United States Patent [19]

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[54] **LIGHT SOURCE APPARATUS FOR ENDOSCOPE**

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[51] **Int. Cl.** **H05b 37/00**

[58] **Field of Search** ..... 315/151, 160, 241 P, 241 R

[56] **References Cited**

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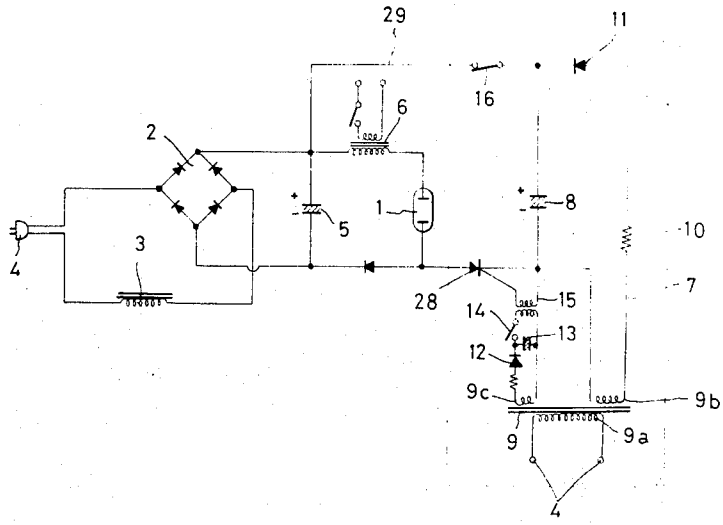
[57] **ABSTRACT**

To adapt a light source of an endoscope for naked eye viewing or for still photography, the source is controlled for continuous or flash lighting. Continuous lighting is provided by connecting an arc lamp to a direct current source. Flash lighting is provided by discharging a capacitor through the lamp under the control of a silicon rectifier in turn controlled by the synchro-switch of a camera. The rectifier can be manually or automatically cut off.

6 Claims, 2 Drawing Figures



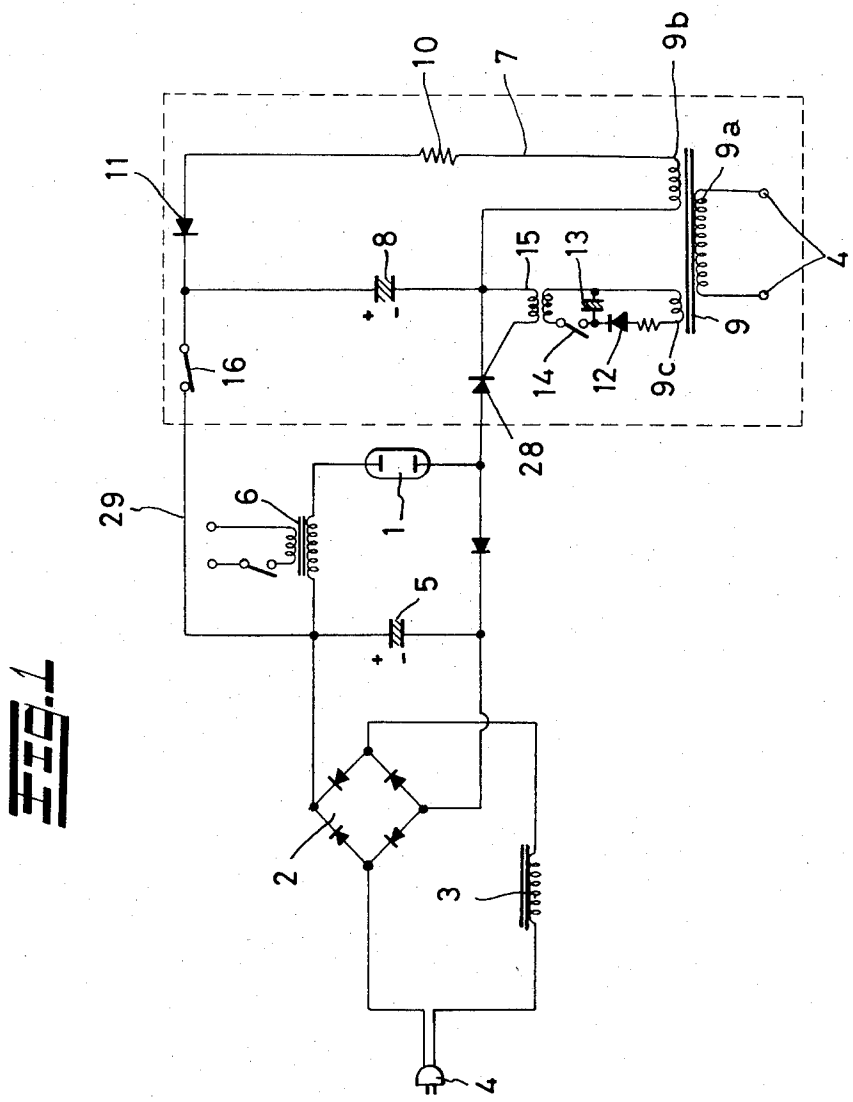


FIG. 1

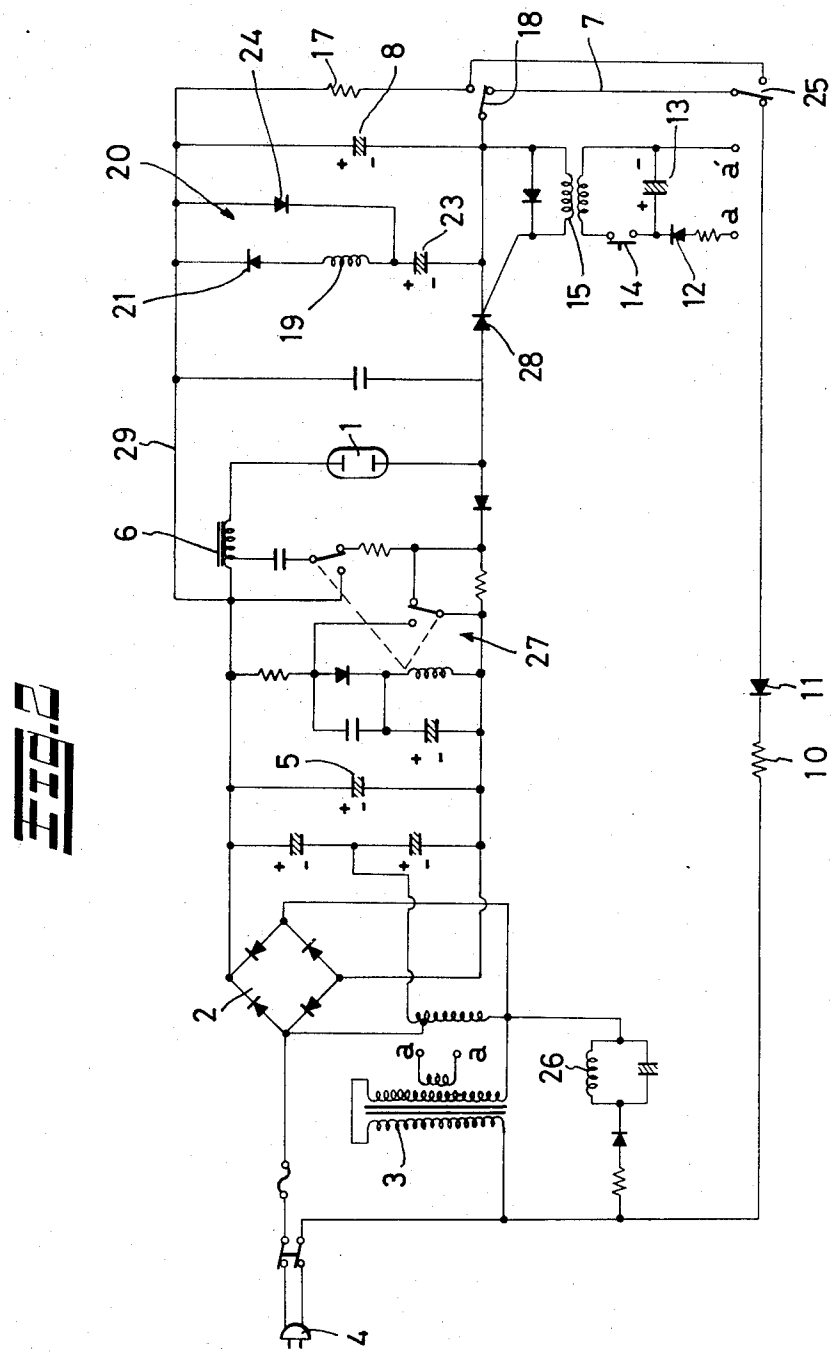


FIG. 2

LIGHT SOURCE APPARATUS FOR ENDOSCOPE

BACKGROUND

Known apparatus of the above kind is usually such that a continuous type light source for observation through an endoscope with the naked eye and a flash type light source for the taking of still photographs are separately provided and selectively used.

SUMMARY OF THE INVENTION

This invention has as an object the provision of a light source apparatus wherein multiple light sources are not employed and instead a single continuous type light source is used which can also be used as a flash type light source for still photography.

Apparatus of the invention is characterized in that a discharging condenser connected to a charging circuit is connected through a silicon control rectifier to a direct current arc lamp connected to a direct current electric source. A discharge circuit through the arc lamp is formed when the silicon control rectifier is closed by the operation of a synchro-switch of a camera.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be more clearly understood from the following description of preferred embodiments as illustrated in the accompanying drawing in which:

FIG. 1 is a schematic circuit diagram of one embodiment of the invention; and

FIG. 2 is a schematic circuit diagram of another embodiment of the invention.

DETAILED DESCRIPTION

FIG. 1 shows a fundamental circuit of the invention. Element 1 is a direct current arc lamp such as a xenon lamp, a mercury lamp or the like. The lamp 1 is connected to an alternating current electric source 4 through a rectifier 2 or, in other words to a direct current electric source comprising an alternating current electric source 4 and a rectifier 2. Element 3 is a choke coil. Element 5 is a smoothing condenser and element 6 is an ignition coil. Coil 6 operates in such a manner that, when a high frequency pulse is applied thereto, a high voltage is applied to the arc lamp 1 and thereby the lamp 1 is ignited.

A discharging condenser 8 connected to a charging circuit 7 is connected to the arc lamp 1 through a silicon control rectifier 28, whereby there is formed a discharging circuit 29. The charging circuit 7 comprises a transformer 9 which is connected via its primary winding 9*a* to an alternating current electric source 4 and via its secondary winding 9*b* to a resistance 10 and a diode 11 in series. The voltage transformed by the transformer 9 is rectified through the resistance 10 and diode 11 and charges the condenser 8.

The transformer 9 is provided with a third winding 9*c*, and a charging condenser 13 is connected thereto through a diode 12. Additionally, a pulse transformer 15 is connected to the condenser 13 through a synchro-switch 14 of a photographic camera. One output terminal of the pulse transformer 15 is connected to the control electrode of the above-mentioned silicon control rectifier 28.

If, in the illustrated embodiment, the arc lamp 1 is fired, it serves as a continuous type light source for observation through an endoscope with the naked eye. In

the case where, however, a photographic camera is attached to the endoscope for taking a still photograph, if the synchro-switch 14 is closed, the charged electric power of the condenser 13 is discharged through the primary side of the pulse transformer 15 and the pulse generated on the secondary side closes the silicon control rectifier 28. As the condenser 8 has already been charged by the charging circuit 7, the electric power therein is discharged through the arc lamp 1 and the silicon control rectifier 28 and thereby the arc lamp 1 can momentarily have an intensity of light which is several times the ordinary intensity. In this circuit arrangement, the silicon control rectifier 28 cannot be opened or cut off after the discharging of the condenser 8. Therefore, a switch 16 is provided in the discharge circuit. By once opening the same, the silicon control rectifier 28 can be opened.

FIG. 2 shows a modified circuit wherein the opening of the silicon control rectifier can be effected automatically. In this modified circuit, a discharge resistance 17 is provided in parallel with the discharging condenser 8 and a change-over switch 18 for selectively connecting the condenser 8 either with the charging circuit 7 or the discharge resistance 17 is provided. Additionally, a control circuit 20 having a relay coil 19 arranged to operate for a predetermined time after the condenser 8 is lowered to a predetermined voltage level by discharging is provided in parallel with the condenser 8. The relay coil 19 is further arranged to operate the above-mentioned change-over switch 18 so that, at the time of operation of the relay coil 19, the switch 18 is changed over to the discharge resistance 17 and the electric potential between the anode and the cathode of the silicon control rectifier 28 is reversed. Thereby, the opening of the silicon control rectifier 28 is effected.

The control circuit 20 is so formed that the relay coil 19 is connected in series with a condenser 23 and a diode 21 and a diode 24 are connected between a junction of the relay coil 19 and the condenser 23 and the positive terminal of the discharging condenser 8, so that the condenser 23 is charged through the diode 24.

If the silicon control rectifier 28 is closed and the arc lamp 1 is increased in its intensity of light and thereby the voltage of the discharging condenser 8 is lowered to a predetermined voltage level, the condenser 23 is then discharged through the relay coil 19 and the diode 21. As a result, the relay coil 19 is operated and the connection of the change-over switch 18 is switched to the discharge resistance 17 side. This condition is continued until the condenser 23 is discharged to a predetermined voltage level. After the discharge, the relay coil 19 becomes inoperative again and the change-over switch 18 is switched to the charging circuit 7 side as a result of which the discharging condenser 8 is charged again.

In this modified circuit, in order that the discharging condenser 8 is kept in the discharged condition when the arc lamp 1 is not lighted, there is provided a second change-over switch 25 for selectively connecting the discharging condenser 8 to either the charging circuit 7 or the discharge resistance 17. This switch 25 is so arranged that it closes the charging circuit 7 as illustrated when a relay coil 26 provided on the electric source side of the regular lighting circuit for the arc lamp 1 is operated, but it closes the discharging circuit when the

relay coil **26** becomes inoperative. Circuit **27** is a circuit for generating a pulse for lamp ignition.

According to this invention, as described above, the discharging condenser connected to the charging circuit is connected through the silicon control rectifier to the direct current arc lamp (which is used for endoscope observation) connected to the direct current electric source and the discharging circuit through the arc lamp is formed when the silicon control rectifier is closed in conjunction with the operation of the synchro-switch of a photographic camera. If the photographic camera is attached to the endoscope and the synchro-switch is closed by the operation of the shutter, the direct current arc lamp undergoes a momentary discharge with several times its usual light intensity for taking a still photograph. Additionally, as the direct current arc lamp undergoes the discharge at several times the usual intensity of light for only a moment, the arc lamp can be used without its life being substantially shortened.

What is claimed is:

1. Apparatus comprising an arc lamp for use with an endoscope, a voltage source coupled to said lamp to light the latter selectively and continuously for observation, a charging circuit, a discharging capacitor coupling said charging circuit to said lamp, a silicon control rectifier coupling said lamp to said discharging capacitor to form a discharge circuit with the latter, a synchro-switch, adapted to be operated by a photographic camera, coupled to and operating said rectifier, and an ignition coil and smoothing condenser coupled to said source and lamp to operate the latter, and means to cut off said rectifier after the rectifier has been operated.

2. Apparatus as claimed in claim **1** wherein said means includes means for operating automatically to cut off said rectifier.

3. Apparatus as claimed in claim **1** wherein the charging circuit includes an alternating current source, a transformer, a resistance and diode connected in series to said discharging capacitor.

4. Apparatus as claimed in claim **3** comprising a diode and condenser coupled between said synchro-switch and transformer and a pulse transformer coupling said switch to said rectifier.

5. Apparatus as claimed in claim **2** wherein the latter said means for operating automatically includes a discharge resistance, a change-over switch for selectively coupling said discharging capacitor to said charging circuit or discharge resistance, and relay means to operate the change-over switch.

6. Apparatus as claimed in claim **5** comprising a second change-over switch for selectively coupling the discharging capacitor to said charging circuit or discharge resistance, relay means to operate said second change-over switch, a capacitor connected between said synchro-switch and the first said relay means, the second said relay means being coupled to said direct current source and response to ignition of said lamp, the first said relay means being responsive to the latter said capacitor.

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