Jan. 15, 1963 C. E. BAKER ET AL 3,073,051

CONTROLLABLY ILLUMINATED DISPLAY DEVICE

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FIG. 1.

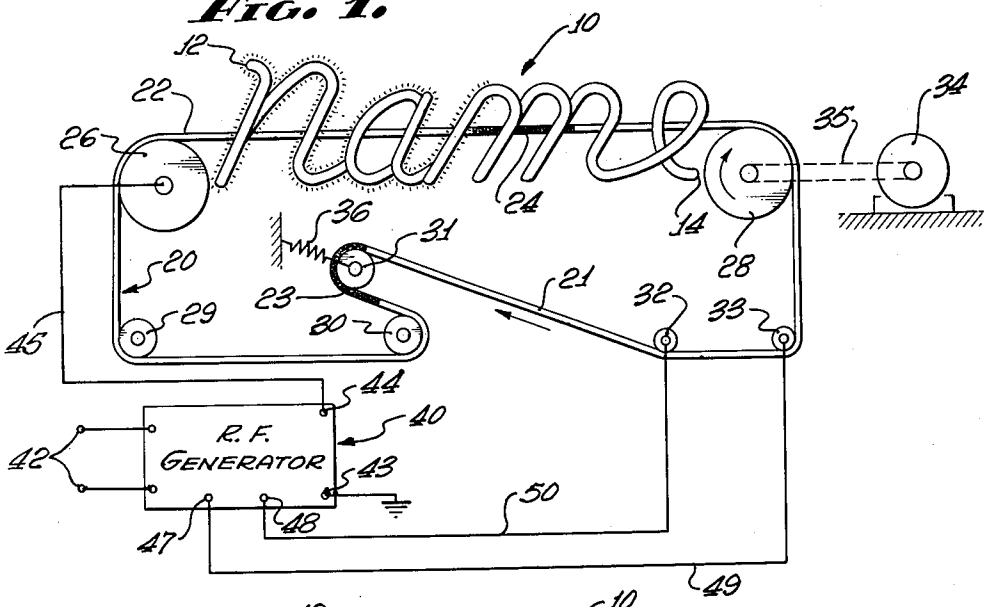


FIG. 2.

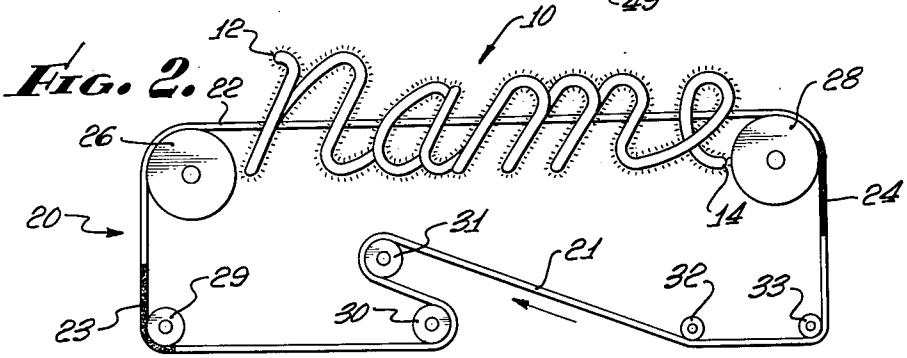
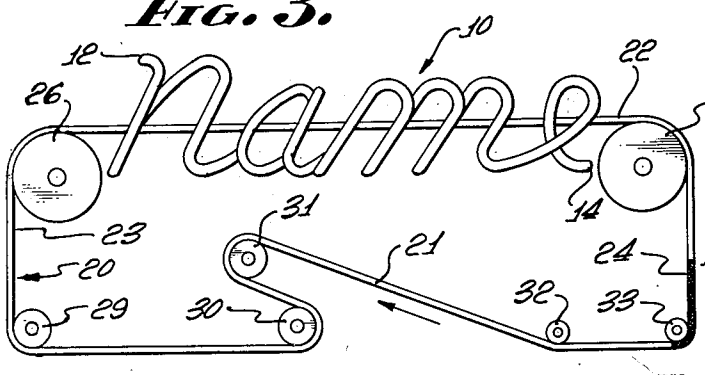


FIG. 3.



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FIG. 4.

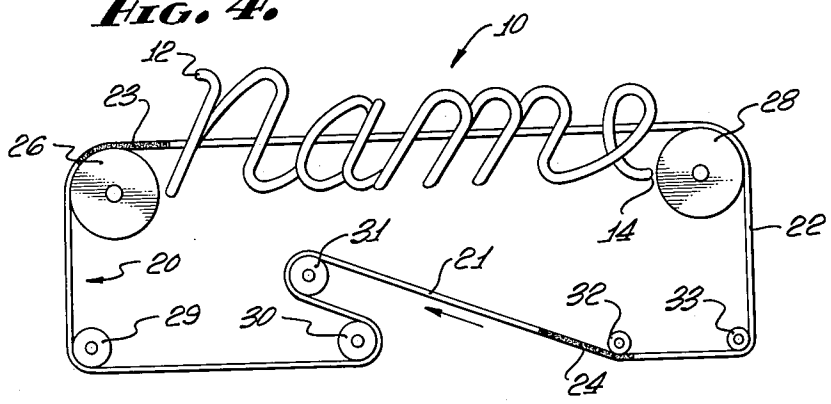


FIG. 5.

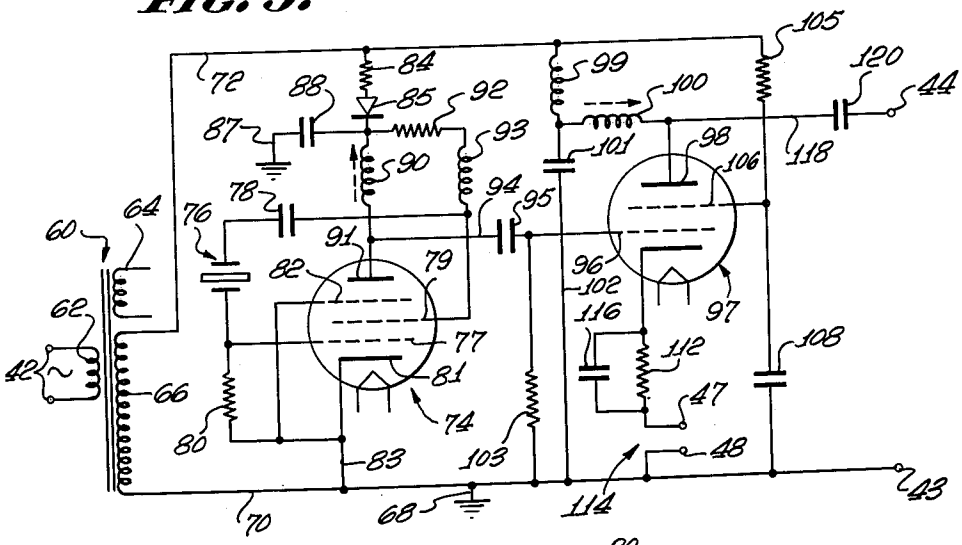
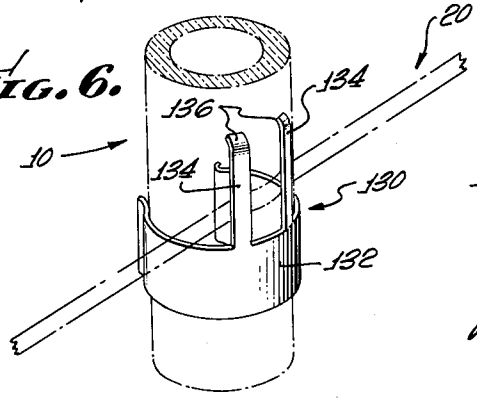


FIG. 6.



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CONTROLLABLY ILLUMINATED DISPLAY DEVICE

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10 Claims. (Cl. 40—130)

The present invention relates generally to electrically energized glow discharge tubing of the type sometimes referred to as "neon" tubes, and particularly to such a device including means for illuminating any desired continuous portion of the tubing.

In the form of the invention hereinafter described and illustrated in detail and constituting the preferred form of the invention, there is provided a conventional elongated glow discharge tubing formed into a desired configuration for advertising or similar purposes. Such tubing is normally provided with energizing electrodes at its ends which are connected in known manner to a suitable source of electric power. The electrodes themselves are not used in accordance with the present invention, but their presence is not objectionable. This fact permits the present invention to be readily adapted for use with existing glow discharge tubing signs, since the end electrodes are immaterial for purposes of the present invention.

The invention contemplates the use of a moving electrode charged with electrical power at radio frequency, the electrode being adapted to move generally longitudinally of the discharge tubing forming the sign. Desirably the electrode is in the form of a flexible electrical wire conductor arranged in an endless loop, the leading end of the charged conductor being moved along a predetermined path by suitable means such as a non-conductive flexible member forming a portion of the endless loop. The glow discharge tubing adjacent the energized electrode is caused to be illuminated by a transfer of radio frequency power from the electrode, and when the electrode is moved in a proper direction along a sign including a plurality of letters forming a word or similar configuration, the impression given to the viewer is that the sign is being written. It is not necessary that the moving electrode travel in a straight line, as suitable guide means may be used to cause it to follow any tortuous path desired. Depending upon the voltage at which the radio frequency power is radiated by the traveling electrode, portions of the glow discharge tube at some distance from the electrode may be illuminated by the power radiated by the electrode. For example, in the case of a sign wherein the maximum height of the individual component portions of the sign is of the order of 6 inches, a single electrode spaced substantially midway of the height of the letters constituting the sign will satisfactorily illuminate the entire height of tubing in the sign when the voltage on the electrode is in the range of approximately 500 to 1000 volts.

A particularly effective use of the present invention is in causing the letters or other portions of the design of a sign to be sequentially illuminated, then maintain the entire sign in illuminated condition for a predetermined period of time and then extinguish the entire sign. This cycle is then repeated. Apparatus and circuitry are provided in accordance with the present invention for accomplishing this including an oscillator and amplifier for generating the necessary radio frequency energizing current, means including pulleys or sheaves for forming a guiding pathway for the travel of the movable electrode and appropriate switching means for energizing and de-energizing the moving electrode to accomplish the stated purpose. As above mentioned, the moving electrode is

desirably in the form of an endless loop, and in the present illustrative embodiment of the invention such a loop includes a pair of conductive electrodes separated by a pair of non-conductive portions. The travel of the loop is so arranged that the high voltage radio frequency portion of the circuit is neither made nor broken while that portion of the circuit is carrying current. Instead, in order to extinguish the sign by removing the high voltage energizing current from the movable electrode, a low voltage portion of the amplifier circuit is interrupted by switch means actuated to make or break condition by the movement of the endless loop including the conductive and non-conductive portions above mentioned.

Accordingly, it is a principal object of the present invention to disclose a novel electrically illuminated sign.

Other objects and purposes of the invention are to disclose an electrically illuminated device including elongated glow discharge tubing and means for sequentially illuminating selected portions of such tubing to disclose a device of the character referred to including an oscillator and amplifier for generating radio frequency power for application to a moving electrode; to provide such a structure wherein an electrically energizable electrode is in the form of a flexible conductive portion of an endless loop including non-conductive portions; to provide a device of the character described including switch means in a low voltage portion of the oscillator-amplifier part of the circuit whereby to sequentially illuminate and extinguish the electrically energized device without making or breaking the high voltage part of the circuit while energized; and for other and additional objects and purposes which will be understood from a study of the following description of a preferred embodiment thereof taken in connection with the accompanying drawings in which:

FIG. 1 is a representation of a sign embodying the present invention including a schematically indicated showing of the major electrical features thereof; the sign is shown as illuminated throughout approximately one-half its length.

FIG. 2 is a representation of the device of FIG. 1 shown a few seconds later when the entire length of the sign is illuminated by reason of the movement of the looped energizing conductor.

FIG. 3 is a representation of the device of FIGS. 1 and 2 showing the parts in their position at the instant of electrically breaking the low voltage circuit, a second or two following the condition as seen in FIG. 2.

FIG. 4 is a representation of the device of FIGS. 1, 2 and 3 showing the condition of the parts a few seconds after that of FIG. 3, with the low voltage switch just about to be closed.

FIG. 5 is a schematic wiring diagram of a typical radio frequency generator which may advantageously be used in the practice of the present invention.

FIG. 6 is a fragmentary view on an enlarged scale of one form of guide element which may be used to establish a pathway for the loped conductor along the sign.

Referring now to the drawings and first to FIG. 1 thereof, there is indicated generally at **10** an illuminable sign or device, here exemplarily shown as including the written word "Name" although it will be understood that any configuration of letters, numerals or designs, may be used in the practice of the present invention. The sign **10** is made of elongated tubing containing a suitable gaseous medium therein, such tubes being identified as glow discharge tubes, frequently known generally as "neon" tubes. In the conventional use of such tubes for illumination, there is provided an electrode at either end of the tube, as at **12** and **14**, the electrodes being adapted to be connected to a source of suitable radio frequency power to energize the tube in known manner. Such elec-

trodes, however, are not needed in the practice of the present invention although their presence in the ends of the tube does not interfere in any way with the energization of the tube in accordance with the present invention.

Means are provided for illuminating a selected portion of the length of the glow discharge tube **10**. Desirably such means are adapted for repetitive or cyclic operation and are here shown as including an endless loop indicated generally at **20**, the loop including first and second conductive portions **21** and **22** separated from one another by non-conductive or insulating portions **23** and **24**. The path of endless loop **20** is determined by a number of guide members in the form of sheaves or pulleys. In the present illustration the guide elements include sheaves **26** and **28** as well as auxiliary guide members **29**, **30**, **31**, and **32** and **33**. Sheaves **26** and **28** are so located as to cause the portion of the loop between them to lie close to and preferably immediately adjacent the traversed parts of the tubing.

Means are provided for moving the loop **20** around the pathway established by the guide members above referred to, such movement taking place in a generally clockwise direction as seen in FIG. 1 so that the loop moves to the right between the sheaves **26** and **28**. In the present illustration, the means for thus moving the endless loop include a motor **34** suitably connected to the sheave **28** by a rotatable shaft **35** and adapted to rotate sheave **28** clockwise as indicated by the arrow thereon.

It is normally desirable that loop **20** be maintained under a certain degree of tension for proper operation and for this purpose one of the guide pulleys, as **31**, may be tensioned by suitable means such as are schematically illustrated at **36**.

Means are provided in accordance with the present invention for sequentially energizing the conductive portions **21** and **22** of the loop **20** with radio frequency electrical energy, and for interrupting such supply of energy to the conductive portions at predetermined points in the cycle. In the present form of the invention there is provided a generator for radio frequency energy indicated generally at **40**, a preferred form of which will be described in detail hereinafter. The generator is supplied with electrical power from a suitable source **42**, and the output terminals **43** and **44** are connected to ground and to sheave **26** respectively. Thus radio frequency power is conducted through the lead **45** connected to output terminal **44** to the sheave **26**, which is made of electrically conductive material such as metal, so that the radio frequency power thus fed to sheave **26** is in turn fed to whichever of the conductive portions **21** or **22** of the loop **20** may be in contact with the sheave **26** at any given instant. Means are provided in the radio frequency generator **40** to interrupt the radio frequency output thereof, and such means, to be described in detail hereinafter in a preferred embodiment thereof, include a switch having two contact points connected to terminals **47** and **48**, these terminals being connected through leads **49** and **50** to contact guide elements **33** and **32** respectively. These contact guide elements are in electrically conductive contact with the endless loop **20**, and it will be seen that whenever one of the conductive portions **21** or **22** of the loop is in position to extend between contact elements **32** and **33**, the switch in this circuit is in effect closed. Under these conditions, the radio frequency generator **40** produces a radio frequency output in conductor **45** to sheave **26** as previously mentioned. When, however, one of the contact guide elements **32** or **33** is in contact with one of the insulating or non-conductive portions **23** or **24** of the looped tape **20**, then the circuit consisting of conductors **49** and **50** is electrically open. As a result, the supply of radio frequency energy to conductor **45** and to sheave **26** is interrupted. Thus, in the situation of FIG. 1, with a portion of the conductive segment **21** extending between elements **32** and **33**, the circuit is closed so that radio frequency power is supplied to sheave **26** and thus to the conductive segment **22** of the loop **20**. Hence, the parts of sign **10** lying adjacent the conductive portion **22** are illuminated by the electrical energy radiated from the conductive portion **22**. The rightward extent of the illuminated portion of the sign **10** as seen in FIG. 1 is determined by the juncture of the insulating or non-conductive segment **24** with conductive portion **22**.

FIGS. 2, 3 and 4 show the device of FIG. 1 at successively later points in the cycle. Thus, several seconds after the position seen in FIG. 1, FIG. 2 shows that the non-conductive segment **24** has proceeded to the right side of the device and has at least partially rounded the driving sheave **28**. Under these conditions, since the rear portion of conductive segment **22** is still in electrical contact with the sheave **26**, the entire length of sign **10** is illuminated by a radiated transfer of energy from the conductive segment **22** to the sign.

FIG. 3 shows the parts as they appear a moment after that shown in FIG. 2. Thus in FIG. 3 the leading portion of the non-conductive segment **24** has reached the guide contact element **33**, thereby breaking the circuit between conductors **49** and **50** and thus removing the radio frequency power from the conductor **45** and extinguishing the sign **10**. It is to be particularly noted that the conductive segment **22** is still in contact with the sheave **26** at this moment, so that the flow of the radio frequency energy at a relatively high voltage from sheave **26** to conductor **22** is not broken. Instead, the low voltage circuit of conductors **49** and **50** is broken as indicated in FIG. 3, thereby interrupting the flow of radio frequency power to the conductor **45** and sheave **26**. Accordingly, a moment after the condition seen in FIG. 3, when segment **22** moves out of contact with sheave **26**, there is no radio frequency high voltage current flowing.

In FIG. 4 the parts are seen one or two seconds after the condition of FIG. 3, the sign **10** still not being illuminated. It will be seen that the conductive segment **22** is completely out of contact with the sheave **26**, while the other conductive segment **21** has made contact with the sheave **26**. However, no radio frequency power is flowing in conductor **45** yet because the circuit between conductors **49** and **50** has not yet been made, since the rear portion of non-conductive segment **24** is still in contact with the guide contact element **32**. It will be readily understood that a very short movement of the loop after the position shown in FIG. 4 will permit the making of the low voltage circuit contact between guide contact elements **32** and **33**, thereby energizing the radio frequency generator and permitting radio frequency energy to be fed through conductor **45** to sheave **26** and thus to the conductive segment **21** in contact with the sheave, so that the entire cycle can be repeated.

A typical circuit for the radio frequency generator in accordance with the present invention is shown in FIG. 5, although it will be readily understood that many different arrangements of circuit elements might be resorted to in order to generate the desired radio frequency power for energizing the sign **10**. Such power is desirably supplied to the conductive elements of the endless loop in accordance with the present invention at a voltage in the range of approximately 500 to 1000 volts. A transformer indicated generally at **60** includes a primary winding **62** having terminals **42** adapted to be connected to a source of alternating current power, typically 115 volts. The transformer includes a secondary winding **64** for supply of low voltage power for the heater filaments of the several thermionic tubes employed in the present circuit, and a main secondary winding **66**, one end being grounded at **68** through a conductor **70** and the other end being connected to lead **72**. An oscillator tube indicated generally at **74** is here shown as a pentode adapted to oscillate at a frequency determined by the crystal **76** connected at one side to grid **77** and at its other side through capacitor **78** to grid **79** of the tube **74**. Control grid **77** is connected through resistor **80** to the cathode **81**, and the cathode, to-

gether with the grid 82, is connected through lead 83 to the grounded conductor 70. High voltage appearing in the conductor 72 is fed through a resistor 84 and a rectifying element 85 to terminal 86 which is grounded at 87 through capacitor 88. Terminal 86 is connected through a tunable inductor 90 to the anode 91 of tube 74. Terminal 86 is connected through resistor 92 and inductor 93 to grid 79.

The output of oscillator tube 74 is fed from the plate 91 to conductor 94 and coupled through capacitor 95 to the control grid 96 of an amplifier tube indicated generally at 97. The plate 98 of this tube is energized by the voltage existing in conductor 72 fed to the plate through an inductor 99 and a tunable inductor 100, the junction between the two said inductors being connected through capacitor 101 and conductor 102 to the grounded conductor 70. Control grid 96 is similarly grounded through resistor 103 to the conductor 70. The high voltage existing in conductor 72 is fed through resistor 105 to the grid 106, such grid being grounded through capacitor 108 to the grounded conductor 70. The cathode 110 of tube 97 is connected through resistor 112 and switch 114 to the grounded conductor 70, there being provided also a capacitor 116 around the resistor 112. The output of the amplifier tube 97 is fed from the plate or anode 98 through conductor 118 and capacitor 120 to a terminal 44, the grounded conductor 70 being connected to the output terminal 43, thus corresponding to the two output terminals indicated in FIG. 1. Switch 114 in the cathode circuit of the output amplifier tube 97 includes contact points or terminals 47 and 48 which are adapted to be connected through leads 49 and 50 to the guide contact elements 33 and 32 respectively of the apparatus as seen in FIG. 1. It will be readily seen that the breaking of the circuit between the points 47 and 48 thus prevents the tube 97 from conducting and thereby interrupts the radio frequency output of that tube appearing at terminal 44.

It will be readily understood that the circuit illustratively shown in FIG. 5 is capable of many variations and modifications within the contemplation of the present invention and any equivalent circuit for generating and supplying a radio frequency output voltage in the range of approximately 500 to 1000 volts is suitable for use in the invention, particularly if such circuitry provides a low voltage point which can be interrupted by suitable switch means to establish or stop the generation of the radio frequency output. The frequency employed may be 13.56 megacycles or other radio frequency permitted by governmental regulations for the present purpose.

The material of the loop 20 may be in the form of either a wire or a tape; in any event it is desirable that the conductor segment 21 or 22 which is actually radiating radio frequency energy to the tubing be maintained close to the tubing, preferably in sliding contact therewith, for most efficient transfer of power to the tubing. This will normally be easily accomplished, depending upon the geometry of the installation, by correctly locating sheaves 26 and 28 so that the segment of loop 20 between them is drawn into the desired contact with the tubing. It is possible under certain conditions that separate means may be desirable to insure such contact and an exemplary form of means for accomplishing this is indicated generally at 130 in FIG. 6. The retaining member 130 includes a skirt portion 132 made of resilient material adapted to partially encircle and thus releasably grasp tubing 10, and one or more fingers 134 are attached to the skirt and project therefrom generally axially of the tubing. The fingers are spaced slightly from the outer wall of the tubing to permit tape or wire 20 to pass beneath the fingers and freely move transversely of the axis of tubing 10; the outermost ends 136 of the fingers may be bent inwardly as shown in order to maintain this spacing.

Accordingly there is provided in the present invention a device for making an illuminable sign of the glow discharge tube variety appear to be writing the words of the sign or, in the case of signs having a design of an artistic nature, such components may be traced out by the principles of the present invention in illuminating the sign.

Modifications and changes from the specific forms of the component parts of the structure as hereinabove illustrated and described will occur to those skilled in the art and all such modifications and changes are intended to be embraced within the scope of the appended claims.

We claim:

1. An illuminable display device comprising: an elongated glow discharge tube arranged in predetermined configuration; an endless flexible loop including electrically conductive segments and electrically non-conductive segments arranged in alternating relation; guide means forming a path for said loop including a plurality of guide members, two of said members being so disposed as to cause the loop portion therebetween to extend adjacent and generally longitudinally of the tube configuration; a source of relatively high voltage radio frequency power including a relatively low voltage circuit, opening of which interrupts the high voltage power; means connecting the high voltage output of said source to one of said two guide members, said one member being electrically conductive; means for causing the loop to move around said path such that the loop travels from said one guide member toward the tube configuration; and means cooperating with a pair of said guide members for opening and closing said low voltage circuit during the period when a given conductive segment is in contact with said one guide member.

2. The invention as stated in claim 1 wherein said pair of guide members include a pair of electrical contact elements contactable by a portion of one of said conductive segments.

3. The invention as stated in claim 2 wherein said segment contacted by the pair of contact elements cannot be contacted by said one guide member.

4. The invention as stated in claim 1 including means carried by said tube for retaining the adjacent loop portion in sliding contact with the tube.

5. In an illuminable display device: an elongated glow discharge tube arranged in predetermined configuration; a flexible endless loop having alternate electrically conductive and non-conductive segments; means guiding a part of said loop from power transfer relation with one portion of said tube to power transfer relation with another portion thereof including electrical contact means ahead of said one portion and means for continuously driving said loop; a high frequency power source connected to said contact means; and means actuated by the arrival thereat of the leading end of one of said segments for de-energizing said source.

6. The invention as stated in claim 5 wherein said one segment is non-conductive and said power source includes a low voltage circuit which is electrically opened by the arrival at said last named means of said non-conductive segment.

7. An illuminable display device comprising: an elongated glow discharge tube arranged in predetermined configuration; an elongated electrical conductor; electrically non-conductive means for moving the leading end of said conductor from adjacent a first portion of said tube to adjacent a second portion of the tube; means for maintaining the conductor in energy-transfer relation with increasing portions of the tube during said movement; a relatively high voltage high frequency power generator for supplying power to said conductor during said movement including a relatively low voltage circuit controlling generation of said power; and means actuated by said electrically non-conductive means in timed relation with said movement for opening said low voltage circuit and thereby de-energizing the generator.

8. The invention as stated in claim 7 wherein said last named means is actuated at a predetermined time interval after arrival of the leading end at said second portion.

9. The invention as stated in claim 7 wherein said mov-

ing means includes an electrically non-conductive element attached to said conductor and said low voltage circuit includes a pair of spaced electrical members electrically closed by a conductor during said movement, opening of said members being caused by arrival of said non-conductive element at one of said members.

10. An illuminable display device comprising: an elongated glow discharge tube arranged in predetermined configuration; an elongated electrical conductor; electrically non-conductive means for moving the leading end of said conductor from adjacent a first portion of said tube to adjacent a second portion of the tube; means for maintaining the conductor in energy-transfer relation with increasing portions of the tube during said movement; a

high frequency power source for supplying power to said conductor during said movement; and means actuated by said electrically non-conductive means at a predetermined time interval after arrival of the leading end at said second portion for de-energizing said high frequency power source.

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