United States Patent

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[54] **HIGH-FREQUENCY LAMP CIRCUIT FOR COPYING APPARATUS**
6 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **315/105,** 315/101, 315/206, 315/224, 315/260, 315/279, 315/DIG. 7, 328/33

[51] **Int. Cl.** **H05b 41/29,** H05b 41/391

[50] **Field of Search** 315/97, 98, 100, 101, 105, 174, 194, 200, 205, 206, 209, 219, 224, 246, 260, 279, 287; 331/109; 328/13, 28, 31–33; 307/261, 264; 323/1, 2, 4

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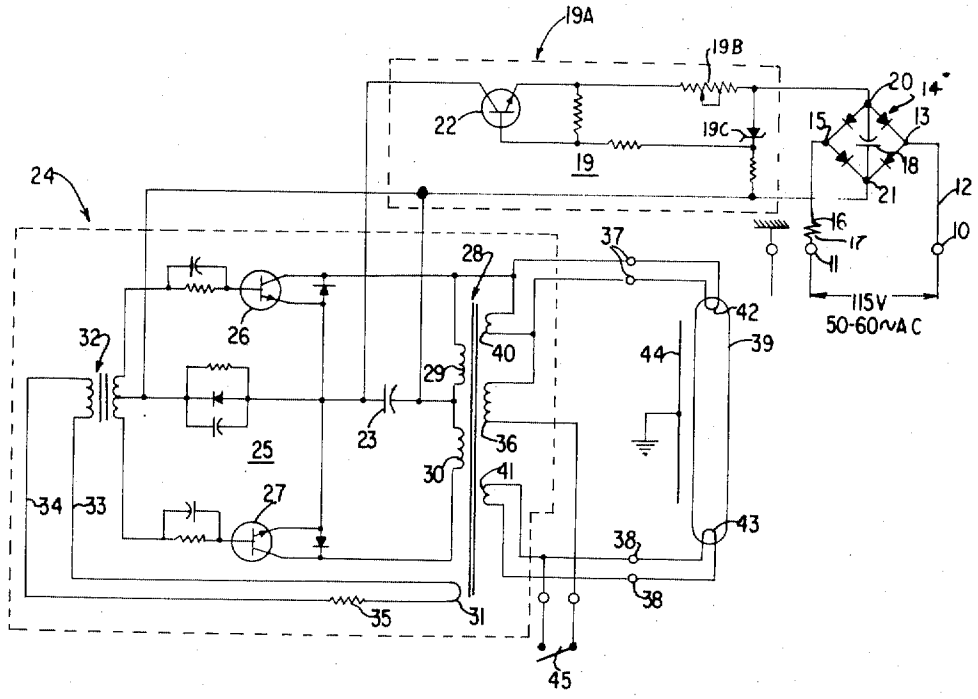
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ABSTRACT: A high-frequency power supply for the light source of a xerographic-type copying machine in which power from a normal 50-60-cycle AC input is rectified and regulated to provide a constant current or constant voltage DC input to a high-frequency oscillator-inverter providing output power at a frequency in the order of 20,000 c.p.s. or above to a light source comprising one or more gaseous-type lamps. In a modified circuit the DC input to the inverter is regulated by a solid-state chopper controlled by a magnetic amplifier pulsed by a free-running multivibrator and modulated by the input current.



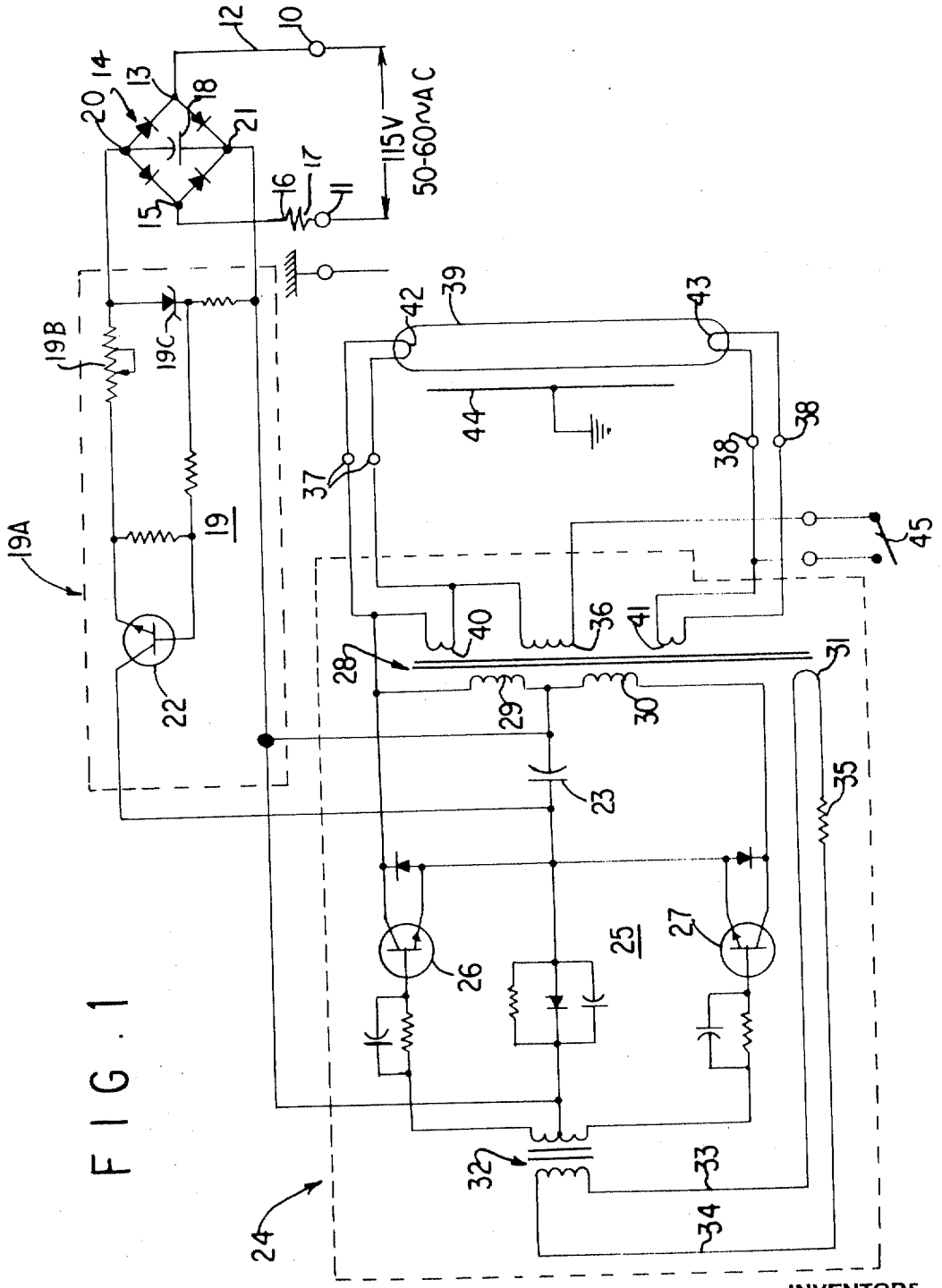


FIG. 1

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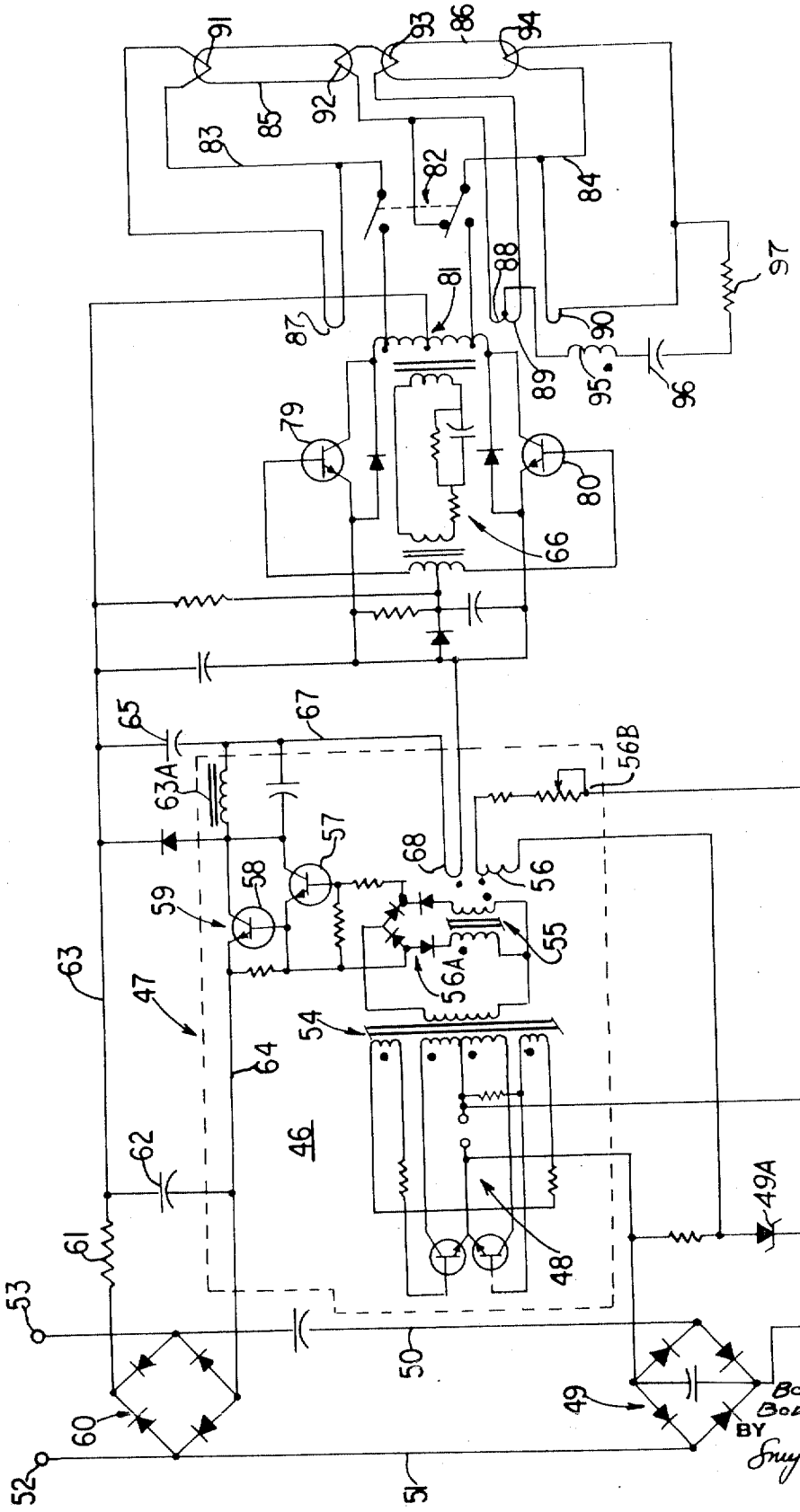


FIG. 2

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HIGH-FREQUENCY LAMP CIRCUIT FOR COPYING APPARATUS

This invention relates to copying apparatus and more particularly to a supply source for the lamps of such apparatus, especially of the xerographic or similar type.

Reproduction machines of the xerographic type are well known, one such being a machine sold under the trademark Xerox, a trademark of the Xerox Corp. One of the disadvantages of the prior art machines, however, has been the flicker induced in the copies by the frequency of the supply source for the lamp. Such machines, furthermore, frequently provide an undesirable audible hum, and require fairly expensive components in the ballast circuit for the light source.

One of the objects of the present invention is to provide an improved circuit for supplying power to the lamps of copying apparatus, especially of the xerographic type.

A further object is the provision of an improved power supply for operating the lamps of reproduction machines at a high frequency so as to eliminate flicker in the reproduced copies.

A further object is to provide a power supply for operating the lamps of reproducing apparatus at a frequency above the audible range, for example, in the order of 20,000 c.p.s. or higher.

A further object is to provide a power supply for copying apparatus which eliminates hum or other audible noises and effects economy in design and operation by utilizing less expensive and more efficient components.

A further object is the provision of a power source for the gaseous-type lamps of copying machines in which a low-loss solid-state regulator replaces the usual high-loss ballast choke as a current limiter for the negative resistance characteristic of the lamps.

A still further object is to provide a power source which delivers square wave pulses of constant magnitude to the lamps of copying apparatus thereby to maintain a constant level of light output during the entire time that the lamps are on.

In one aspect of the invention, power from a normal 50–60-cycle AC power line or the like is fed to a filtered rectifying bridge providing a filtered DC input to a constant current or constant voltage regulator. The output of the regulator is fed to an oscillator-inverter producing a square wave output at a frequency above audible frequency. The output of the inverter is fed to one or more lamps of the fluorescent or gaseous-discharge-type thereby to produce a constant, flicker-free light output for the light source of a copying apparatus such as the xerographic type.

In a second aspect, the regulator for feeding constant current DC to the inverter comprises a solid-state chopper controlled by a magnetic amplifier pulsed by a free-running multivibrator and modulated by output current feedback.

The above and other objects, advantages and features of the invention will be apparent from the following description taken in conjunction with the accompanying drawings which illustrate exemplary embodiments of the invention.

In the drawings:

FIG. 1 is a schematic wiring diagram illustrating one form of the invention; and

FIG. 2 is a schematic wiring diagram illustrating a modified form of the invention.

Referring to the drawings and more particularly to FIG. 1, there are shown input terminals **10** and **11** adapted for connection to any suitable source of 115-volt, 50–60-cycle AC power. The terminal **10** is connected by line **12** to the input terminal **13** of a rectifying bridge **14**. The terminal **15** of the bridge is connected through line **16** to the input terminal **11**. A resistance **17** and a capacitor **18** provide for filtering the output of the bridge **14**. A constant current regulator **19** indicated generally by the dashed lines **19A** is connected to the output terminals **20** and **21** of the bridge **14**. Variable resistance **19B** can be used to adjust output current. Zener diode or reference means **19C** is used to provide a feedback signal to provide a closed loop operation to series-regulating transistor **22**. The regulator **19** may be of any desired type but as shown in FIG. 1 comprises temperature-compensated series transistor **22**.

The output of the regulator **19** is fed to the capacitor **23** of an oscillator inverter **25** indicated generally by the dashed lines **24**. The inverter **25** may be of any desired type but, as shown in FIG. **1**, includes transistors **26** and **27**, an output transformer **28** having primary windings **29** and **30** and feedback winding **31**, and a feedback transformer **32** connected by the lines **33** and **34** and a resistance **35** to the winding **31**. The inverter **25** is designed to operate at a high frequency in the order of 20,000 c.p.s. or more and provides a square wave output of constant current amplitude. This output is fed by the secondary **36** of transformer **28** to the terminals **37** and **38** of a fluorescent gaseous lamp **39** comprising the light source of any well-known copying machine. Windings **40** and **41** on the transformer **28** energize the filaments **42** and **43** of the lamp **39**, and a small step-up voltage through the secondary **36** of transformer **28** in conjunction with a grounded plate **44** provides for quick starting of the lamp **39** as a result of the high-frequency input to the lamp. The constant current, square wave output of the converter **25** effects constant light output from the lamp **39** during the entire time that the lamp is on. A switch **45** shown in open or standby position operated in any well-known manner provides for connecting the lamp **39** to the inverter **25**.

Referring now to FIG. **2** of the drawings, there is shown a more efficient constant current regulator **46** indicated generally by the dashed lines **47**. As shown, this regulator comprises a free-running multivibrator **48** of a well-known type fed by a filtered rectifying bridge **49** connected by lines **50** and **51** to the terminals **52** and **53** to a suitable source of AC power. Reference means **49A** is similar to reference means **19C** of FIG. **1**. An output transformer **54** of the multivibrator **48** magnetically couples the multivibrator to a magnetic amplifier **55** to provide square wave pulses of a frequency in the order of 2,000 c.p.s., for example, to the magamp **55** biased by a winding **56** or a frequency to avoid beat frequencies. The output of the magamp **55** is fed through a rectifying bridge **56** to the transistors **57** and **58** of a chopper **59**. A variable resistor **56B** is provided similar to **19B** of FIG. **1**. The chopper **59** is connected in series with the output lines **63** and **64** of a rectifying bridge **60** connected to the AC input terminals **52** and **53** and filtered by the resistance **61** and capacitor **62**. The output of chopper **59** is filtered by an inductance **63A** and capacitor **65** and is fed to the oscillator-inverter **66** by means of a line **67** and a feedback winding **68** on the magnetic amplifier **55** which modulates the pulse width delivered to the transistor **58**, thereby to provide a constant current to inverter **66**.

The inverter **66** is of a well-known type and includes the transistors **79** and **80** and an output transformer **81**. The transformer **81** is connected through a switch **82** shown in open or standby position, and lines **83** and **84** to a pair of fluorescent lamps **85** and **86**. Windings **87**, **88**, **89** and **90** on the transformer **81** energize the filaments **91**, **92**, **93** and **94** of the lamps **85** and **86**. A winding **95** on the transformer **81**, connected in series with a capacitor **96** and resistance **97**, provides a starting voltage for the lamps **85** and **86**. As in FIG. **1**, the transformer **81** provides a square wave, constant current input to the lamps **85** and **86**.

While certain embodiments of the invention have been shown and described, changes and modifications may be made as defined within the scope of the appended claims.

What is claimed is:

1. In a circuit for supplying power to at least one gaseous discharge lamp means for energizing copying machines or the like apparatus, the combination including input means for connection with a source of AC having normal power line frequency, rectifying means for converting said AC into DC to provide a DC output, filtering means connected with said rectifying means, series regulator means in said DC output operating in a closed loop having a DC reference means providing a feedback, so that in the standby mode of the lamp

means, power supply filament voltage at open circuit lamp-starting voltage is provided and said voltages are automatically decreased to operating voltages for said gaseous discharge lamp means when switched from standby to operating mode, inverter means connected to said series regulator means and operating above audible frequency and including an output transformer connected to said inverter means, said inverter means providing a substantially square wave to said gaseous discharge lamp means, and connecting means from said output transformer to said gaseous discharge lamp means.

2. A circuit as claimed in claim 1 including means wherein said reference means includes manually adjustable means to adjust the luminous intensity of the gaseous discharge lamp means.

3. A circuit as claimed in claim 1 including a magnetic-amplifier-driven chopper in said series regulator, said magnetic amplifier having an isolated feedback and bias current circuit means providing the regulation function.

4. A circuit as claimed in claim 3 wherein said series regulator includes a solid-state chopper and means for controlling the pulse width operation of said chopper.

5. A combination as defined in claim 4 in which said means for controlling said chopper includes a multivibrator magnetically coupled to said magnetic amplifier, and a feedback winding on said magnetic amplifier connected in series with the output from said chopper.

6. A combination as defined in claim 5 wherein said multivibrator operates at a different frequency from the inverter to avoid beat frequency oscillations.

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