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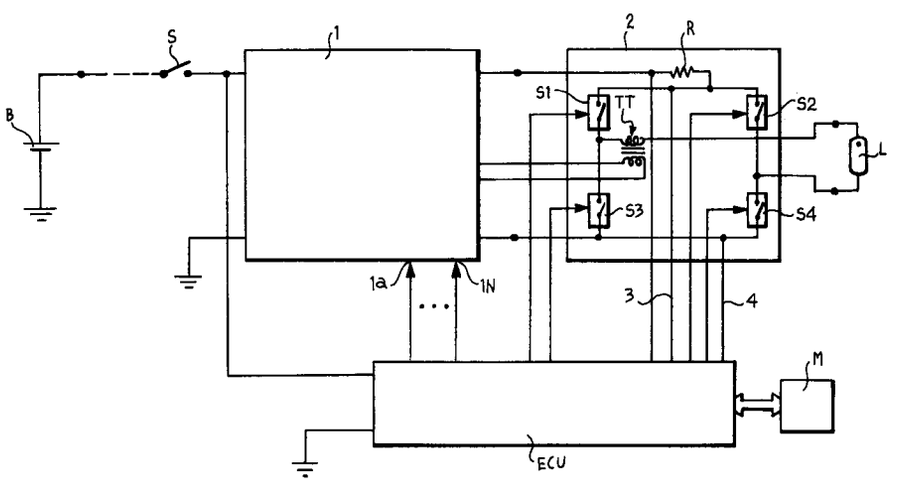
(54) A control device for a gas-discharge lamp

(57) The device comprises a dc voltage source (B), a dc/dc converter (1) operable to provide a higher voltage than that of the source (B), an inverter (2) to which the lamp (L) is connected and a control unit (ECU) which controls the converter (1) and/or the inverter (2) in such a way as to apply to the lamp (L) a higher power at striking and a lower power during subsequent operation of the lamp under normal conditions. Detector devices (R; 3, 4) provide signals to the unit (ECU) indicative of the impedance of the lamp (L).

Non-volatile memory devices (M) associated with the unit (ECU) store data indicative of the values of the impedance (Z_L) of the lamp upon variation of the time (t_{off}) elapsed since it was extinguished. The unit (ECU) is arranged to acquire, at each striking, the impedance (Z_L) presented by the lamp (L), to compare this impendence (Z_L) with the values stored in the said memories (M), and to determine on the basis of this comparison the time (t_{off}) elapsed since the lamp (L) was previously extinguished.

FIG. 1



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Description

The present invention relates to a control device for a gas-discharge lamp, particularly for motor vehicles.

More specifically the subject of the invention is a control device for a gas-discharge lamp comprising

a low-voltage dc source,
dc/dc converter means connectable to the said source and operable to provide at its output a higher dc voltage than that of the source,
inverter means connected to the said dc/dc converter means and to which the lamp is connected, and
an electronic control unit arranged to control the said dc/dc converter means and the said inverter means in a pre-determined manner in such a way as to transfer to the lamp a high electric power in the striking and heating phase, and a low electric power in the subsequent normal operation of the lamp.

Upon striking a gas-discharge lamp must be supplied with a high electric power which can cause rapid evaporation of the materials (metal halides, rare earths) contained within its interior. During this striking stage the electric power supplied to the lamp must also be suitably regulated in order to ensure that the light flux emitted has the desired characteristics.

After striking the electric power supplied to the lamp is gradually reduced, and finally stabilises when the lamp reaches normal operating conditions.

At each re-striking of the lamp the manner in which the high electric power is applied must be suitably modified in dependence on the time elapsed since the lamp was last extinguished, for the purpose of avoiding a dangerous overload of the lamp which could appreciably compromise its operating life.

The control unit which regulates the application of electric power to the lamp during striking must therefore have access to information about the time elapsed since the lamp was last extinguished.

In known systems the control unit, which is typically formed using a microprocessor, remains connected to the dc voltage supply source even when the lamp is extinguished. This unit is, moreover, arranged to measure (for example by means of a counter) the time for which the lamp remains extinguished. At each re-striking of the lamp the control unit regulates the electric power applied to the lamp on the basis of the time elapsed since it was last extinguished.

This arrangement has the disadvantage of having to have a specific connection between the voltage supply source and the control unit.

The object of the present invention is to provide a control device for a gas-discharge lamp which allows a differentiated control of such a lamp as a function of the time elapsed since it was last extinguished without requiring the control unit to be permanently supplied via a suitable supply line.

This object is achieved according to the invention with a control device of the previously-specified type, characterised in that it further includes:

detector means operable to provide to the said control unit electrical signals indicative of the impedance of the lamp,
and in that the said control unit has associated therewith memory means of non-volatile type in which are stored data indicative of the values of the impedance of the lamp upon variation in the time elapsed since it was extinguished;
the said control unit being arranged to:

- acquire, at each striking of the lamp, signals provided by the said detector means to determine the impedance presented by the lamp,
- compare the thus-determined impedance values with the values stored in the said memory means and on the basis of this comparison determine the time elapsed since the lamp was previously extinguished, and
- control the said dc/dc converter means and/or the said inverter means in such a way as to apply to the lamp, immediately after it has been struck, an electric power which varies as a function of the elapsed time as determined above.

The invention is based on the observation that the impedance of the lamp measured immediately after its striking varies appreciably as a function of the time elapsed since the lamp was previously extinguished. Upon striking, a gas-discharge lamp presents for example an impedance of about 200 Ohm if the striking follows immediately after the lamp has been extinguished, and an impedance of for example about 10 Ohm when the lamp is re-struck from cold, that is to say after a considerable time has elapsed since it was last extinguished.

By experimental measurements it is possible to determine, for a given type of lamp, the correlation between its impedance upon striking and the time elapsed since it was last extinguished. This correlation converted, for example, into the form of a table stored in memory devices of non-volatile type, makes possible an acceptable determination of the time elapsed since the lamp was extinguished, without the necessity for the control unit to remain supplied when the lamp is extinguished.

Further characteristics and advantages of the invention will become apparent from the following detailed description which is given purely by way of non-limitative example, with reference to the attached drawings in which:

Figure 1 is a partly block-schematic diagram of a control device for a gas-discharge lamp, according

to the invention, and

Figure 2 is an experimental graph which plots the variation of the ratio between the impedance which a lamp presents upon striking and the impedance presented during normal operation, as a function of time elapsed since it was extinguished.

In Figure 1 the reference letter B indicates a low voltage dc source such as, for example, the battery on board a motor vehicle.

To the battery B is connected the input of a dc/dc conversion circuit unit generally indicated 1. This circuit unit can comprise, for example, a dc/dc converter of the push-pull type and/or of other known types. This circuit unit typically includes one or more electronic switches (not illustrated) which can be controlled in a pre-established manner by means of control signals applied to inputs 1a ... 1N of this unit.

At the output of the dc/dc conversion circuit unit 1 is connected an inverter generally indicated 2, which is connected to the gas-discharge lamp L. In the exemplary embodiment illustrated the inverter 2 is of the totally controlled bridge type and includes four electronic switches S1-S4. The lamp L is connected across one diagonal of the bridge circuit. The secondary winding of a striking transformer TT is connected in series with this lamp.

An electronic control unit indicated ECU formed, for example, with the use of a microprocessor, is connected to the control inputs 1a-1N of the dc/dc conversion circuit unit 1 and to the control inputs of the electronic switches S1-S4 of the inverter 2.

A measurement resistor R is connected to the output of the circuit unit 1 in series with the bridge circuit of the inverter 2. The terminals of this resistor are connected to corresponding inputs of the electronic control unit ECU. In operation the resistor R allows the unit ECU to acquire information relating to the magnitude of the current flowing in the lamp L. This information can however be acquired from the unit ECU via other means or devices known per se.

In the embodiment illustrated in Figure 1 the unit ECU is further connected to the upper and lower terminals of the bridge circuit of the inverter 2 by connections indicated 3 and 4, in such a way as to be able to acquire, during operation, information relating to the voltage applied to the lamp L. Also In this case, this Information may be acquired from the unit ECU in other known ways.

Associated with the unit ECU are memory devices M of non-volatile type, preferably of the re-writable type.

In these memory devices are stored data indicative of the values of the impedance Z_L presented by the lamp at striking, upon variation of the time elapsed since the lamp gas extinguished. This data can be determined by experimental measurements as previously mentioned.

The control unit ECU is arranged to acquire, at each striking of the lamp L, the voltage across the terminals of the resistor R which is indicative of the current flowing in the lamp, and the voltage across the terminals of the bridge of the inverter 2, which is indicative of the voltage applied to the lamp. On the basis of this information the unit ECU determines the impedance Z_L of the lamp L at striking.

The unit ECU is therefore arranged to compare the thus-determined values of the impedance with the values stored in the memory devices M, and to determine on the basis of this comparison the time t_{off} elapsed since the lamp L was last extinguished.

The control unit ECU therefore acts to control the dc/dc conversion circuit unit 1 and/or the inverter 2 in such a way that, immediately after the lamp L is struck, a variable electrical power is supplied to the lamp depending on a predetermined law stored in the said control unit, as a function of the time t_{off}.

In the exemplary embodiment illustrated in Figure 1 the control of the striking of the lamp L is achievable by manual actuation of a control switch indicated S. Closure of this switch causes coupling of the dc/dc conversion unit 1 and the unit ECU to the dc supply voltage source B.

When the user opens the switch S to cause the lamp to be extinguished the unit ECU likewise no longer receives the supply voltage. However, thanks to the data stored in the non-volatile memory devices M and to the procedure for detection and comparison of the impedance presented by the lamp at striking the system is always able to perform a regulation of the electrical power applied to the lamp at striking as a function of the time elapsed since it was previously extinguished.

In a variant of the Invention the memory devices M associated with the control unit ECU conveniently have stored therein data relating to the ratio between the impedance Z_L of the lamp L at striking and the impedance Z_{LO} of the said lamp during normal operation, upon variation of the time t_{off} elapsed since the lamp was extinguished.

The control unit ECU is then correspondingly prearranged to acquire and store (in a non-volatile manner), during each striking period of the lamp L, the impedance presented by the said lamp during normal operation, and to determine at each striking of the lamp the ratio between the current impedance of the lamp at striking and the impedance of the lamp during normal operation in the preceding striking period. The unit ECU then compares the value of the thus-determined ratio with the values stored in the memory devices M and on the basis of this comparison determines the time t_{off} elapsed since the lamp was previously extinguished.

In Figure 2 is shown, by way of example, a graph based on the experimental detections made on a lamp. This graph plots the variation of the ratio between the impedance Z_L of a gas-discharge lamp at striking and the impedance Z_{LO} of the same lamp during normal operation, plotted as a function of the elapsed time t_{off} since it was extinguished. Such a graph is stored in the memory devices M for example in the form of a table.

The variant of the invention now described allows a more precise regulation of the electrical power applied to the lamp L at striking as a function of the time elapsed since it was last extinguished.

In fact it is possible to hypothesise that the values of the ratio Z_L/Z_{LO} remain relatively stable as a function of time t_{off} even with ageing of the lamp, whilst in general the impedances Z_L and Z_{LO} can be subject to variations.

The variant of the invention described above also makes it possible to render the control system of the lamp L self-adjusting, even in the case of possible replacement of the lamp L.

Naturally, the principle of the invention remaining the same, the embodiments and details of construction can be widely varied with respect to what has been described and illustrated purely by way of non-limitative example, without by this departing from the scope of the present invention as defined in the appended claims.

Claims

1. A control device for a gas-discharge lamp (L), particularly for motor vehicles, comprising

   a low voltage dc source (B),
   dc/dc converter means (1) connectable to the said source (B) and operable to provide at its output a higher dc voltage than that of the source (B),
   inverter means (2) connected to the said dc/dc converter means (1) and to which the lamp (L) is connected, and
   a control unit (ECU) arranged to control the said dc/dc converter means (1) and/or the said inverter means (2) in a predetermined manner in such a way as to apply to the lamp (L) a high electrical power during striking and heating, and a lower electrical power during the subsequent operation of the lamp during its normal operating conditions;

   the device being characterised in that it further includes:
   detector means (R; 3, 4) operable to provide to the said control unit (ECU) electrical signals indicative of the impedance of the lamp (L),
   and in that the said control unit (ECU) has associated therewith memory means (M) of non-volatile type In which are stored data Indicative of the values of the impedance (Z_L) of the lamp upon variation in the time (t_{off}) elapsed since the lamp (L) was extinguished;

   the said control unit (ECU) being arranged to:

   - acquire, upon each striking of the lamp (L), signals provided by the said detector means (R; 3, 4) to determine the impedance (Z_L) of the lamp (L),
   - compare the thus-determined values of the impedance (Z_L) with the values stored in the said memory means (M), and on the basis of this comparison to determine the time (t_{off}) elapsed since the lamp (L) was previously extinguished, and
   - control the said dc/dc converter means (1) and/or the inverter means (2) in such a way as to apply, immediately after striking of the lamp (L), an electrical power which varies as a function of the elapsed time (t_{off}) as determined above.

2. A device according to Claim 1, characterised in that the said memory means (M) store data indicative of the ratio between the impedance (Z_L) of the lamp (L) upon striking and the impedance (Z_{LO}) of the lamp during normal operation upon variation of the time (t_{off}) elapsed since the lamp (L) was extinguished;

   and in that the said control unit (ECU) is arranged to acquire, and store in a non-volatile manner in each striking period of the lamp (L) the impendence presented by the said lamp (L) during normal operation, and to determine at each striking of the lamp (L) the ratio between the current impedance (Z_L) presented by the lamp (L) and the impendence (Z_{LO}) presented by the lamp in normal operation during the preceding period of use, and to compare the value of the thus-determined ratio with the values stored in the said memory means (M), and to determine the elapsed time (t_{off}) since the lamp was previously extinguished on the basis of this comparison.

FIG. 1

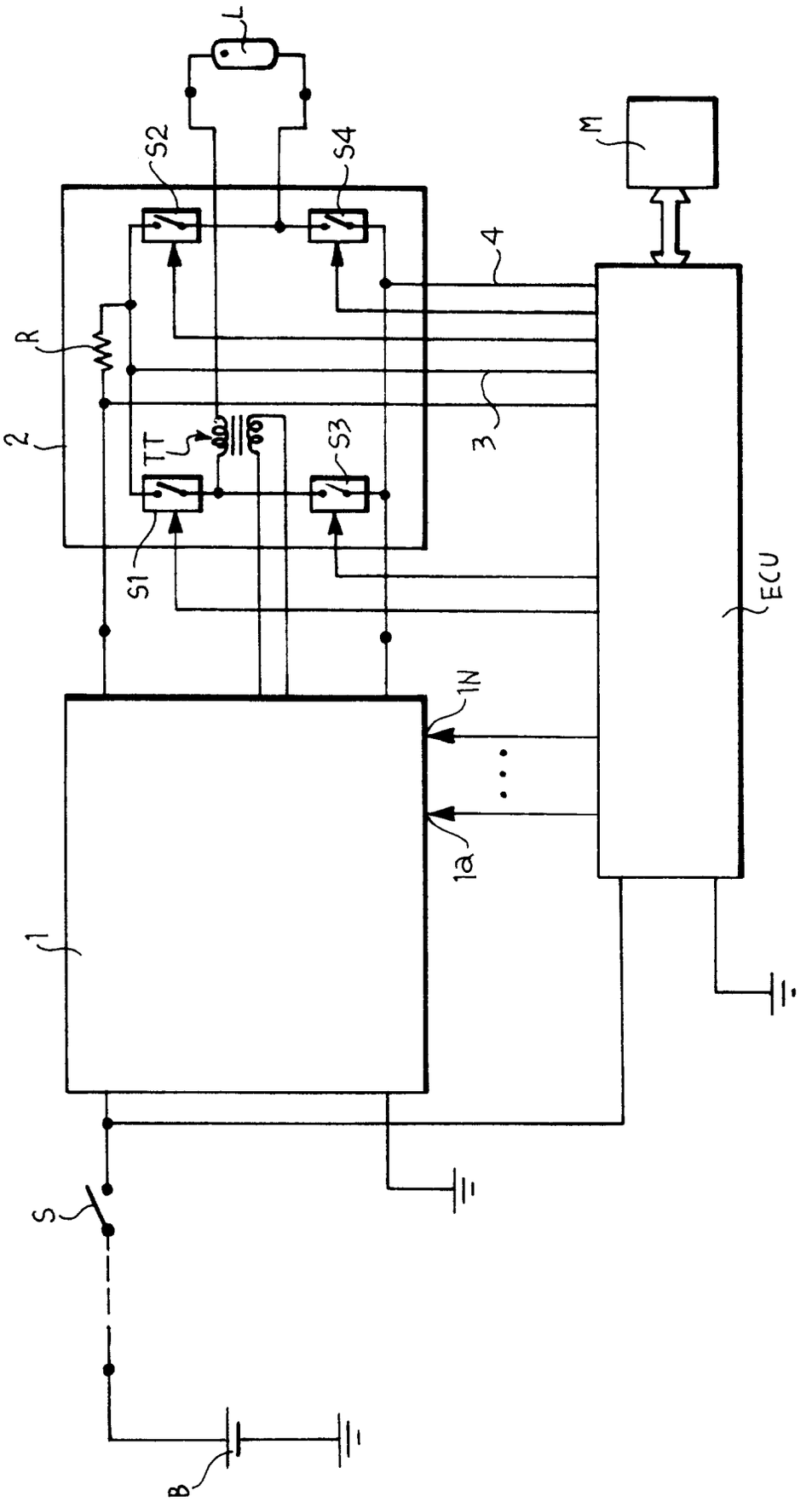
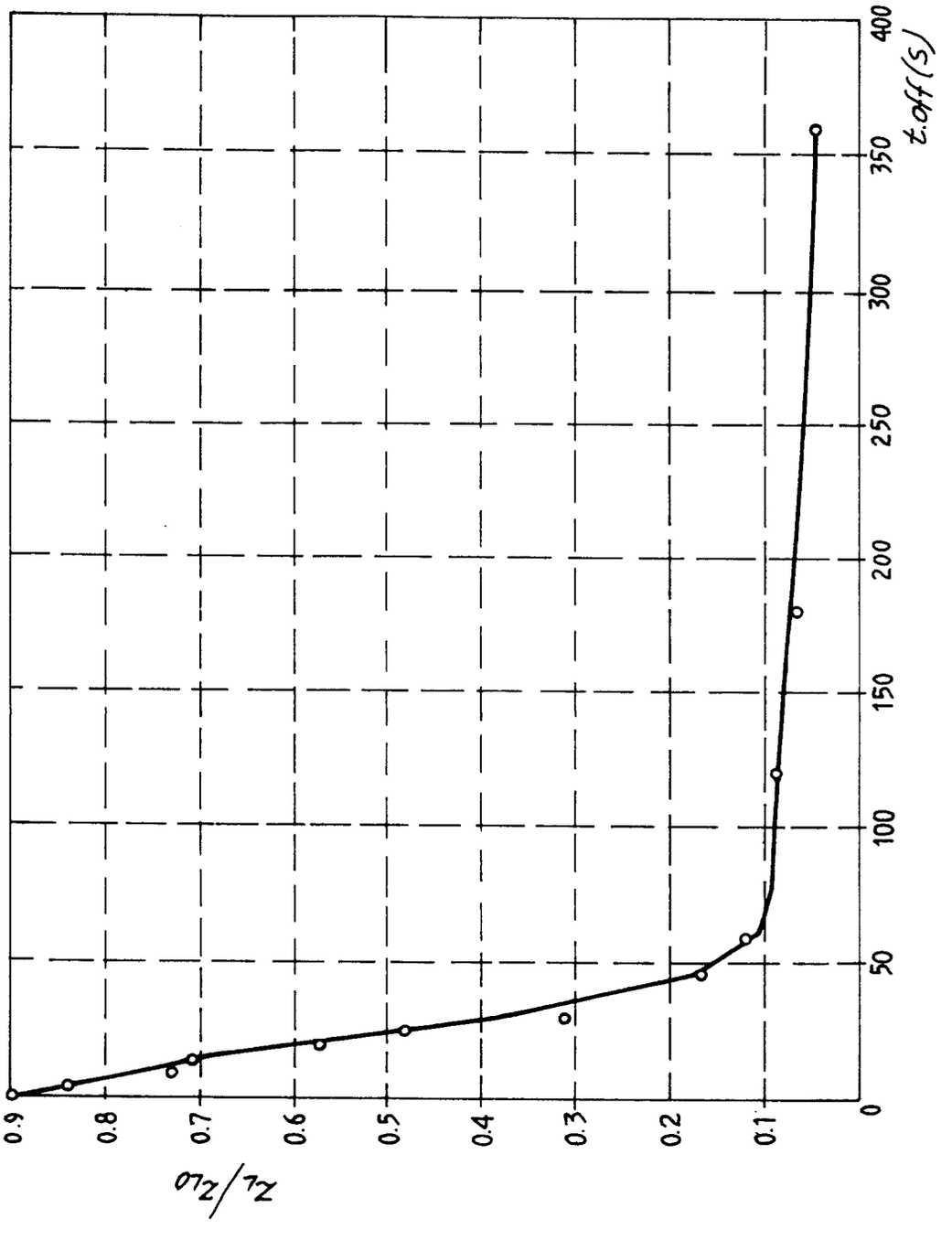


FIG. 2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EUROPEAN SEARCH REPORT

Application Number
EP 96 11 0478

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 459 126 (HELLA HUECK) * column 9, line 52 - column 12, line 30; figures 1-3 *	1	H05B41/38 H05B41/29
A	FR-A-2 648 000 (KOITO) * page 35, line 32 - page 37, line 20; figure 5 *	1	
A	EP-A-0 536 535 (MATSUSHITA) * column 15, line 51 - column 16, line 47; figures 6,7 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 September 1996	Speiser, P

CATEGORY OF CITED DOCUMENTS

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