# United States Patent [19]

**Houck**

[11] **3,833,761**

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[54] **FLUORESCENT LAMP SYSTEM FOR FACSIMILE**


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[52] **U.S. Cl.** ..... **178/7.1,** 315/97

[51] **Int. Cl.** ..... **H04n 1/24**

[58] **Field of Search** ..... 178/7.1; 315/97, DIG. 2, 315/DIG. 5, DIG. 7



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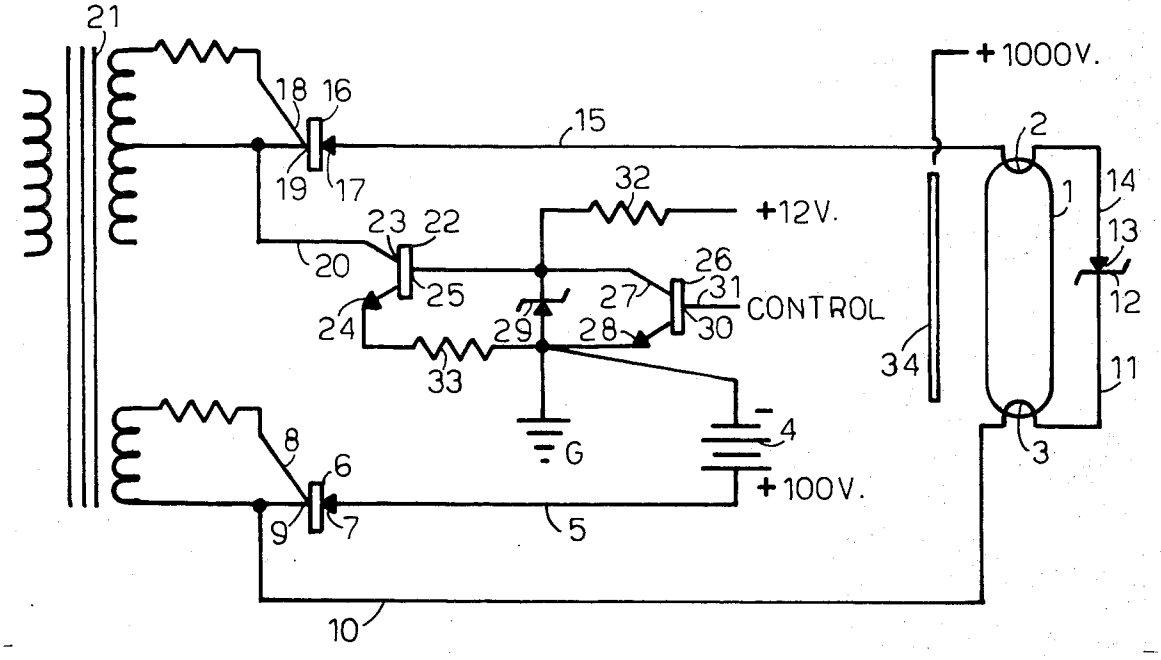
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[57] **ABSTRACT**

A fluorescent lamp for facsimile copy scanning is provided with regulated constant current for constant illumination; all solid state starter circuitry; and automatic current direction reversal once for each scanning line to prevent uneven darkening due to prolonged DC passing through the lamp in one direction.


**5 Claims, 2 Drawing Figures**



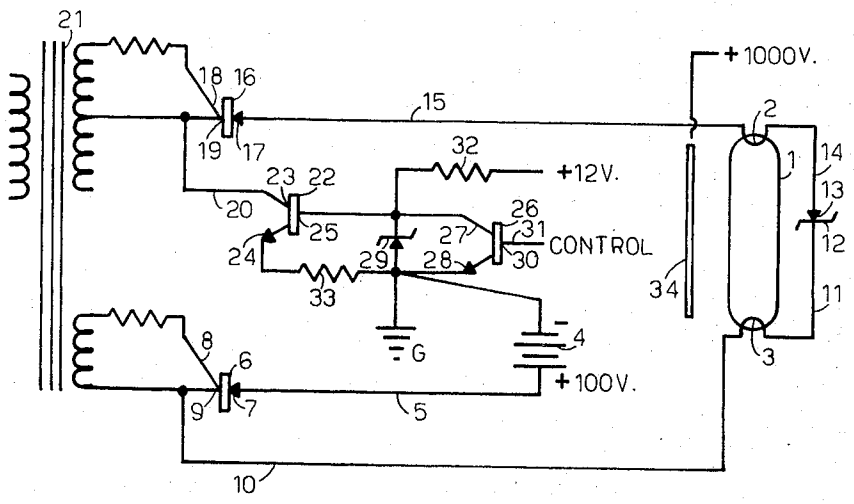



FIG. 1

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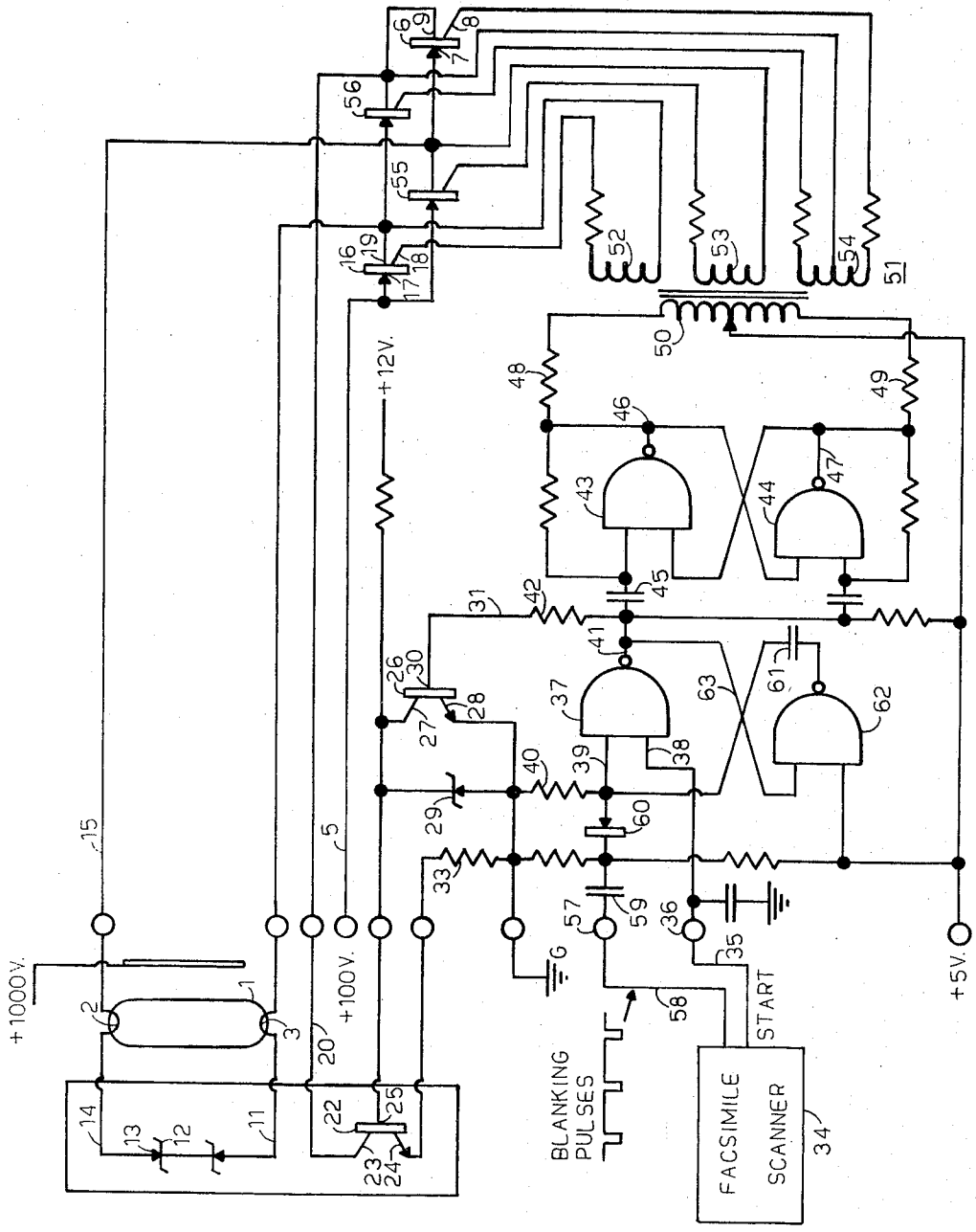



FIG. 2

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# FLUORESCENT LAMP SYSTEM FOR FACSIMILE

Facsimile scanners which scan copy to be transmitted a line at a time require a long linear light source of very even illumination along the length of the line and very constant illumination with time. The linear fluorescent lamp is a convenient source of such illumination. However, a number of problems have arisen with these lamps and their operation. For one thing operating on direct current over a long period of time the lamps blacken more at one end than at the other. This has been partially corrected by reversing the direction of current flow from time to time. This, on the other hand, permits the lamp to extinguish momentarily during the process of reversing causing a black line to appear in the facsimile copy. Starting the lamps has also been a problem since ordinarily a fluorescent lamp fires sporadically on starting making the usually desired instant starting problematical. Again, attempts to provide a very constant illumination by regulating the voltage across the lamp have not been completely successful.

## SUMMARY

In accordance with the present invention starting of the fluorescent lamp is provided by an all solid state circuit eliminating the usual ballast transformer. The lamp is operated on constant current providing an improved uniform illumination over long periods of time. Furthermore, the polarity of the direct current feeding the lamp is automatically reversed at each scanning line during the blanking pulse interval so that not only is uneven blackening of the lamp prevented but no lines are produced in the copy. The lamp current is regulated by a power transistor in a constant current circuit. The direction of current flow through the lamp is determined by which pair of two oppositely connected pair of silicon controlled rectifiers is conducting. At each scanning line the blanking pulse of the facsimile signal triggers the constant current transistor off thereby dropping the SCR current to zero allowing the previously conducting pair to go off and the current reversal to pick up in the second pair.

## IN THE DRAWING

FIG. 1 is a schematic circuit diagram of a portion of the present invention and is used to help explain its operation.

FIG. 2 is a schematic circuit diagram of the complete system of the present invention.

FIG. 1 is a schematic circuit diagram of a portion of the complete system (see FIG. 2) to clearly show the basic circuit for energizing the fluorescent lamp with constant current and how it is turned on and off. Lamp **1** includes filaments **2** and **3** at opposite ends of the lamp cylinder. Lamp current is supplied from a suitable 100 volt direct current source represented by battery **4** connected with negative to ground G and positive on lead **5.** This positive potential is applied over lead **5** to anode **7** of silicon controlled rectifier **6** and assuming it is conducting, the current flows out of cathode **9** and over lead **10** to one side of lamp filament **3.** SCR **6** also has a gate **8** for turn-on purposes as will be described in connection with FIG. **2.** Continuing, current leaves filament **3** over lead **11** to cathode **12** of zener diode **12–13** and through this zener diode leaves anode **13** over lead **14** to one side of filament **2.** From the other side of filament **2,** the current passes over lead **15** to anode **17** of the second SCR **16.** Assuming SCR **16** is conducting, the current leaves cathode **19** and flows over lead **20** to collector **23** of power transistor **22** and with transistor **22** in a conducting state, leaves by emitter **24** and flows through resistor **25** back to the negative end of battery **4** at ground G. Pulse transformer **21** is part of the circuit for turning on SCRs **6** and **16** and its function will be fully described in connection with FIG. **2.**



The circuit outlined in the above paragraph provides a constant current to lamp **1.** With a regulated voltage drop across zener diode **29** supplied through resistor **32** from a source of positive 12 volts, base **25** to which the cathode of zener diode **29** is connected is maintained at the zener regulating voltage, say 4.7 volts, with respect to ground G. With this connection emitter **24** must assume the base voltage minus the base to emitter drop, say 0.7 volt, or 4.0 volts and the current through transistor **22** must therefore be the emitter voltage divided by the resistance of the emitter series resistor **33** say **24** ohms or 166 milliamperes. Thus, since current regulating transistor **22** is in series with lamp **1,** the current through lamp **1** is kept constant.

In actual operation, control transistor **26** is initially on or conducting as by applying a logic **1** (positive bias) to base **30** over lead **31.** With transistor **26** conducting, collector **27** is in saturation and the collector **27** to emitter **28** circuit is a substantial short circuit, shorting the voltage across zener diode **29** and hence the voltage from base **25** to ground G to a low value. With a very low bias on base **25,** transistor **22** becomes substantially non-conducting and the lamp current is reduced to a very low value or substantially zero. In other words, the lamp **1** is turned off. To turn lamp **1** on, control lead **31** is switched to logic 0 (ground) and transistor **26** with no bias opens allowing full zener voltage across zener diode **29** and between base **25** and ground G. This turns on transistor **22** which now supplies a regulated current (166 ma) to the lamp filaments **2** and **3** as described above. When filaments **2** and **3** become heated the presence of the high voltage (1,000 volts) on wire **34** close to the lamp causes the lamp to ionize or "fire." In the ionized state the voltage across the lamp between filaments **2** and **3** drops to a low value, well below the regulating voltage of zener diode **12–13** (for example 68 volts) and all of the constant regulated current flows through the lamp. The lamp is now operating at constant current and will supply a very constant illumination over a long period of time.

FIG. **2,** the complete circuit diagram of the preferred form of the present invention, incorporates the portion shown in FIG. **1** and described above. The numbers correspond for corresponding circuit components and similar functions. Facsimile scanner **34** supplies two signals in any suitable manner and well known in the art. One is a starting signal which is logic 0 for lamp off and logic 1 for lamp on conditions. The second signal comprises blanking pulses generally provided between lines of facsimile copy and comprising logic 1 going to logic 0 at the end of each scanning line. Initially, before turning on lamp **1,** logic 0 is applied to terminal **36** over line **35** placing logic 0 on input **38** of NAND gate **37.** Input **39** is also logic 0 since it is connected to ground G through resistor **40.** With both inputs at logic 0, NAND gate **37** provides logic 1 at output terminal **41.** As described above this logic 1 applied to base **30** of

transistor **26** through resistor **42** and over lead **31**, causes transistor **26** to conduct shorting zener diode **29** and the input to current regulating transistor **22** so that little or no current is supplied to lamp **1** and it is in an off condition. When lamp **1** is to be turned on, a logic 1 is applied to terminal **36** over lead **35** and to input **38** of NAND gate **37**. This causes NAND gate **37** to change state and the resulting pulse applied through capacitor **45** causes the flip-flop made up of cross-connected NAND gates **43** and **44** to change condition. Since outputs **46** and **47** are coupled to primary **50** of pulse transformer **51** through resistors **48** and **49** respectively, the flipping of the flip-flop induces a pulse in primary **50** which in turn induces pulses in secondary windings **52, 53** and **54**. These secondaries being coupled to the gates of SCRs **6, 16, 55** and **56** causes one pair to fire. Assuming for purposes of this description that SCRs **6** and **16** fire, the on condition for lamp **1** is provided as described above in conjunction with FIG. **1**. The logic 0 now provided at output **41** of NAND gate **37** places logic 0 on base **30** turning transistor **26** off and allowing the zener **26** to receive a voltage and to turn on current control transistor **22**. Now, the complete condition described above in connection with FIG. **1** has been established and lamp **1** is turned on.

Now, between each scan line there is a blanking pulse, logic 0 applied to terminal **57** over lead **58** and through capacitor **59** and diode **60** to input terminal **39** of NAND gate **37**. This causes NAND gate **37** at output **41** to go momentarily to logic 1, transistor **26** to turn on (shorting zener diode **29**) and transistor **22** to turn off. The lamp goes out and without conduction current SCRs **6** and **16** turn off. Now, NAND gates **37** and **62** are cross-coupled by lead **63** and capacitor **61** to form a one-shot which in turn limits the duration of the logic 1 at output **41** to approximately **50** microseconds. At the end of the 50 microsecond interval NAND gate **37** returns to output logic 0 state turning off transistor **26** and turning on transistor **22** restoring the constant lamp current. This return of output **41** to zero causes flip-flop **43–44** to again reverse its state triggering SCRs **55** and **56** which in turn conduct current through lamp **1** in the opposite direction. The lamp immediately turns on since over the very short off time, sufficient ions remain to cause it to strike again. This action continues, reversing the direction of the lamp current flow in response to each blanking pulse, until the end of the transmission and thereby providing precisely equal lamp current in each direction and preventing unequal blackening of the lamp envelope.

At the end of the transmission an off signal (logic 0) is again applied over lead **35** to terminal **36**, output **41** goes to logic 1, transistor **26** conducts and transistor **22** goes off, and lamp **1** goes out.

I claim:

**1.** In a facsimile scanning system including line by line copy scanning means and means for providing blanking pulses for each scanned line, the combination of;

a fluorescent lamp for illuminating facsimile copy to be scanned;

a source of constant current connected in series with said lamp and four silicon controlled rectifiers in turn connected to provide current reversing switching to said lamp;

and means responsive to the line frequency blanking pulses of said facsimile system for actuating said switching means and thereby reversing the direction of current flow through said lamp for each scanning line of said facsimile copy.

**2.** In a facsimile scanning system the combination of;

a fluorescent lamp including two filaments for illuminating facsimile copy to be scanned;

means for supplying constant current to said lamp through said filaments;

and means for starting said lamp including two back-to-back zener diodes connected in shunt with said lamp for conducting said constant current through said filaments prior to firing of said lamp and a source of static high voltage in proximity to the main body of said lamp.

**3.** A facsimile scanning lamp system as set forth in claim **1**, and including;

means for holding said constant current at a value substantially below a normal operating current prior to starting.

**4.** A facsimile scanning lamp system as set forth in claim **1**;

wherein said switching is fast enough to reverse the current through said lamp before deionization can take place.

**5.** A facsimile scanning lamp system as set forth in claim **2**;

wherein the zener voltage of said zener diodes is substantially greater than the voltage drop across said lamp while conducting.

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