

1 568 506

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- (22) Filed 9 Mar. 1978
- (44) Complete Specification Published 29 May 1980
- (51) INT. CL.³ H01J 17/56 15/02
- (52) Index at Acceptance
H1D 12B47Y 12B6 17A1X 17A1Y 17A4 17AY
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(54) IMPROVEMENTS IN OR RELATING TO LASER ARRANGEMENTS

(71) We, ENGLISH ELECTRIC VALVE COMPANY LIMITED, a British Company, of 106, Waterhouse Lane, Chelmsford, Essex, CM1 2QU, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to laser arrange-

to act as a cathode protectively permitting reversal of said thyatron.

It will be noted that a thyatron utilised in accordance with the last mentioned feature of the present invention does not rely, as a so called double-ended thyatron relies, upon the provision of an anode which incorporates a heater and cathode material so as to be operable as a cathode or an anode. In the thyatron utilised according to the present invention it is the

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PATENTS ACT 1949

SPECIFICATION NO 1568506

The following amendments were allowed under Section 29 on 15 July 1986

Page 2 Line 70 After thyatron insert having the thyatron constructional features as set forth in any of claims 3 to 6 and

THE PATENT OFFICE
30 September 1986

arrangement includes in its discharge circuit a switching thyatron which is adapted or arranged to be capable of conduction normally in one direction and protectively in the reverse direction if said thyatron is subjected to a reversal of voltage.

Said switching thyatron may be of the double-ended type as known *per se*, for example, from the specification of our U.K. patent 1,334,527. However, it is preferred to use a special construction of thyatron and according to a feature of this invention said switching thyatron has an anode formed as a hollow body adapted to retain plasma generated during a pulse of forward conduction whereby said anode is provided

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Referring to the drawing, the thyatron consists of an envelope formed of two ceramic cylinders 1 and 2 separated by an annular flange 3, which forms the connection for a control grid electrode 4. The interior 5 of the envelope is filled with hydrogen or one of the hydrogen isotopes. The ends of the envelope are closed by cover plates 6 and 7, the cover plate 7 carries a conductive platform 8 on which is mounted a cylindrical cathode 9, surrounded by a heat shield 10. The cathode 9 is heated by a cathode heater 11.

At the end of the envelope opposite the cathode 9 is an anode 12. The anode 12 is in

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This invention relates to laser arrangements.

The use of thyratrons in a laser discharge circuit has been proposed by, for example, D. Turnquist, S. Merz and R. Plante in a paper entitled "Grounded Grid Thyratrons" EG&G, Inc. Salem, Massachusetts 01970.

A difficulty which arises, however, and to which Turnquist, Merz and Plante refer, is that with a conventional thyatron, it is likely to suffer severe damage due to the sputtering of anode material and the formation of arc spots on the anode surface if subjected to a reversal of voltage such as those which occur in laser discharge circuits.

One object of the present invention is to provide an improved laser arrangement in which the above difficulty is reduced.

According to this invention a laser arrangement includes in its discharge circuit a switching thyatron which is adapted or arranged to be capable of conduction normally in one direction and protectively in the reverse direction if said thyatron is subjected to a reversal of voltage.

Said switching thyatron may be of the double-ended type as known *per se*, for example, from the specification of our U.K. patent 1,334,527. However, it is preferred to use a special construction of thyatron and according to a feature of this invention said switching thyatron has an anode formed as a hollow body adapted to retain plasma generated during a pulse of forward conduction whereby said anode is provided

to act as a cathode protectively permitting reversal of said thyatron.

It will be noted that a thyatron utilised in accordance with the last mentioned feature of the present invention does not rely, as a so called double-ended thyatron relies, upon the provision of an anode which incorporates a heater and cathode material so as to be operable as a cathode or an anode. In the thyatron utilised according to the feature of the present invention it is the plasma, retained within the hollow body of the anode, which enables the anode to act as a cathode and afford protective reverse conduction if the voltage applied thereto reverses.

Preferably said anode of said thyatron comprises a cylinder which is closed at both ends except for an aperture in an end closure towards said cathode which aperture is partially obstructed by a flanged plate.

Preferably said aperture is round and said plate is a co-axial circular flanged disc.

The invention is illustrated in and further described with reference to the accompanying drawing which is a section through one relatively simple thyatron utilised in accordance with the feature of the present invention as a switching thyatron in the discharge circuit of a laser.

Referring to the drawing, the thyatron consists of an envelope formed of two ceramic cylinders 1 and 2 separated by an annular flange 3, which forms the connection for a control grid electrode 4. The interior 5 of the envelope is filled with hydrogen or one of the hydrogen isotopes. The ends of the envelope are closed by cover plates 6 and 7, the cover plate 7 carries a conductive platform 8 on which is mounted a cylindrical cathode 9, surrounded by a heat shield 10. The cathode 9 is heated by a cathode heater 11.

At the end of the envelope opposite the cathode 9 is an anode 12. The anode 12 is in

the form of a hollow box formed by a
 conductive platform 13 mounted on cover
 plate 6, a conductive cylindrical wall 14 and
 a conductive end closure 15 which faces the
 grid 4. The end closure 15 has a central
 round aperture 16 which is partially closed
 by a circular flanged disc 17 carried from the
 platform 13 by a cylinder 18.

The construction of the anode 12 is such
 that plasma generated during a pulse of
 forward conduction initiated by a trigger
 pulse applied to the control grid 4 via the
 flange 3 is retained within the hollow in-
 terior of the anode 12 after forward conduc-
 tion ceases. The result of this is that if the
 thyatron is subjected to a reversal of
 potential which might otherwise result in
 damage due to arcing, the anode 12 is
 enabled to act as a cathode permitting
 reversal of the thyatron. Thus sputtering of
 anode material and the formation of arc
 spots on the anode surface tends to be
 avoided since if the potential applied to the
 thyatron reverses the thyatron merely
 conducts in a reverse direction.

It will be noted that this reverse conduc-
 tion of the thyatron is due entirely to the
 plasma trap within the hollow anode which
 is not constructed with a heater and cathode
 material whereby normally to act as a
 cathode or an anode, as in the case of a so
 called double ended thyatron.

The thyatron is connected as known *per
 se* to switch energy from a capacitive source
 (not shown) into a pulsed laser (also not
 shown).

WHAT WE CLAIM IS:-

1. A laser arrangement including in its
 discharge circuit a switching thyatron which
 is adapted or arranged to be capable of
 conduction normally in one direction and
 protectively in the reverse direction if said
 thyatron is subjected to a reversal of
 voltage.

2. A laser arrangement as claimed in
 claim 1 and wherein said switching thyatron
 is of the double-ended type.

3. A laser arrangement as claimed in
 claim 1 and wherein said switching thyatron
 has an anode formed as a hollow body
 adapted to retain plasma generated during a
 pulse of forward conduction whereby said
 anode is provided to act as a cathode
 permitting protective reversal of said thyr-
 atron.

4. A laser arrangement as claimed in
 claim 3 and wherein said anode of said
 thyatron comprises a cylinder which is
 closed at both ends except for an aperture in
 an end closure towards said cathode which
 aperture is partially obstructed by a flanged
 plate.

5. A laser arrangement as claimed in
 claim 4 and wherein said aperture is round
 and said plate is a co-axial circular flanged

disc.

6. A laser arrangement including in its
 discharge circuit a switching thyatron sub-
 stantially as herein described with reference
 to the accompanying drawing.

7. A switching thyatron suitable for use
 in the switching of energy in the discharge
 circuit of a laser arrangement substantially
 as herein described with reference to the
 accompanying drawing.

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 by Croydon Printing Company Limited, Croydon, Surrey, 1980.
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This drawing is a reproduction of the Original on a reduced scale

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