

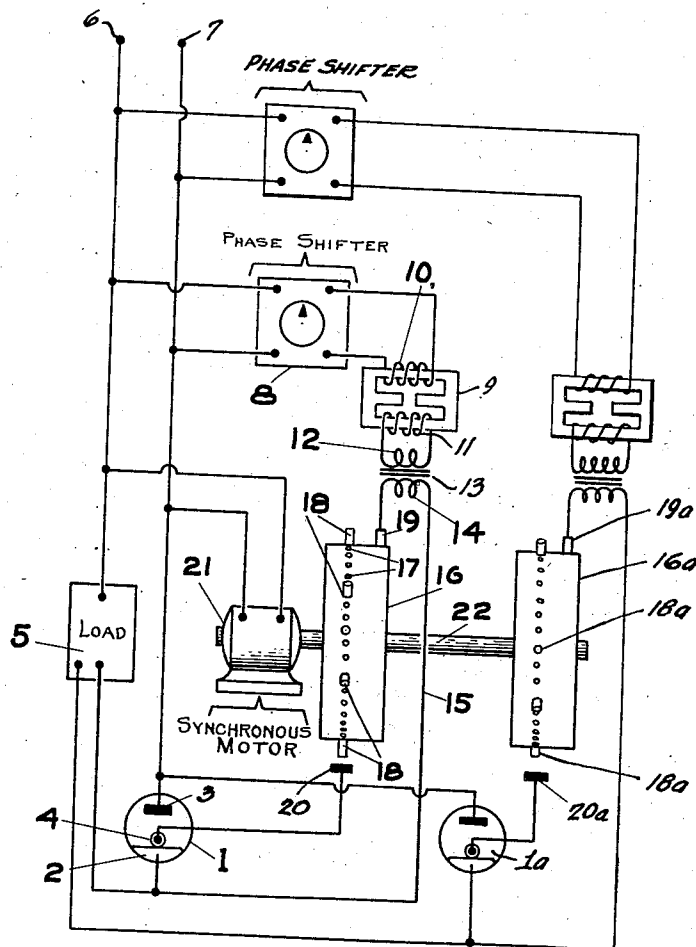
July 3, 1945.

P. L. SPENCER

2,379,462

IGNITION TUBE TIMING ARRANGEMENT

Filed July 30, 1941



INVENTOR
PERCY L. SPENCER,
BY Elmer J. Gorn
ATTY.

UNITED STATES PATENT OFFICE

2,379,462

IGNITION TUBE TIMING ARRANGEMENT

Percy L. Spencer, West Newton, Mass., assignor to
Raytheon Manufacturing Company, Newton,
Mass., a corporation of Delaware

Application July 30, 1941, Serial No. 404,647

12 Claims. (Cl. 250—27)

This invention relates to an arrangement for determining the time, duration and sequence of the conduction of one or more electrical space discharge tubes of the type in which conduction occurs upon an igniting impulse being supplied to said tube. The arrangement is particularly adapted for the control of electrostatically ignited tubes in which the igniting element consists of a conductor insulated and separated from a pool type cathode by a thin insulating layer, preferably as described and claimed in my copending application, Serial No. 303,963, filed November 13, 1939.

An object of this invention is to distribute regularly recurring igniting impulses to one or more tubes through a synchronously-rotating distributor in a simple reliable manner so as to control the time, duration and sequence of conduction of said tube or tubes.

Another object is to cause the igniting impulses to be delivered across a spark gap between a stationary electrode and one or more movable electrodes mounted on said synchronously-rotating distributor.

A further object is to provide for flexible and simple adjustment of the timing means.

The foregoing and other objects of my invention will be best understood from the following description of an exemplification thereof, reference being had to the accompanying drawing in which the single figure is a diagrammatic representation of a tube-igniting system incorporating my invention.

In the arrangement as shown, one or more ignition type tubes 1 are to be ignited by means of igniting impulses supplied thereto. The tube 1 is preferably of the electrostatically-ignited type, as described and claimed more fully in my copending application, Serial No. 303,963. The tube has a pool type cathode 2, preferably of mercury, an anode 3, and an igniter 4. This igniter is the type consisting of a conductor insulated and separated from the pool by an insulating layer thereon in contact with the surface of the pool. Said anode and cathode are connected in series with a suitable load device 5, the current to which is to be controlled by the tube 1. The above series circuit is energized from a pair of terminals 6 and 7 which are adapted to be connected to a suitable source of alternating current.

In order to derive a series of regularly recurring igniting impulses, a phase-shifting device 8, of any well-known type, is energized from the terminals 6—7 and supplies a peaking transformer 9. Said peaking transformer has a primary

winding 10 energized from the output of the phase-shifting device 8, and a secondary winding 11 which is connected to the primary winding 12 of an igniting transformer 13 having a secondary winding 14. The peaking transformer 9 causes a peaked impulse to be generated in the secondary winding 11 during each positive and negative half cycle of the alternating voltage supplied to said transformer. By adjusting the phase-shifting device 8, the phase relationship of these peaked impulses to the alternating voltage supplied to the terminals 6 and 7 may be regulated in any desired way. The igniting transformer 13 transforms peaked impulses supplied thereto to high voltage impulses of the order of 1000 volts or more which appear across the secondary winding 14.

One side of the secondary winding 14 is connected by means of a conductor 15 to the cathode 2 of the tube 1. Interposed in the connection from the other side of said secondary winding to the igniter 4 is a distributor 16. This distributor is preferably in the form of a circular rotatable drum having a series of regularly spaced holes 17 around the outer circumference thereof. These holes 17 are adapted to receive and retain detachable pins 18. The distributor 16 is made of conducting material, and is preferably insulated from the shaft 22 by which it is driven. A brush 19, which is connected to one side of the secondary winding 14, engages a bearing surface on the drum 16 so as to establish electrical connection thereto. An electrode 20 is supported in a stationary position opposite the ends of the pins 18 as they pass by said electrode. The spacing between the electrode 20 and the ends of the pins 18 is such that when each pin is substantially opposite the brush 19, the voltage supplied from the secondary winding 14 is sufficient to break down the gap and cause an igniting impulse to be delivered to the igniter 4. Of course the position of the electrode 20 may be adjusted to control the breakdown voltage between it and the pins 18.

The shaft 22 which carries the distributor 16 is driven from a suitable synchronous motor 21 which is energized from the alternating voltage appearing across the terminals 6—7.

When it is desired to ignite an additional tube 1a similar to 1 in predetermined sequence relationship with respect to said tube 1, an additional distributor 16a, being provided with pins 18a, brush 19a, and electrode 20a, may be provided on the same shaft 22. As a matter of fact, any number of such distributors and associated tubes may be provided in this system. Of course it is to

be understood that such additional tubes as 1a are all associated with the common load 5.

It is desirable that the distributor 16 be provided with a sufficient number of holes 17 so that one hole passes the electrode 20 during each half cycle of the alternating voltage of the system. If the frequency of the alternating voltage is sixty cycles per second and the synchronous motor 21 rotates at 180 R. P. M., by providing forty holes 17 on the distributor 16, the above desired relationship is secured. Thus, by selecting the holes 17 into which pins 18 are inserted, voltage impulses are supplied to the igniter 4 only during those half cycles so selected. In absence of a pin 18, the voltage of the secondary winding 14 is insufficient to cause breakdown between the distributor 16 and the electrode 20. The above arrangement affords a convenient and reliable means for also selecting any predetermined sequence of operation of the tube 1. For example, said tube may be caused to conduct current for a predetermined number of consecutive positive half cycles and be deenergized during another predetermined number of alternating current cycles. By relating the pins 18a to the pins 18, the other tube or tubes in the system may be caused to conduct current either at the same time as the tube 1 or in some other predetermined sequence. The phase-shifting device 8 enables the igniting impulse in the selected half cycles to occur at a predetermined phase relationship with respect to the alternating voltage supplied to the tube 1, and thus the tube 1 can be caused to conduct current through any predetermined portion of its normal conducting half cycle.

It will be seen that the above system is one which is very simple and reliable, and yet accomplishes the various objects for which it is intended.

Of course it is to be understood that this invention is not limited to the particular details as described above as many equivalents will suggest themselves to those skilled in the art. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of the invention within the art.

What is claimed is:

1. An electrical space discharge device of the ignition type having a cathode, an anode, and an igniting electrode, means for supplying an alternating voltage between said cathode and anode, an igniting circuit connecting said igniting electrode and said cathode, impulse means for producing regularly recurring igniting impulses substantially in synchronism with said alternating voltage, means independent of said impulse means to distribute said impulses to said igniting electrode only during selected half cycles of said alternating voltage comprising a pair of electrodes forming a normally non-conductive spark gap, means for impressing said igniting impulses between said pair of electrodes in series with the igniting electrode-cathode path, and means for causing said spark gap to become conductive under the influence of said igniting impulses only during said selected half cycles of said alternating voltage.

2. An electrical space discharge device of the ignition type having a cathode, an anode, and an igniting electrode, means for supplying an alternating voltage between said cathode and anode, an igniting circuit connecting said igniting electrode and said cathode, impulse means for producing regularly recurring igniting impulses bearing a predetermined phase relation to said alternating voltage, means independent of said impulse means

to distribute said impulses to said igniting electrode only during selected half cycles of said alternating voltage comprising a pair of electrodes forming a normally non-conductive spark gap, means for impressing said igniting impulses between said pair of electrodes in series with the igniting electrode-cathode path, and means for causing said spark gap to become conductive under the influence of said igniting impulses only during said selected half cycles of said alternating voltage.

3. An electrical space discharge device of the ignition type having a cathode, an anode, and an igniting electrode, means for supplying an alternating voltage between said cathode and anode, an igniting circuit connecting said igniting electrode and said cathode, impulse means for producing regularly recurring igniting impulses substantially in synchronism with said alternating voltage, means independent of said impulse means to distribute said impulses to said igniting electrode only during selected half cycles of said alternating voltage comprising a pair of electrodes forming a normally non-conductive spark gap, means for impressing said igniting impulses between said pair of electrodes in series with the igniting electrode-cathode path, means for causing said spark gap to become conductive under the influence of said igniting impulses only during said selected half cycles of said alternating voltage, and means for selecting at will the half cycles during which said igniting electrode is so supplied.

4. An electrical space discharge device of the ignition type having a cathode, an anode, and an igniting electrode, means for supplying an alternating voltage between said cathode and anode, an igniting circuit connecting said igniting electrode and said cathode, impulse means for producing regularly recurring igniting impulses substantially in synchronism with said alternating voltage, and means independent of said impulse means to distribute said impulses to said igniting electrode only during selected half cycles of said alternating voltage comprising a distributor, means for driving said distributor in synchronism with said alternating voltage, a spark gap electrode spaced from said distributor to normally prevent electrical breakdown of the intervening gap, said distributor being formed to cause breakdown of said gap under the influence of said igniting impulses only during said selected half cycles of said alternating voltage.

5. An electrical space discharge device of the ignition type having a cathode, an anode, and an igniting electrode, means for supplying an alternating voltage between said cathode and anode, an igniting circuit connecting said igniting electrode and said cathode, impulse means for producing regularly recurring igniting impulses substantially in synchronism with said alternating voltage, and means independent of said impulse means to distribute said impulses to said igniting electrode only during selected half cycles of said alternating voltage comprising a distributor, means for driving said distributor in synchronism with said alternating voltage, a spark gap electrode spaced from said distributor to normally prevent electrical breakdown of the intervening gap, and means mounted on said distributor to pass sufficiently close to said spark gap electrode to cause said impulses to break down said gap and supply igniting impulses to said igniting electrode without coming into physical contact with each other, said means being selectably detachable

from said distributor to select predetermined half cycles during which igniting impulses are so supplied to said igniting electrode.

6. An electrical space discharge device of the ignition type having a cathode, an anode, and an igniting electrode, means for supplying an alternating voltage between said cathode and anode, a phase-shifting device energized from said alternating voltage and furnishing regularly recurring igniting impulses, and means to distribute said impulses to said igniting electrode only during selected half cycles of said alternating voltage comprising a distributor, means for driving said distributor in synchronism with said alternating voltage, a spark gap electrode spaced from said distributor to normally prevent electrical breakdown of the intervening gap, said distributor being formed to cause breakdown of said gap under the influence of said igniting impulses only during said selected half cycles of said alternating voltage.

7. An electrical space discharge device of the ignition type having a cathode, an anode, and an igniting electrode, means for supplying an alternating voltage between said cathode and anode, a phase-shifting device energized from said alternating voltage and furnishing regularly recurring igniting impulses, and means to distribute said impulses to said igniting electrode only during selected half cycles of said alternating voltage comprising a distributor, means for driving said distributor in synchronism with said alternating voltage, a spark gap electrode spaced from said distributor to normally prevent electrical breakdown of the intervening gap, and means mounted on said distributor to pass sufficiently close to said spark gap electrode to cause said impulses to break down said gap and supply igniting impulses to said igniting electrode without coming into physical contact with each other, said means being selectably detachable from said distributor to select predetermined half cycles during which igniting impulses are so supplied to said igniting electrode.

8. A plurality of electrical space discharge devices of the ignition type, each having a cathode, an anode, and an igniting electrode, said discharge devices being related to a common load device, means for supplying an alternating voltage between said cathodes and anodes, means for producing regularly recurring igniting impulses substantially in synchronism with said alternating voltage, means to distribute said impulses to predetermined igniting electrodes only during selected half cycles of said alternating voltage, each comprising a pair of electrodes forming a normally nonconductive spark gap, means for impressing said igniting impulses between said pair of electrodes, and means for causing said spark gap to become conductive under the influence of said igniting impulses only during said selected half cycles of said alternating voltage, said distributing means being related to each other to cause said discharge devices to be ignited in predetermined sequence relationship.

9. A plurality of electrical space discharge devices of the ignition type, each having a cathode, an anode, and an igniting electrode, said discharge devices being related to a common load device, means for supplying an alternating voltage between said cathodes and anodes, means for producing regularly recurring igniting impulses sub-

stantially in synchronism with said alternating voltage, and means to distribute said impulses to predetermined igniting electrodes only during selected half cycles of said alternating voltage, each comprising a distributor, means for driving said distributor in synchronism with said alternating voltage, and a spark gap electrode spaced from said distributor to normally prevent electrical breakdown of the intervening gap, said distributor being formed to cause breakdown of said gap under the influence of said igniting impulses only during said selected half cycles of said alternating voltage, said distributing means being related to each other to cause said discharge devices to be ignited in predetermined sequence relationship.

10. An electrical space discharge device of the ignition type having a cathode, an anode, and an igniting electrode, means for supplying an alternating voltage between said cathode and anode, means for producing peaked voltage igniting impulses in predetermined phase relation to said alternating voltage, means to distribute said impulses to said igniting electrode only during selected half cycles of said alternating voltage comprising a pair of electrodes forming a normally non-conductive spark gap, means for impressing said igniting impulses between said pair of electrodes, and means for causing said spark gap to become conductive under the influence of said igniting impulses only during said selected half cycles of said alternating voltage.

11. An electrical space discharge device of the ignition type having a cathode, an anode and an igniting electrode, means for supplying a periodic voltage between said cathode and said anode, an ignition circuit connecting said ignition electrode and said cathode, impulse means for producing energy impulses for said igniting electrode substantially in synchronism with said periodic voltage, means independent of said impulse means to distribute said impulses to said igniting electrode only during selected periods of said periodic voltage comprising a pair of electrodes forming a normally non-conductive spark gap, means for impressing said igniting impulses between said pair of electrodes in series with the igniting electrode cathode path, and means for causing said spark gap to become conductive under the influence of said igniting impulses only during selected periods of said periodic voltage.

12. An electrical space discharge device of the ignition type having a cathode, an anode and an igniting electrode, means for supplying a periodic voltage between said cathode and said anode, an ignition circuit connecting said ignition electrode and said cathode, impulse means for producing energy impulses for said igniting electrode substantially in synchronism with said periodic voltage, means to vary the phase relation between said impulses and said alternating voltage, means independent of said impulse means to distribute said impulses to said igniting electrode only during selected periods of said periodic voltage comprising a pair of electrodes forming a normally non-conductive spark gap, means for impressing said igniting impulses between said pair of electrodes in series with the igniting electrode cathode path, and means for causing said spark gap to become conductive under the influence of said igniting impulses only during said selected half cycles of said periodic voltage.

PERCY L. SPENCER.