

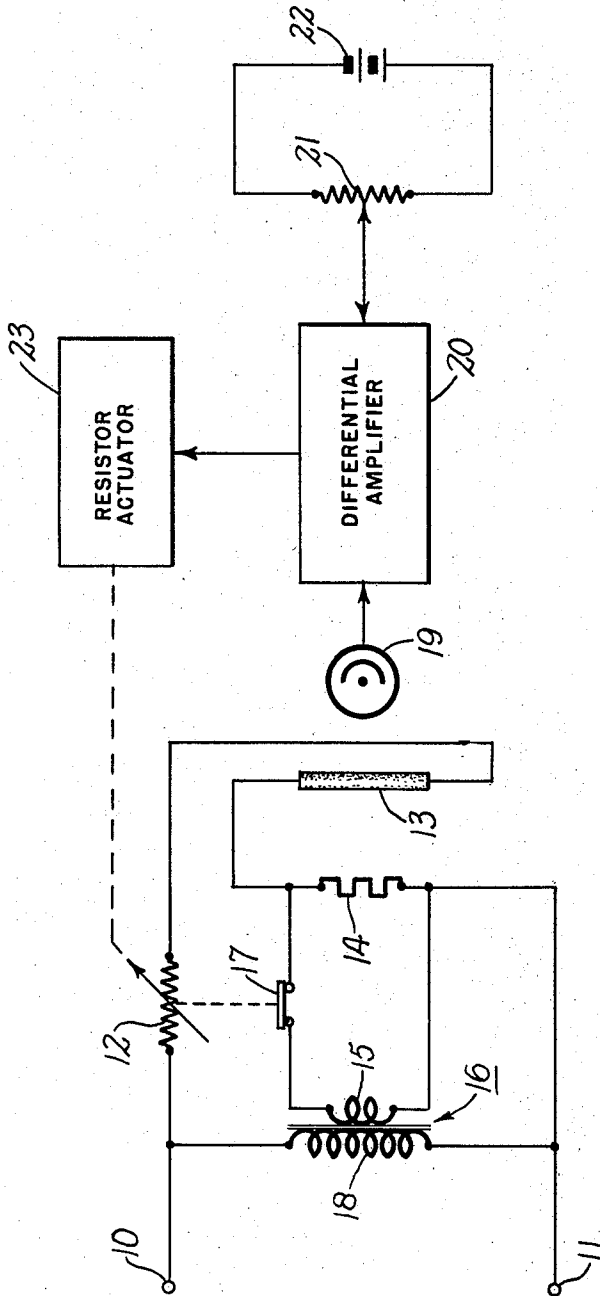
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RADIATION SOURCE AND MEANS FOR STARTING

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RADIATION SOURCE AND MEANS FOR
STARTING

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This invention relates to sources of radiant energy for use in such instruments as spectrometers, gas analyzers, etc., and is concerned more particularly with a novel device for producing radiation, which includes a glower of the Nernst type and means for bringing the glower rapidly to operating condition.

At the present time, infrared spectrometers require a source of radiant energy which is especially strong in the range from two to fifteen microns and up, and one source of such radiation, which is in common use, is the silicon carbide rod sold commercially under the trade name "Globar." While such a rod is satisfactory in most respects, it must frequently be of such size as to require water cooling and the provision of such cooling means is sometimes inconvenient. A second source of infrared radiation in general use is the Nernst glower, which is a body composed of rare earth oxides and can be operated without cooling means at temperatures higher than may be reached with rod sources. However, the glower has a negative temperature coefficient of resistance and it is essentially non-conductive at room temperature with its resistance decreasing as its temperature is raised. Because of this characteristic, a glower requires for its functioning an external source of heat to raise its temperature and thereby lower its resistance, until it becomes conductive and is in operating condition. The heating of the glower to place it in condition for use requires time, particularly if the construction of the instrument is such that heat can be applied at one side only of the glower, and the loss of instrument time resulting from the requirement that the glower be externally heated before use is an objection to the glower.

The present invention is directed to the provision of a novel device for producing radiation, which contains a glower but requires less time than prior glower sources for bringing the glower to operating condition. The new device includes a main source of voltage, a heater so placed as to heat the glower, and a subsidiary source of voltage, which can be impressed upon the heater. The main and subsidiary sources of voltage can be connected in series aiding and the sum of the voltages can be impressed upon the glower, so that the glower will become conductive at a lower temperature and a shorter heating time will be required to bring the glower to that temperature. After the glower has become conductive, the magnitude of the subsidiary source of voltage is automatically reduced and the subsidiary source remains in this condition, until used again in starting the glower.

For a better understanding of the invention, reference may be made to the accompanying drawing, the single figure of which is a circuit diagram of the new device.

The form of the device illustrated in the drawing comprises terminals 10, 11, to which an A. C. line voltage may be applied. The terminal 10 is connected through a variable resistor 12 to a Nernst glower 13, which is a typical body made up of earth oxides. The glower is in turn connected through a heater 14 to the terminal 11 and the heater is so positioned as to heat the glower,

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when the heater is functioning. The subsidiary source of voltage is the secondary winding 15 of a transformer 16 and the heater is connected across the winding terminals and the connections include means for reducing the magnitude of the subsidiary voltage. Any suitable expedient may be employed for the purpose, as, for example, the connections may include an adjustable resistor, which can be adjusted to increase its resistance and effect a corresponding reduction in the subsidiary voltage applied to the heater, or the connections may include a switch, which can be opened to cause the subsidiary voltage impressed on the heater to be reduced to zero. The means for reducing the subsidiary voltage is automatically operated and, in the circuit illustrated, the reducing means is the switch 17, which is mechanically connected to the adjusting element of the variable resistor 12 and is opened through that mechanical connection as soon as the element is moved to increase the resistance of resistor 12 above a selected value. The primary winding 18 of the transformer is energized from any suitable source and, in the instrument shown, is connected across the terminals 10 and 11.

A detector responsive to radiation and illustrated as a phototube 19 is disposed adjacent the glower in position to receive radiation therefrom and the output of the detector is fed into a conventional differential amplifier 20, where it is compared with a reference voltage derived from any suitable source, such as a potentiometer 21 receiving current from a source 22. Any excess of the output of the detector over the reference voltage is amplified and fed to an actuator 23 operating the movable element of resistor 12. The combination of the variable resistor and its actuator may take various forms, and the resistor may be of the carbon pile type and actuated by a solenoid. Another suitable actuator is that shown in Cohen Patent 2,550,779, issued May 11, 1951.

In the operation of the device illustrated, A. C. line voltage applied to the terminals 10 and 11 appears across the primary winding 18 of transformer 16 and the closing of switch 17 causes the voltage developed across the secondary winding 15 of the transformer to operate heater 14. With a line voltage of 117 volts, for example, the secondary voltage may be 20 volts. The heater and the transformer secondary winding are so connected to the glower that the line voltage and the voltage developed across the secondary winding of the transformer are in series aiding relation with the result that the voltage across the glower when it is virtually non-conductive is the sum of the two voltages and, in the example given, is equal to 137 volts. Since a voltage greater than line voltage is impressed upon the glower in its non-conductive state, it becomes self-conductive at a lower temperature than would be required if line voltage only were impressed upon it.

When the temperature of the glower has been increased sufficiently to permit it to pass enough current to raise its temperature further with an accompanying lowering of its resistance, the glower emits radiation, which falls upon the detector 19. So long as the output of the detector is below the reference voltage, the secondary winding of the transformer is connected to heater 14 and the sum of the line and the transformer secondary voltages is impressed upon the glower. As soon as the phototube output exceeds the reference voltage, the amplified difference in voltages, or error signal, causes the resistor actuator to operate the resistor 12 to increase its resistance from its minimum value. The movement of the adjustable element of the resistor then opens switch 17, so that thereafter the body and heater have line voltage only impressed thereon. Under these conditions very little voltage drop is developed across the heater because it has much less impedance value than the glower. Conse-

quently, nearly all the line voltage is impressed upon the glower. During the operation of the device, the phototube acts through the means described to regulate resistor 12 and keep the output of radiation from the glower 13 within selected limits.

It will be apparent to those skilled in the art that the amount of radiation which will actuate the device to remove the subsidiary voltage from the heater and the glower, is determined by the adjustment of the variable reference signal. The setting of the variable tap on potentiometer 21 therefore may be used to effectively control the amount of emitted radiation from glower 13 which will render the heater substantially inoperative and simultaneously reduce the voltage across the glower 13.

In the infrared spectroscopy art it is most desirable to be able to control and adjust this operative point from outside the instrument without risking any interference with the radiation source itself. The present invention embodies this most desirable feature in addition to the novel arrangement by which several of the components of the combination perform dual and simultaneous functions.

I claim:

1. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, a subsidiary source of voltage, means for impressing said subsidiary voltage across said heater and in series aiding relation to said main voltage, and radiation-sensitive means for controlling the flow of current through said body including means for disconnecting said subsidiary voltage in response to a determinable amplitude of radiation by said body.

2. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, a subsidiary source of voltage, means for impressing said subsidiary voltage across said heater and in series aiding relation to said main voltage, and adjustable current controlling means responsive to the radiation of said body for regulating the flow of current therethrough, including means for disconnecting said subsidiary voltage after a determinable radiation output of said body.

3. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, a subsidiary source of voltage, means for impressing said subsidiary voltage across said heater and in series aiding relation to said main voltage, and adjustable current controlling means responsive to the radiation of said body for regulating the flow of current therethrough, including means for disconnecting said subsidiary voltage after a determinable amplitude of said current flow.

4. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, means for deriving a sub-

sidary voltage from said main source of voltage, means for impressing said subsidiary voltage across said heater and in series aiding relation to said main voltage, and radiation-sensitive means for controlling the flow of current through said body including means for disconnecting said subsidiary voltage in response to a determinable amplitude of radiation by said body.

5. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, a subsidiary source of voltage, means for impressing said subsidiary voltage across said heater and in series aiding relation to said main voltage, and means responsive to the radiation of said body for producing a signal as a function of the intensity thereof, a source of reference signal, means connected to receive said radiation intensity signal and said reference signal for producing an output signal as a function of the difference therebetween, and means responsive to a determinable output signal for disconnecting said subsidiary voltage.

6. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, a subsidiary source of voltage, means for impressing said subsidiary voltage across said heater and in series aiding relation to said main voltage, and means responsive to the radiation of said body for producing a signal as a function of the intensity thereof, a source of reference signal, means connected to receive said radiation intensity signal and said reference signal for producing an output signal as a function of the difference therebetween, and means for continuously regulating the current flow through said body in accordance with the amplitude of said difference signal, including means for disconnecting said subsidiary voltage in response to a determinable amplitude of said difference signal.

7. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, a transformer having its primary winding connected across said main source of voltage and its secondary winding connected to said heater for impressing a subsidiary voltage thereacross in series aiding relation with said main voltage, radiation-sensitive means for controlling the flow of current through said body including means for disconnecting said subsidiary voltage in response to a determinable amplitude of radiation by said body.

8. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, a transformer having its primary winding connected across said main source of voltage and its secondary winding connected to said heater for impressing a subsidiary voltage thereacross in series aiding relation with said main voltage, radiation-sensitive means for controlling the flow of current through

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said body including means for disconnecting the secondary winding of said transformer from said heater in response to a determinable amplitude of radiation by said body.

9. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, a subsidiary source of voltage, means for impressing said subsidiary voltage across said heater and in series aiding relation to said main voltage, and means responsive to the radiation of said body for producing a signal as a function of the intensity thereof, a source of reference signal, means connected to receive said radiation intensity signal and said reference signal for producing an output signal as a function of the difference therebetween, variable impedance means connected in circuit with said body and said main voltage source, means to continuously vary the effective value of said impedance in accordance with the amplitude of said difference signal, said last-named means including means for disconnecting said subsidiary voltage from said heater in response to a determinable amplitude of said difference signal.

10. A device for producing radiation in accordance with claim 1 wherein the means for disconnecting said subsidiary voltage comprises a relay-operated switch.

11. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body and positioned to raise the temperature of said body, a subsidiary source of voltage derived from said main source of voltage, means for impressing said

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subsidiary voltage across the heater and in series aiding relation with said main voltage, whereby an increased amplitude of voltage is impressed upon said body when it is substantially non-conductive and said body is simultaneously heated to a conductive condition.

12. In a device for producing radiation, the combination of a body of material capable of emitting radiation in response to the flow of electrical current therethrough and having a negative temperature coefficient of resistance, a main source of voltage connected in circuit with said body, a heater serially connected between said main source of voltage and said body and positioned to raise the temperature of said body, a subsidiary source of voltage, means for impressing said subsidiary voltage across said heater and in series aiding relation to said main voltage, and means responsive to the radiation of said body for producing a signal as a function of the intensity thereof, an adjustable reference signal, means connected to receive said radiation intensity signal and said reference signal for producing an output signal as a function of the difference therebetween, variable impedance means connected in circuit with said body and said main voltage source, means to continuously vary the effective value of said impedance in accordance with the amplitude of said difference signal, said last-named means including means for disconnecting said subsidiary voltage from said difference signal dependent upon the adjustment of said reference signal.

References Cited in the file of this patent

UNITED STATES PATENTS

1,121,979	Collins	Dec. 22, 1914
1,837,179	Benner et al.	Dec. 15, 1931
2,231,723	Jung et al.	Feb. 11, 1941
2,291,007	Titcomb	July 28, 1942
2,339,635	Hall	Jan. 18, 1944
2,551,319	Eiklid	May 1, 1951