NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO ATTN OF: GP

AUG 7 1973

TO: KSI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code KSI, the attached NASA-owned U.S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,745,410

Government or Corporate Employee : General Dynamics
P.O. Box 1128
5001 Kearny Villa Rd.
San Diego, CA

Supplementary Corporate Source (if applicable) :

NASA Patent Case No. : MFS-21,214-1

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes [X] No [ ]

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of column No. 1 of the Specification, following the words ". . . with respect to an invention of . . ."

Elizabeth A. Carter

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Enclosure
Copy of Patent cited above

United States Patent [19]

Fletcher et al.

[11] **3,745,410**

[45] **July 10, 1973**

[54] **DRIVING LAMPS BY INDUCTION**

[76] Inventors: **James C. Fletcher**, Administrator of the National Aeronautics & Space Administration with respect to an invention of; **Helmuth H. Laue**, Escondido; **Leonard G. Clough**, Poway, both of Calif.

[22] Filed: **Mar. 16, 1972**

[21] Appl. No.: **235,269**

[52] **U.S. Cl.** **315/248**, 313/161, 315/324

[51] **Int. Cl.** **H05b 41/16**

[58] **Field of Search** 315/248, 324; 313/161

[56] **References Cited**

UNITED STATES PATENTS

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Primary Examiner—Alfred L. Brody

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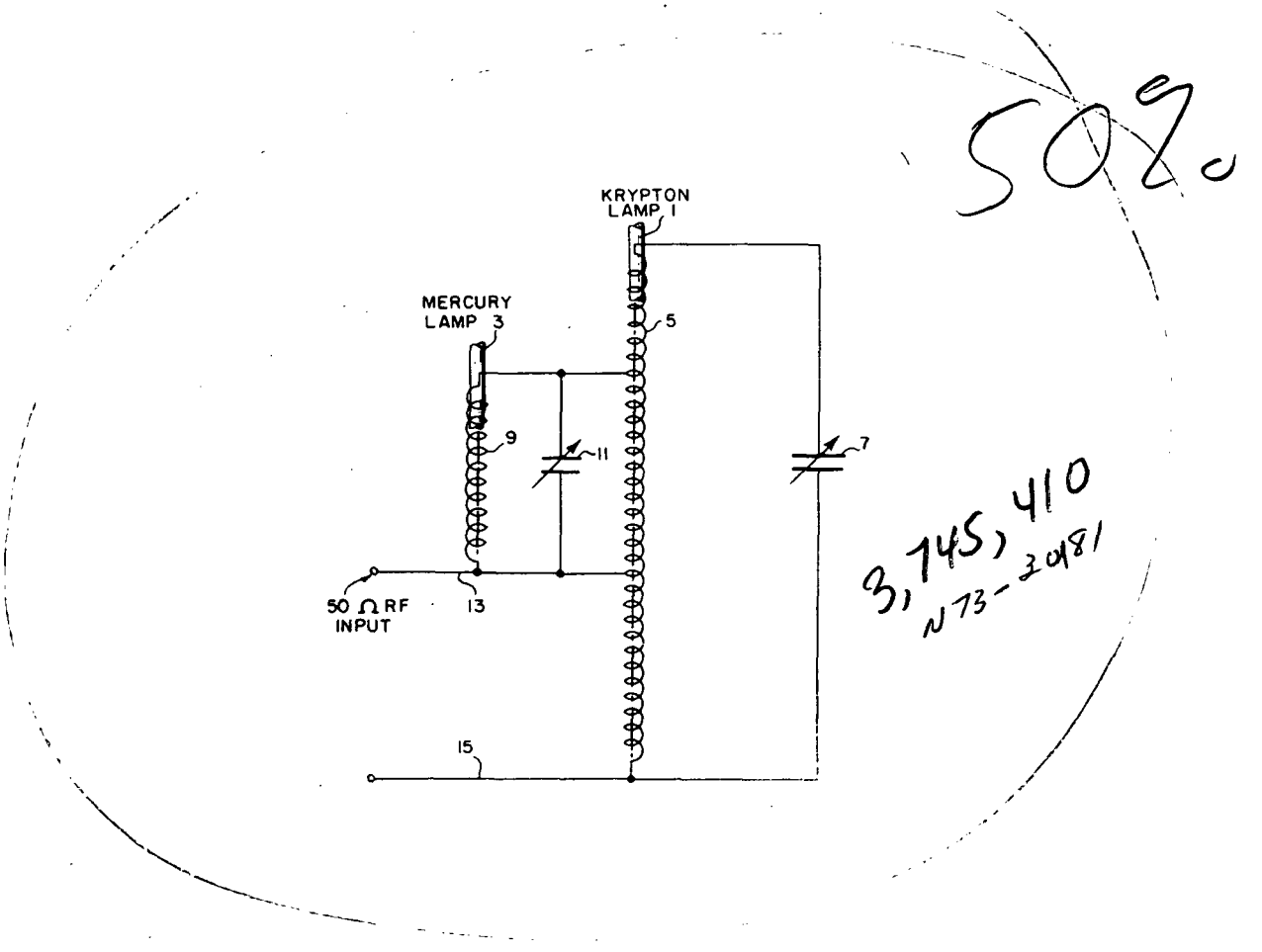
[57] **ABSTRACT**

An electrodeless lamp circuit with a coil surrounding a krypton lamp driven by an RF input source tapped across an end part of the coil and with a coil surrounding a mercury lamp tapped across the connection of the input central to the krypton-lamp coil and a point of the krypton-lamp coil electrically away from both input connections. Each coil is connected in parallel with separate capacitors which form resonant circuits at the input frequency.

4 Claims, 1 Drawing Figure



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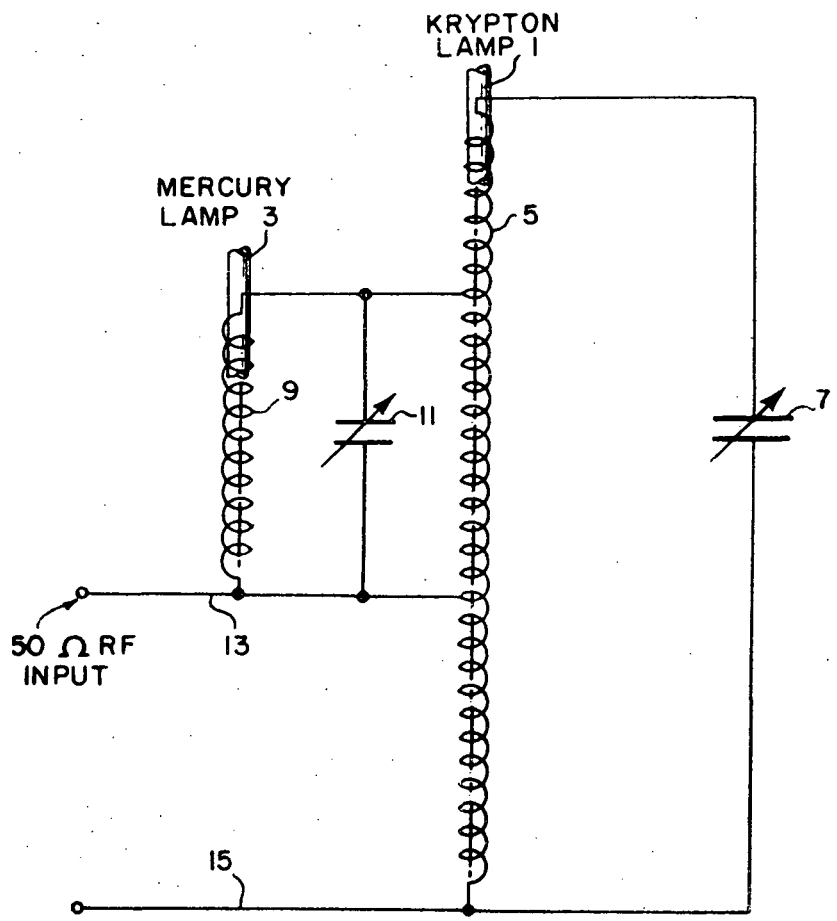
KRYPTON
LAMP 1
MERCURY
LAMP 3
5
9
11
7
50 Ω RF
INPUT
13
15

DRIVING LAMPS BY INDUCTION

ORIGIN OF THE INVENTION

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics and Space Act of 1958, Public Law 85-568 (72 Stat. 435; 42 U.S.C. 2457).

BACKGROUND OF THE INVENTION

Light-weight, efficient vacuum ultraviolet sources are needed for various applications. Conventionally, two light sources have been used to create two, single lines in the spectrum produced, separated by at least 300 angstroms. Inductively powered electrodeless lamps have been preferred to eliminate any possibility of contamination by metal ion emissions.

Self-starting and low power requirements to sustain light emission are particularly desired criteria for such a system. The total system in which the light production would be a part is particularly useful for experiments and the like in extraterritorial space.

Existing methods of driving those electrodeless lamps into resonance (or ionization) have required heavy power supplies and large amounts of AC power. In many cases, high frequency medical microwave power generators were employed which produced high power, up to 100 watts carrier wave.

The present invention employes an autotransformer arrangement in a circuit with conventional electrodeless lamps and other electrical elements. A similar use in the prior art of an autotransformer design or the like is not known.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an efficient and useful induction lamp driving system.

It is a more specific object of this invention to provide a small or light-weight induction lamp driving system.

It is another object of this invention to provide an induction lamp driving system with reduced power requirements, both during starting and in operation.

It is a more general object of this invention to provide a driving circuit for electrodeless lamps and the like comprising circuits made up basically or ordinary coils and capacitors.

In accordance with this invention a coil is positioned to drive an inductively driven lamp, and the power input to the coil is tapped across the coil generally in the manner of an autotransformer. A capacitor is positioned across the coil, the capacitor being of magnitude to form a resonant circuit with the coil at the input frequency. Additionally, in accordance with the more general aspects of the preferred embodiment, a second coil is tapped across the first coil at least partially past the part of the first coil which the input is across. The coil is positioned to drive a second, inductively driven lamp having characteristics different from the first, and a second capacitor is positioned across the second coil, that capacitor being of magnitude to form a resonant circuit with the second coil at the input frequency.

BRIEF DESCRIPTION OF THE DRAWING

The drawing illustrates the preferred system, in which a krypton electrodeless lamp and a mercury electrodeless lamp are driven simultaneously.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred system is a light-weight one of a krypton lamp **1** and a mercury lamp **3**, suitable for use in a laboratory or test environment. The lamps **1** and **3** are essentially conventional in every respect except for the circuit connections of the driving circuit. Lamp **1** contains krypton and lamp **3** contains mercury, within a transparent tube or the like in accordance with conventional designs for such lamps, so that magnetically induced energy at radio frequencies will drive the krypton or mercury into ionization (resonance) and thereby produce useful ultraviolet radiation.

Such lamps have previously been designed for lower radio frequency operation when employing increased wire size, coil diameter, and wire shape to promote heat dissipation.

Coil **5** surrounds krypton lamp **1** in electrically inductive relationship for driving lamp **1**. (Although only a section of lamp **1** is illustrated in the drawing, it will be understood, of course, as is conventional, that lamp **1** extends within all or substantially all of coil **5**.) Capacitor **7** is connected electrically across coil **5** and is of magnitude to form a resonant circuit at the frequency of the input power when lamp **1** is ionized and is thereby producing the desired output radiation.

Similarly, coil **9** surrounds mercury lamp **3** in electrically inductive relationship for driving lamp **3**. (As with respect to lamp **1**, lamp **3**, although only a part is shown in the drawing, actually is located within all or substantially all of coil **9**.) Capacitor **11** is connected electrically across coil **9** and is of magnitude to form a resonant circuit at the frequency of the input power when lamp **3** is ionized and thereby producing the desired output radiation.

Coil **9** is connected electrically to one line **13** of the input power and to a point on coil **5** spaced electrically from the line **13** and the other input power line **15**. Mercury is ionized more readily than krypton, and the coil **9** is tapped across coil **5** at a point at which the proper, smaller voltage is provided.

Input power to lines **13** and **15** is by a 7 watt, 50 MHz radio frequency, 14 mhos supply.

In operation, the radio frequency input power is applied across lines **13** and **15**, and the response of the lamps is automatic in accordance with the natural response of the elements and circuits involved. Initially, the lamps **1** and **3** are not ionized. Self ignition of the lamps occurs a short time later (up to 2 minutes, depending on tuning of the overall circuit). After ignition, both coils **5** and **9** are in resonant circuit with their associated capacitors **7** and **11** respectively, and the resonant operation minimizes power consumption. In the preferred embodiment, RF power requirements have been brought to below 7 watts.

Prior to ignition, the voltage standing wave ratio seen by the RF source is infinite. Mismatch protection of some kind associated with the power source is therefore required. As soon as the gas in the lamps has ionized, the voltage standing wave ratio drops to low levels, the extent depending on tuning of the system. Such ratios of 1.3 to 1 have been readily achieved.

This system may be categorized as low frequency, since some driving systems require microwave frequencies, and the lower RF frequency range drivers preferably used with this system are less complex than higher

frequency drivers. The power requirements of this embodiment are greatly reduced, to less than one-fiftieth of those of comparable prior systems. The total system, including RF power supply and the like, has also been weight reduced by at least 50 to 1. The reduced power requirements make readily possible the use of an all-solid-state driver.

Lamp performance versus temperature has been studied. Heat sinking or other control appears desirable. Spectral response curves obtained with the aid of the McPherson spectrometer indicate that excellent quality vacuum ultraviolet light is emitted. Modulation of the light sources utilizing a 50 percent duty cycle square wave modulated signal further simplified photo multiplier tube signal processing, and the modulation does not impair the spectral purity of the light sources.

It would be possible to connect coil **9** across coil **5** at points at which the desired capacity is supplied inherently instead of by a separately provided capacitor, such as capacitor **11**.

Other variations of the invention described will be apparent, and variations may well be developed which employ more than ordinary skill in this art, but nevertheless employ the basic contribution and elements of this invention. Accordingly, patent protection should not be essentially limited by the preferred embodiments disclosed, but should be as provided by law, with particular reference to the accompanying claims.

What is claimed is:

1. A system for driving lamps by induction comprising:

a first lamp adapted to be driven for production of electromagnetic radiation by induction from an electrical coil;

a first coil positioned to drive said lamp for said production of radiation;

first capacitve means electrically connected across said coil of a magnitude to form a resonant circuit with said coil when said lamp is being driven and producing said radiation at a given radio frequency;

a power source operative at said radio frequency connected across a part only of said first coil;

a second lamp adapted to be driven for production of electromagnetic radiation by induction from an electrical coil;

a second coil positioned to drive said second lamp for said production of radiation;

second capacitive means electrically connected across said second coil of a magnitude to form a resonant circuit with said second coil when said lamp is being driven and producing said radiation at said radio frequency, said second coil being connected electrically across said first coil at locations at least one of which is electrically separated from the part of said first coil across which said power source is connected.

2. The system as in claim **1** in which said second coil is connected at locations across said first coil at which said second capacitive means is inherently supplied by said first coil and said second coil.

3. The system as in claim **1** in which the radiation producing material of said first lamp consists essentially of krypton and the radiation producing material of said second lamp consists essentially of mercury.

4. The system as in claim **3** in which said second coil is connected substantially across one of said connections of said power source to said first coil and said electrically separated location.

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