parallel charge and series discharge combination is used to eliminate the need for real high voltage static charges, and provide a high output without constituting a constant danger to the layman or unskilled operator.

Another object is to supply a means for exciting one section of a dual flash tube, said section being supplied by a large condenser of relatively low voltage, by a high-voltage high intensity flash through the remaining section of said tube, this intense flash exciting the cathode and by its coupling effect also helping to fire the low-voltage section.

Many flash discharge circuits have been devised in the past few years, but as far as the present applicant is aware none offer the unusual advantages incorporated in my present invention.

In considering this invention, it should be taken into account that two actual phases, or forms, of flash discharge are obtained in a single tube. This fact is significant for several reasons and will be hereinafter discussed more fully.

Since the type of flash tube generally used in the subject type of circuit has a very high starting voltage, especially so in tubes using high gas pressures, as for example in the tube of my Patent No. 2,284,263, for which the present circuit is especially suited, it is necessary to supply power under conditions of rapidly increasing stress until ignition takes place.

When ignition from high stress occurs in one section of a flash tube, to which has been added a second similarly constructed discharge section, said second section will fire a condenser charged to a lower voltage than that firing thru the first section, when both are immersed directly in the same gaseous atmosphere. This condition I have also found is accentuated if strong coupling or

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close coupling exists between the two discharge paths, flowing thru the relatively small diameter inner tube, or tubes, and especially when said inner tubes describe at least a single-turn loop.

The advantages gained by the use of circuits and tubes having the above outlined characteristics are many. In the circuit embodying the present invention, low-voltage static charges only are required. In addition to the safety feature thus had, this fact also makes possible the use in my circuit of certain special classes of parts, such as electrolytic type condensers which cannot economically be used at very high voltages, or in series, especially where very rapid discharge cycles are desired.

For certain classes of devices, such as used for photo-flash illumination and flash welding, where high peak and rapid pulses of current must be handled, the present invention offers economically and safely the powerful and fast discharge needed, and also actually can provide a combination of two distinct types of discharges, as shown by discharge curves. It can be readily understood in view of this that my device will provide output characteristics of a sufficiently flexible nature to meet many and varied requirements.

Briefly described, the present invention comprises a source of electric power of several hundred volts, either D. C. or rectified A. C. This source charges two or more banks of condensers, one directly and the succeeding bank or banks thru an isolating rectifier and a series resistance or inductance.

The isolating rectifier, of visual glow type, which gives an indication of full charge, makes it possible, in conjunction with the series inductance, to connect both condensers in series by the closing of a single switch. Practically the total output of the series condensers can thus be applied to a flash tube connected thru one electrode to the positive of one condenser, and at the other electrode to the negative of the second condenser. The sudden great increase of potential from this series connection readily fires the flash tube.

In the preferred form of my invention, a third condenser bank of relatively low voltage is charged in parallel with condensers one and two thru a suitable impedance and its terminal that connects to the series impedance also connects to a third electrode in my flash tube. Under these circuit conditions when the series condensers fire one section of the flash tube, conduction is initiated by discharge to the third

electrode, thus discharging the third condenser bank. This will take place even though the voltage of this third condenser is too low to provide a discharge, when its discharge path in the tube is normally excited by any other method at present exhibited by the art, when my new coupled ignition is employed.

Referring to the drawing, Fig. 1 is a schematic view of my novel circuit.

As shown in the drawing, 1 is a retifier charging a primary condenser 2 and energized by a source of power 3, which latter may be a transformer, a high-voltage battery, a voltage multiplier, or the like, all suitably energized. Condenser 2 feeds thru rectifier 10, for which I prefer a gas-filled cold cathode glass type tube, into condenser 4 returning thru resistor or impedance 5.

A third condenser 7 is fed thru resistance 8 from condenser 2. Flash tube 9 connects at 11 to positive terminal of condenser 4; its electrode 12 connects thru power output transformer 14 to the negative of condenser 2 and its electrode 13 to the positive terminal of condenser 7. A trigger tube 6 is shown with its anode connected to positive terminal of condenser 2, its cathode connected to negative terminal of condenser 4, and its grid thru resistor 15 to the negative of condenser 2 with a direct connection also to one pole of momentary switch 16 which has its remaining pole connected to resistor 17, the opposite end of which, in turn, connects to the anode of tube 6. Thus, I provide means to effect a variable bias.

With the circuit ready to operate, and condensers fully charged if switch 16 is closed, condensers 2 and 4 become series connected and tube section 11 to 12 of flash tube 9 discharges series condensers 2 and 4 as reconnected. The stress and the coupling effect of this discharge in the flash tube cause condenser 7 to discharge between 13 and 12, even though the voltage on condenser 7 is only half that of condensers 2 and 4 combined. Transformer 14, representing a power output connection, may have its secondary terminated by welding electrode 18 when so desired.

To control the firing of the circuit with very small amounts of input power, by means of trigger tube 6, is my preferred procedure. If desired, however, tube 6 and its controls may be replaced by a high capacity mechanical switch. The novel feature of changing condensers 2 and 4 from parallel to series connection, without using the usual multiple action and contact type of switch, would still be retained.

The tube 6 may also, if desired, be operated as a cold cathode switching tube, in which case good results have been had by allowing the grid to float during the hold-off period, which may be accomplished by simply disconnecting the resistor 15 from the negative terminal of condenser 2. All other connections may remain unchanged when using a conventional hot cathode gas triode as a cold cathode device. If a correctly designed cold cathode gas triode is used, no circuit change would be required.

The ability of my new parallel to series condenser feature to function properly will be readily understood when it is recalled that the time period of condenser discharge thru the flash tube is a matter of micro-seconds; whereas the time period of the condenser resistor combination 2—5 may readily be made a matter of seconds.

Since the present device is a pulse or power flash producer, it may be employed for a wide

variety of uses, such as the production of high intensity light pulses from flash tube 9, which may be had by shorting-out transformer 14, or when unshorted, transformer 14 may be used for flash welding. 19 indicates a switch to cut out the output transformer, when desired.

When used as a controlled flash welding device, it is possible with my present invention to obtain a wide range of power output characteristics, due to being able to provide with my device a combination of two different volt-ampere characteristics in my dual tube and circuit.

Thus I can provide for properly controlled welding, of flash illumination operations giving the exact combination of effects required for best results, either by the substitution of flash tubes of varied internal geometries in the circuit, or by a change in the various capacities whose values effect the two volt-ampere time characteristics of my dual tube.

I claim:

1. In combination in an electron discharge power device, primary, secondary, and tertiary condensers in parallel connection, a source of unidirectional current feeding said primary condenser, an isolating device in the input connection to said primary condenser, means comprising a visually glowing rectifier and a series resistor for charging said secondary condenser, and means for charging said tertiary condenser from said uni-directional current source comprising a series connected resistor, a dual flash tube containing three electrodes, one of the electrodes of said tube connected to the negative of said primary condenser, the second electrode connected to the positive of said secondary condenser, and the remaining tube electrode connected to the positive of said tertiary condenser, transformer output means connected in series with the common lead to said flash tube, and a switch means comprising a gas triode for connecting said primary and secondary condensers in series to initiate their discharge in said flash tube.

2. An electric flash discharge device comprising a power source, a primary condenser, a secondary condenser, an output transformer and an electron flash discharge tube containing a plurality of electrodes, means comprising a rectifier for charging said primary condenser, and means comprising a visually observable glow rectifier and a resistor for charging said secondary condenser from said primary condenser and said power source, a connection from the negative of said primary condenser to one electrode of said flash discharge tube and a connection from the positive of said secondary condenser to another electrode of said flash discharge tube, means comprising a switching device for momentarily connecting the positive of said primary condenser to the negative of said secondary condenser for causing said flash discharge tube to fire.

3. An electric flash discharge device comprising a power source, a primary condenser, a secondary condenser, and an electron flash discharge tube, means comprising a rectifier for charging said primary condenser and means comprising a visually observable glow rectifier and a resistor for charging said secondary condenser from said primary condenser and said power source, a connection from the negative of said primary condenser to one electrode of said flash discharge tube having a plurality of electrodes and a connection from the positive of said secondary condenser to another electrode of said flash discharge tube, means comprising a switch-

ing device for momentarily connecting the positive of the primary condenser to the negative of said secondary condenser for causing said flash tube to discharge both aforementioned condensers.

4. An electric flash discharge device comprising a power source, a primary and a secondary condenser, separate rectifiers for charging each condenser and a resistor in series with said secondary condenser, a flash discharge tube having a plurality of electrodes, a connection from one electrode of said tube to the negative of said primary condenser and a connection from another tube electrode to the positive of said secondary condenser, a controllable switching device for connecting the positive of said primary condenser to the negative of said secondary condenser for discharging both condensers thru said flash tube.

5. An electric flash discharge device comprising a power source, a primary and a secondary condenser, separate rectifiers for charging each condenser and a resistor in series with said secondary condenser, a flash discharge tube having a plurality of electrodes, a connection from one electrode of said tube to the negative of said primary condenser and a connection from another tube electrode to the positive of said secondary condenser, a controllable switching device, comprising a gas-filled triode, one electrode for controlling said triode being provided with a variable bias, the anode of said triode being connected to the positive of said primary condenser and the cathode of said triode being connected to the negative of said secondary condenser, and means to vary the bias of said triode to cause it to fire and to discharge said condenser thru said flash tube.

6. An electric flash discharge device comprising a power source, a primary and a secondary condenser and uniconductional means for charging each condenser separately, a discharge circuit comprising a flash discharge tube and an output transformer connected in series from the positive of one condenser to the negative of the other condenser, combined with a single-pole, single-throw

electrical switching means for connecting said two condensers in series to discharge them thru said flash tube and output transformer.

7. An electric flash discharge device comprising a multiple section electron discharge tube, circuit means comprising an electric power supply, static charge receivers, current-limiting means for charging said receivers in parallel combined with conducting elements including said multiple section electron discharge tube for selectively discharging at least two of said static receivers in series and the remaining charge receivers at their normal charge voltage.

8. An electric flash discharge device comprising static charge receivers, electrical supply means for charging said receivers in parallel, a multiple section flash tube, electrical-switching means for discharging at least two of said static receivers in series thru one section of said flash tube, whereby the remaining section, or sections, of said tube may discharge one or more of said remaining static receivers at a lower voltage than initially possible.

9. An electric flash discharge device comprising a power source, a multiple condenser bank arranged for parallel unidirectional charging, rectifiers for separately charging two halves of said condenser bank in parallel, controllable electric switching means, comprising a gaseous discharge triode, for discharging said banks in series, and a load including a two-element flash tube connected directly to the positive of one half of said bank, and the negative of the other half of said bank, said load having no intermediate electron tubes therein.

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