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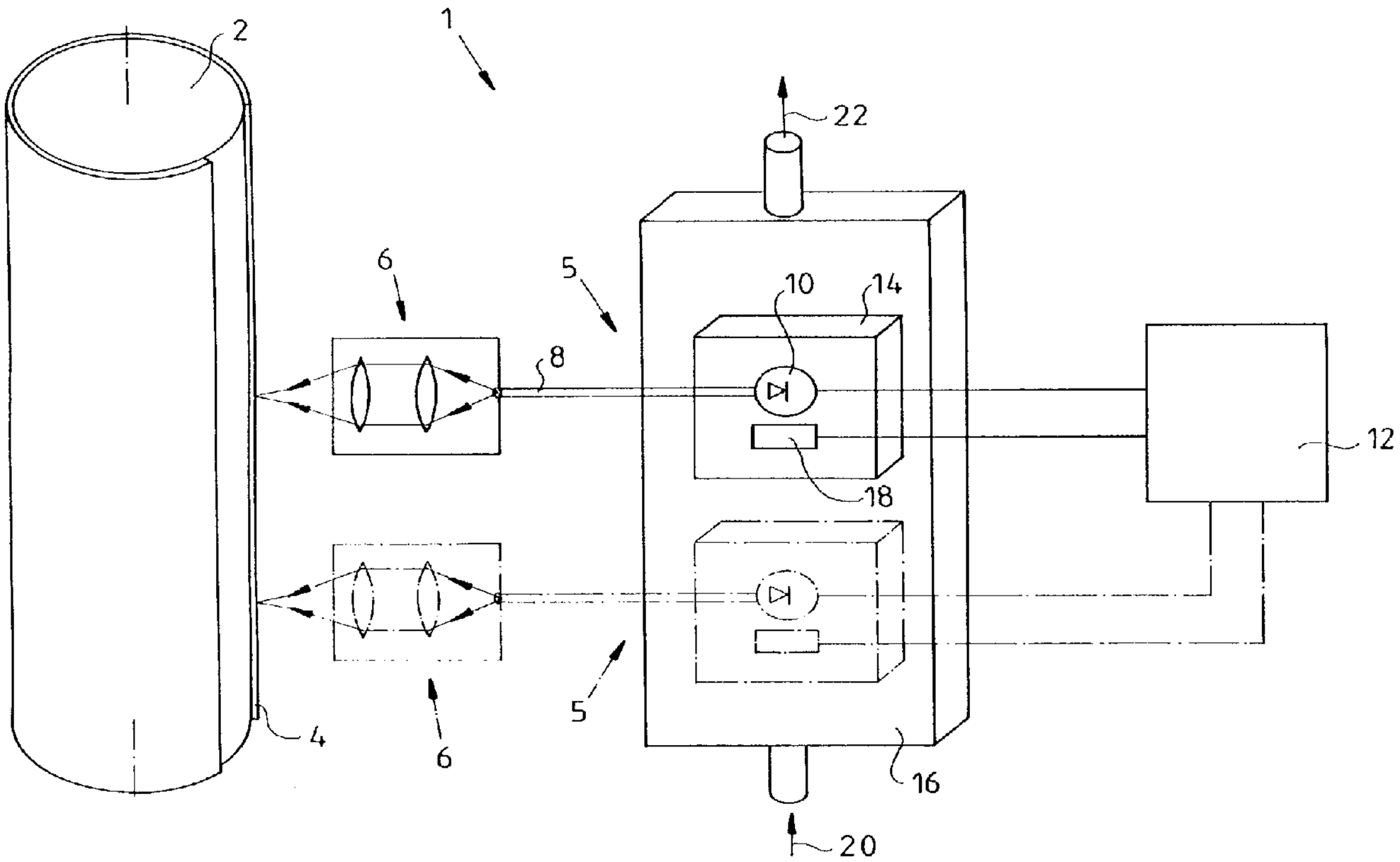
(54) **METHODE ET DISPOSITIF DE STABILISATION DE LA TEMPERATURE DANS UNE UNITE D'IMAGERIE A LASER POUR PLANCHES D'IMPRESSION DE PRESSE A IMPRIMER, PARTICULIEREMENT DE PRESSE OFFSET**

(54) **METHOD AND DEVICE FOR REGULATING THE TEMPERATURE IN A LASER-OPERATED PRINTING PLATE IMAGING UNIT OF A PRINTING PRESS, PARTICULARLY OF AN OFFSET-PRINTING PRESS**



(57) L'invention est un dispositif d'imagerie (1) à laser pour planches d'impression (4) monté sur un cylindre (2) de presse à imprimer. Ce dispositif comporte une ou plusieurs unités d'imagerie (5) et des diodes laser (10) utilisés en opposition de phase avec un élément chauffant (18) voisin pour maintenir leur température essentiellement constante durant le processus d'imagerie.

(57) A laser-operated printing plate imaging device (1) for imaging an even printing plate (4) or a printing plate (4) mounted on a printing press plate cylinder (2) comprises one or multiple printing plate imaging units (5), the laser diode units (10) of which being operated in phase opposition with a heating element (18) arranged near the laser diode units (10), in order to keep the temperature of the laser diode units (10) essentially constant during the imaging process.

ABSTRACT OF THE DISCLOSURE

A laser-operated printing plate imaging device (1) for imaging an even printing plate (4) or a printing plate (4) mounted on a printing press plate cylinder (2) comprises one or multiple printing plate imaging units (5), the laser diode units (10) of which being operated in phase opposition with a heating element (18) arranged near the laser diode units (10), in order to keep the temperature of the laser diode units (10) essentially constant during the imaging process.

(Fig. 1)

TITLE: **METHOD AND DEVICE FOR REGULATING THE TEMPERATURE IN A LASER-OPERATED PRINTING PLATE IMAGING UNIT OF A PRINTING PRESS, PARTICULARLY OF AN OFFSET PRINTING PRESS**

The invention relates to a method and a device for regulating the temperature in a laser-operated printing plate imaging unit of a printing press, particularly an offset printing press.

For the imaging of printing plates for printing presses, digitally operated imaging units are increasingly used nowadays in addition to the conventional method of film exposure; said imaging units receive the image data in the form of digital bit-patterns generated in the pre-press system and transfer them to the printing plate. For this purpose the imaging units possess a light source and the light from said light source is focused on a respective location of the printing plate through an optical lens system, the light source being switched on or off, depending on whether or not a pixel is to be produced on a respective spot.

US 5,351,617 discloses a laser-operated imaging unit for a printing plate provided with a special coating and mounted on the plate cylinder of an offset printing press, the laser light of said imaging unit being generated through a laser diode unit and being subsequently conducted via an optical light-guiding cable to a optical focusing unit arranged near the plate cylinder, said focusing unit being motorically moved across the surface of the plate cylinder, in parallel with the longitudinal axis of the plate cylinder, and focusing the laser light on the respective spots on the printing plate. By rotating the plate cylinder accordingly, imaging is performed on the entire surface of the printing plate mounted on the cylinder.

US 5,351,617 further shows a device, whereby multiple optical focusing units connected with respective laser-light sources via optical light-guiding cables are moved across an even printing plate to expose it on the respective spot.

With the described imaging units operated by laser diodes there is the problem that the intensity of the laser light is greatly influenced by the temperature of the respective laser-light source, in this case a laser diode. Owing to the known substantially exponential temperature-dependency of the intensity of the generated laser light, temperature variations between 0.5°C and 2°C, in the case of a laser diode, already have such a disadvantageous effect on the imaging results, that the quality deficiencies in the finished printed image caused thereby can easily be noticed by the human eye.

The quality deficiencies occur in that, due to a varying light intensity of the laser light caused by too low or too high temperature of the respective laser diode, the pixels to be produced on the printing plate vary greatly, so that the printed image created through the printing plate shows defects leading to the above described noticeable quality deficiencies.

With the imaging of a printing plate the temperature variations of the laser diodes are particularly caused in that the laser diodes, in their switched-on state, convert a great part of the electric energy fed to them into joulean heat, and in their switched-off state, i. e. in the regions where no imaging takes place, the laser diodes do not generate any heat. In practice, the quality deficiencies occur especially in those areas of the printing plate, where pixels are produced by the respective laser diode unit only sporadically, as the laser diode unit, having been switched off for a longer period of time, has cooled off and

when switched on again, generates a reduced light intensity on account of the required heating-up time.

Therefore, it is the object of the present invention, to provide a method for regulating the temperature in a printing plate imaging unit operated with laser light, whereby the temperature of the laser-light source generating the laser light, particularly a laser diode, can be kept substantially constant by simple means.

It is a further object of the present invention, to provide a device for keeping constant the temperature of the laser-light source of a printing plate imaging unit, particularly a laser diode, by simple means and in an efficient and low-cost way.

This invention offers the special advantage, that even with imaging devices comprising a greater number of individual laser diode units and associated optical focusing systems, a high degree of stability and thereby a high quality level can be achieved when producing the individual pixels on the printing plate over the entire image.

It is a further advantage of the device according to the invention, that existing printing plate imaging units for even or flat printing plates, as well as for printing plates mounted on a plate cylinder, can be retrofitted with said device in simple manner and at low cost.

Further characteristic features and advantages of the invention will be apparent from the following description of exemplary embodiments in view of the accompanying drawings, wherein

Fig. 1 is a schematic view of two printing plate imaging units arranged at a plate cylinder of a printing press, said imaging units including temperature regulator devices according to the invention;

Fig. 2 shows an electric switching plan of a preferred embodiment of the temperature regulator device according to the invention;

Fig. 3 is a diagram of the voltage supplied to the resistor or the laser diode and of the heat quantity given off by the resistor or the diode in a first exemplary embodiment of the invention, in which the voltage of the resistor is regulated down to zero when the laser diode is switched on; and

Fig. 4 is a view of a further embodiment of the invention, in which, in the switched-off state of the laser diode unit, a certain heat quantity is generated by the heating element, said heat quantity being reduced by a predetermined value after the laser diode unit is switched on.

The device 1 for imaging a printing plate 4 mounted on a plate cylinder 2 of a printing press shown in Fig. 1 includes one or multiple, for example, 16 individual printing plate imaging units 5, of which for illustrative reasons only two units are indicated in Fig. 1. The imaging units 5 for imaging a printing plate 4 mounted on a plate cylinder 2 can also be used for imaging evenly extending printing plates. Each of the imaging

units 5 comprises an optical focusing system 6 arranged near the printing plate 4, said focusing system 6 being connected with a laser diode unit 10 via an optical light conductor 8. The optical focusing system 6 focuses the laser light generated by the laser diode unit 10 on a region or spot on the printing plate which is equivalent to a pixel to be produced, thereby removing the surface layer of the printing plate in said region, so that an underlying ink-receptive layer is exposed. The construction and composition of such a printing plate are known, for example, from US 5,351,617 and are not discussed in detail herein.

The laser diode unit 10 is controlled by a control unit 12 causing the laser diode unit 10 to be switched on or off, depending on whether a pixel is to be produced or not in accordance with a bit-pattern created in the pre-press stage.

In the preferred embodiment of the invention shown in Fig. 1 the laser diode units 10 are accommodated in a housing 14 which is fastened to a carrier or basic body 16. Near the laser diode unit 10, preferably within the housing 14, there is arranged a heating element 18 which is actuated by the control unit 12. The actuation of the heating element 18 through the control unit 12 takes place in alternation with or in phase opposition to the laser diode unit 10 in a manner that, when the laser diode unit 10 is switched off, the heating element 18 is actuated to heat up said switched-off laser diode unit 10. When the laser diode unit 10 is switched on, i. e. when imaging the printing plate with a pixel, the heating element 18 is switched off, so that no thermal energy is generated by said heating element 18 during the time the laser diode unit 10 is switched on. In the preferred embodiment of the invention the heating element 18 is formed by an ohmic resistor which is connected in alternation with the laser diode unit 10 to a respective high

or low voltage source. Alternatively, the heating element 18 may be formed of any other electronic component generating joulean heat, which will be connected with a respective power and/or voltage source in phase opposition to the laser diode unit 10. Such a component may be, for example, a transistor, a diode or a so-called Peltier element etc.

Instead of the heating element 18 being arranged in the housing 14 of the laser diode unit 10, as shown in Fig. 1, the heating element 18 can also be arranged outside of the housing 14, for example on said housing 14 or on the carrier body 16. In another embodiment of the invention, there is also the possibility to cool or heat the carrier body 16 of the device 1 carrying the imaging unit 5, for example, in that the carrier body 16 is formed with a hollow interior through which a suitable cooling or heating medium of a desired temperature is streaming, as indicated by the arrows 20, 22. Instead of using a cooling or heating medium streaming through the carrier body 16, the latter can also be heated electrically. Thereby, an independent preheating temperature - which is not dependent on the temperature regulation through the heating element 18 - can be superposed on the laser diode unit 10 and/or the heating element 18, so that, for example, the working point of a printing plate imaging device 1 consisting of multiple units, e. g. 16 printing plate imaging units 5, can, for instance in dependence on the respective environmental temperature, be commonly changed for all imaging units 5.

The regulation of the temperature of the laser diode unit 10 through the heating element 18 can be carried out, for example, through an electronic circuit 30 illustrated in Fig. 2. The circuit 30 comprises a power and/or voltage source 32 having a pole, for example a plus-pole, to which the control unit 12 and

the heating unit 18 and in parallel to the heating unit 18 the laser diode unit 10 are connected. The heating element 18 as well as the laser diode unit 10 are further connected with the second pole of the power and/or voltage source 32 via respectively assigned power transistors 34 and 36. The base of the power transistor 34 associated with the heating element 18 is connected with the control unit 12 preferably via a fixed or controllable resistor 35. The base of the power transistor 36 associated with the laser diode unit 10 is preferably connected with the control unit 12 via a second fixed or controllable resistor 37 as well as via an inverting Schmitt trigger switch 38. The control unit 12 controls the bases of the power transistors 34 and 36 in phase-opposition operation or push-pull operation, so that when the laser diode unit 10 is switched off, current flows through the heating element 18 and the electric magnitude of the current can be set via the resistor 35 accordingly for the respective heating element 18 of a printing plate imaging unit 5, whereby the signal supplied to the base of the power transistor 36 associated with the laser diode unit 10 is inverted, due to the inverting Schmitt trigger switch 38, so that the power transistor 36 is locked and the laser diode unit 10 remains switched off. For switching on the laser diode unit 10 a signal of reversed polarity is generated by the control unit 12 and the power transistor 34 of the heating element 18 is locked accordingly, and the power transistor 36 is switched through and becomes conductive, due to the inverting effect of the Schmitt trigger switch 38, so that current flows through the laser diode unit 10, the electric magnitude of which being adjustable via the resistor 37. The control unit 12 generates the signals in dependence on a pixel to be produced on the printing plate 4.

The course of the voltage UR supplied to the heating element 18 as well as the course of the voltage ULD supplied to the laser diode unit 10 are illustrated in Fig. 3 in idealized form. As it can be seen from Fig. 3, the heating element 18, during the preheating phase V, is connected with the voltage source 32 or equivalently with a respective power source, thereby giving off a certain heat quantity QR, the amount of which being preferably regulated via the controllable resistor 35 such, that the temperature of the laser diode unit 10, which is switched off at this time, is set to a desired working temperature. The voltage ULD supplied to the laser diode unit 10 during the preheating phase V in this embodiment of the invention is preferably equal to zero volt, so that the heat quantity per time unit generated by the laser diode unit 10 is accordingly equal to 0 Joule. In the subsequent imaging phase B the laser diode unit 10 is switched on by connecting it to the voltage ULD and simultaneously, i. e. in alternation or phase opposition, the heating element 18 is switched off. In this embodiment of the invention the heat quantity per time unit QLD given off by the laser diode unit 10 and the heat quantity per time unit QR given off by the heating element 18 are preferably essentially equal, whereby the heat quantity QR given off by the heating element 18 can also be smaller or larger than the heat quantity QLD given off by the laser diode unit 10, depending on the arrangement of the heating element 18 or the preheating of the carrier body 16 or the total of the given-off thermal energy. A balancing or adjustment of the heat quantities can be performed, for example, via the controllable resistors 35, 37 of the circuit shown in Fig. 2, preferably such, that the temperature variations between the switched-on state and switched-off state of the laser diode unit 10 are minimized.

In a further embodiment of the invention shown in Fig. 4, the heating element 18 is also supplied with a preferably adjustable basic voltage UR1 or respective basic current, when the laser diode unit 10 is switched on, and the heating element 18 gives off a first basic heat quantity QR1 which is illustrated in the upper diagram of Fig. 4. When the laser diode unit 10 is switched off, the heating element 18 is supplied with a second higher voltage UR2 and generates a heat quantity QR2 per time unit. The difference between the heat quantities QR1 and QR2 given off by the heating element 18 in this embodiment of the invention is preferably selected such, that the temperature variations or the temperature difference between the switched-off and the switched-on state of the laser diode unit 10 will be minimal. The thermal energy value of the heat quantity QR1 generated by the heating element 18 in the switched-on state of the laser diode unit 10 is preferably equal to the value of the heat quantity QR2 , reduced by the difference between the heat quantity QLD given off by the laser diode unit 10 and the heat quantity QR2 ; or as expressed in the following formula:

$$QR1 = QR2 - (QLD - QR2),$$

whereby the heat quantity QR2 is preferably smaller than the heat quantity QLD .

The heat quantities QR1 , QR2 and QLD as well as the respective voltages UR1 , UR2 and ULD , particularly the difference between QR2 and QR1 , may, however, have another value which is preferably empirically determined - in dependence on the heat quantity per time unit given off to the environment, the thermal conductivity of the individual components, the arrangement and design of the heating element 18, the preheating of the carrier body 16 or the housing 14 etc.- by setting the voltage and/or power via the

controllable resistors 35, 37 such , that the temperature differences of the laser diode unit 10 will be minimal.

The switching-on of the laser diode unit 10 and the corresponding switching-off of the heating element 18 preferably take place simultaneously. However, it is also possible that the time periods in which the laser diode unit 10 is switched on and the heating element 18 is switched off overlap, so that, for example, the heating element 18 can already be switched on before the laser diode unit 10 is switched off. In the same way, the heating element 18 can remain switched on for a short period of time beyond the time when the laser diode unit 10 is switched on.

In a further embodiment of the invention not shown in the drawings, the carrier body 16 or the laser diode unit 10 and/or its housing may be provided with a layer of thermal insulating material, so that variations of the environmental temperature have little or no influence on the temperature of the laser diode units 10.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Method for regulating the temperature in a printing plate imaging unit of a printing press, particularly an offset printing press, said imaging unit operating with laser light generated by a laser diode unit which is switched on and off in dependence on an image pattern to be produced on the printing plate, wherein a heat source arranged near the laser diode unit is operated in alternation with the laser diode unit such, that the temperature of the laser diode unit is substantially constant.

2. Method according to Claim 1,
wherein the heat quantity per time unit given off by the heat source is increased in the switched-off state of the laser diode unit and is decreased in the switched-on state of the laser diode unit.

3 Method according to Claim 1 or 2,
wherein the heat quantity per time unit given off by the heat source is essentially equal to the heat quantity per time unit given off by the laser diode unit.

4. Method according to Claim 1 or 2,
wherein in the switched-on state of the laser diode unit, the heat source gives off a given basic heat quantity per time unit which is smaller than the heat quantity per time unit given off by the laser diode unit, and
whereby in the switched-off state of the laser diode unit, the heat source gives off a second larger heat quantity, with the first and second heat quantities being such, that the temperature difference between the switched-on and the switched-off state of the laser diode unit will be minimal.

5. Method according to Claim 4,
wherein the difference between the first and second heat quantities is essentially equal to the difference between the heat quantity given off by the switched-on laser diode unit and the second heat quantity.

6. Method according to anyone of the preceding claims, wherein the laser diode unit and/or the heat source are preheated or cooled to a predetermined temperature.

7. Method according to anyone of the preceding claims, wherein the laser diode units and/or the heat sources are thermally insulated against the environment.

8. Device for regulating the temperature in a laser-operated printing plate imaging unit of a printing press, particularly an offset printing press, the laser light being generated by at least one laser diode unit which is switched on and off in dependence on the pixel pattern to be produced on the printing plate,
wherein in the vicinity of the laser diode unit (10) there is arranged an electric heating element (18) which, in alternation with the laser diode unit (10), generates a first heat quantity (QR1) in the switched-on state of the laser diode unit 10 and which generates a second larger heat quantity (QR2) in the switched-off state of the laser diode unit (10).

9. Device according to Claim 8,
wherein the second heat quantity (QR2) is essentially equal to the heat quantity (QLD) generated by the laser diode unit (10), and the first, smaller heat quantity (QR1) has a value of zero.

10. Device according to Claim 8,
wherein the value of second heat quantity (QR2) generated by the heating element (18) in the switched-off state of the laser diode unit (10) is such, that the temperature of the laser diode unit (10) is equal to a predetermined reference value.

11. Device according to Claim 10,
wherein the first heat quantity (QR1) generated by the heating element (18) in the switched-on state of the laser diode unit (10) has a value equal to the second heat quantity (QR2), reduced by the difference between the heat quantity (QLD) generated by the laser diode unit (10) and the second heat quantity (QR2).

12. Device according to anyone of the Claims 8 to 11,
wherein the heating element (18) consists of an electric component generating joulean heat, said electric component being connected to an electric voltage and/or power source (32) in accordance with the heat quantity to be generated.

13. Device according to Claim 12,
wherein there are provided an electronic phase opposition circuit (30) comprising a first power transistor (34) controlled by a control unit (12) for regulating the current flow through the heating element (18) and a second power transistor (36) controlled by the control unit (12) via an inverting Schmitt trigger switch (38) for regulating the current flow through the laser diode unit (10).

Fig.1

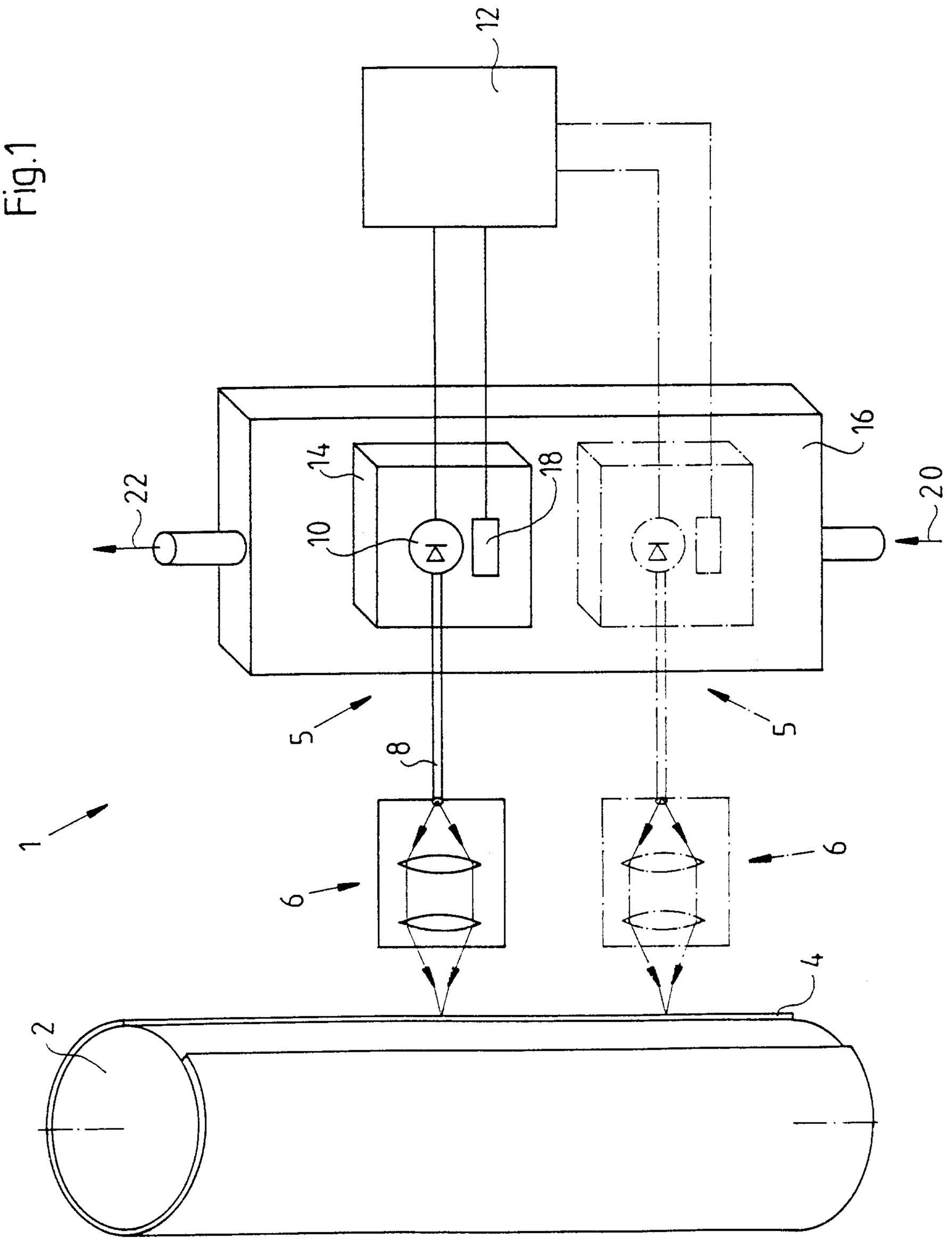


Fig.2

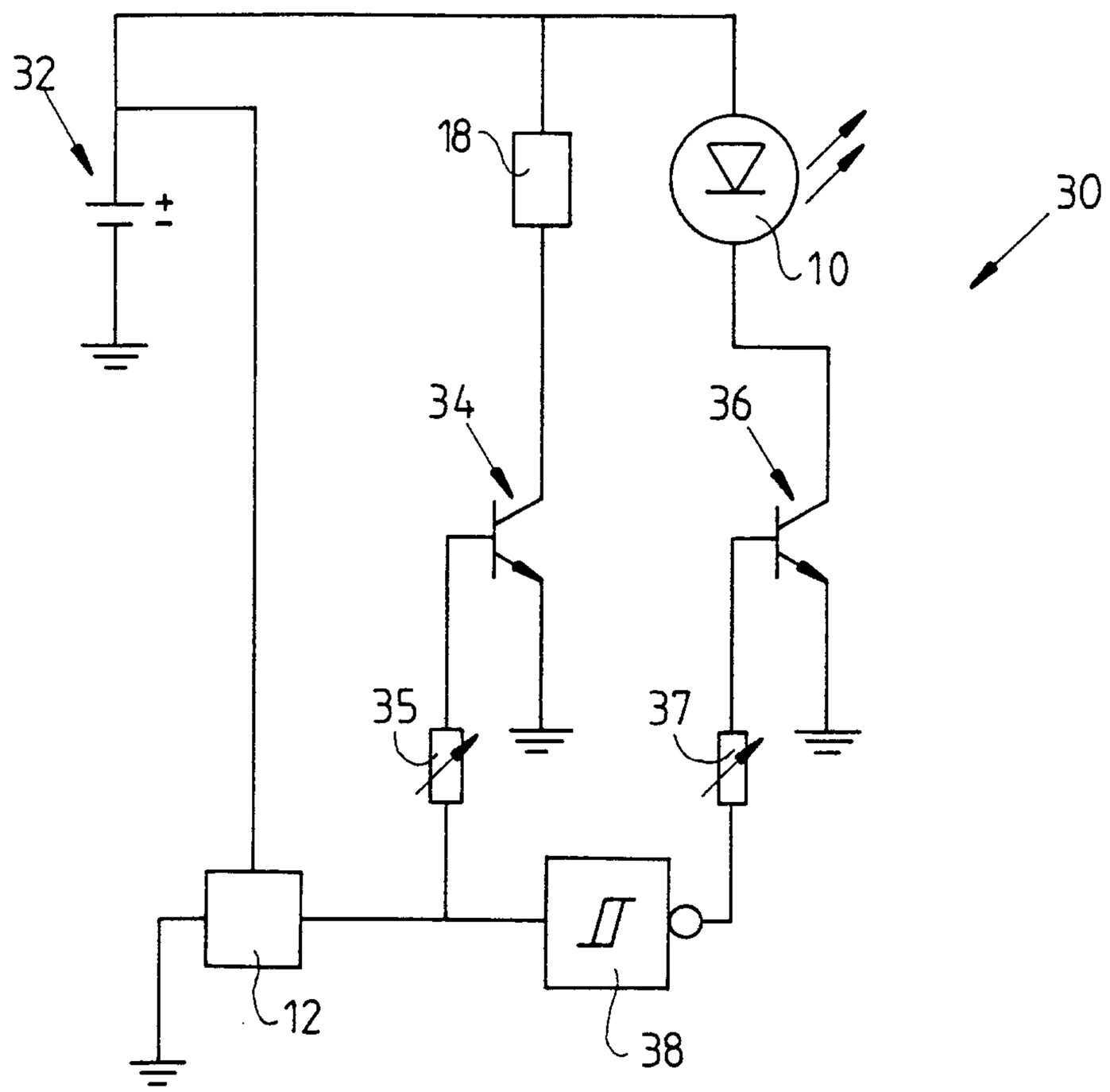


Fig.3

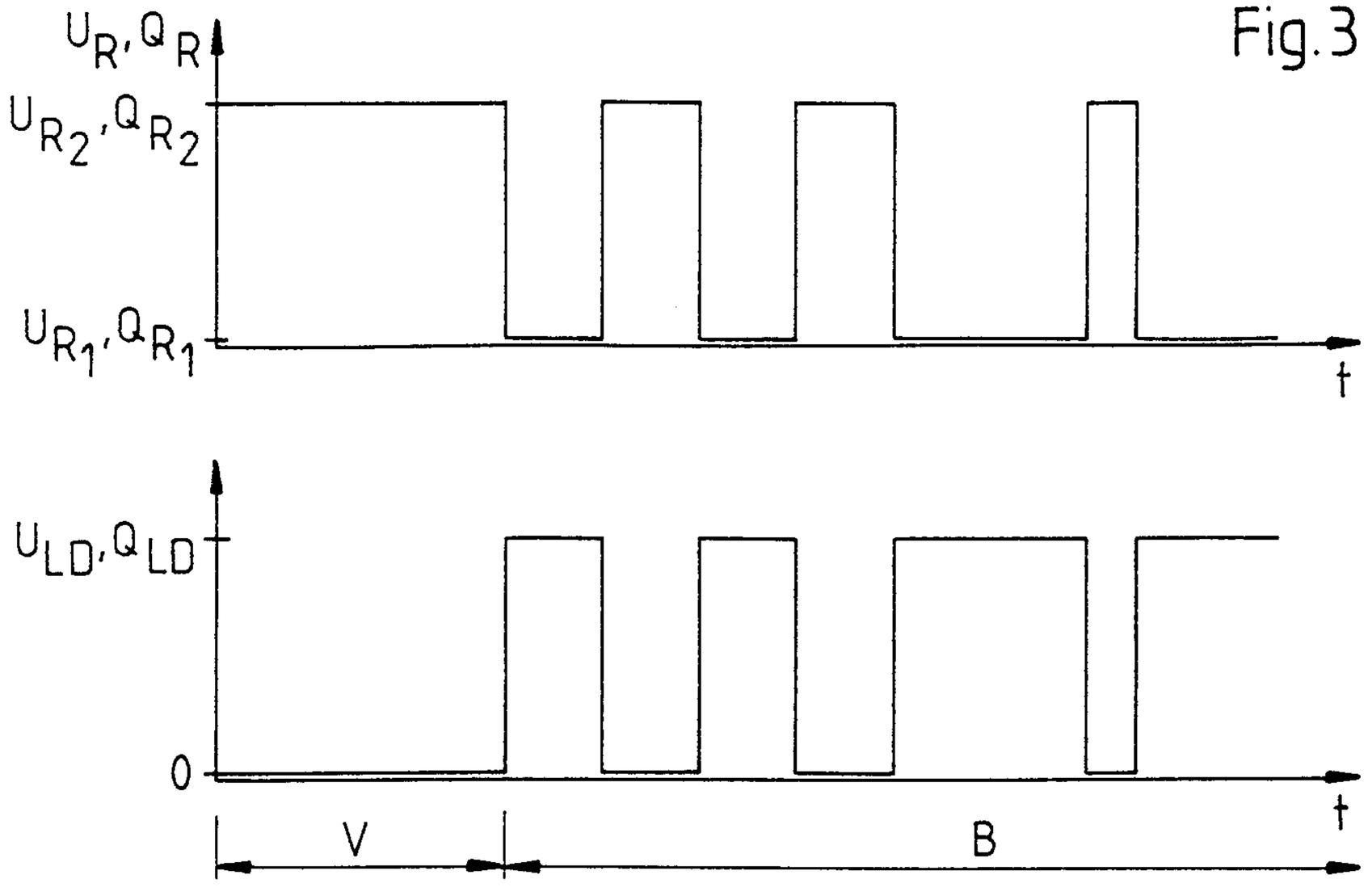

U_R, Q_R
U_{R_2}, Q_{R_2}
U_{R_1}, Q_{R_1}
t
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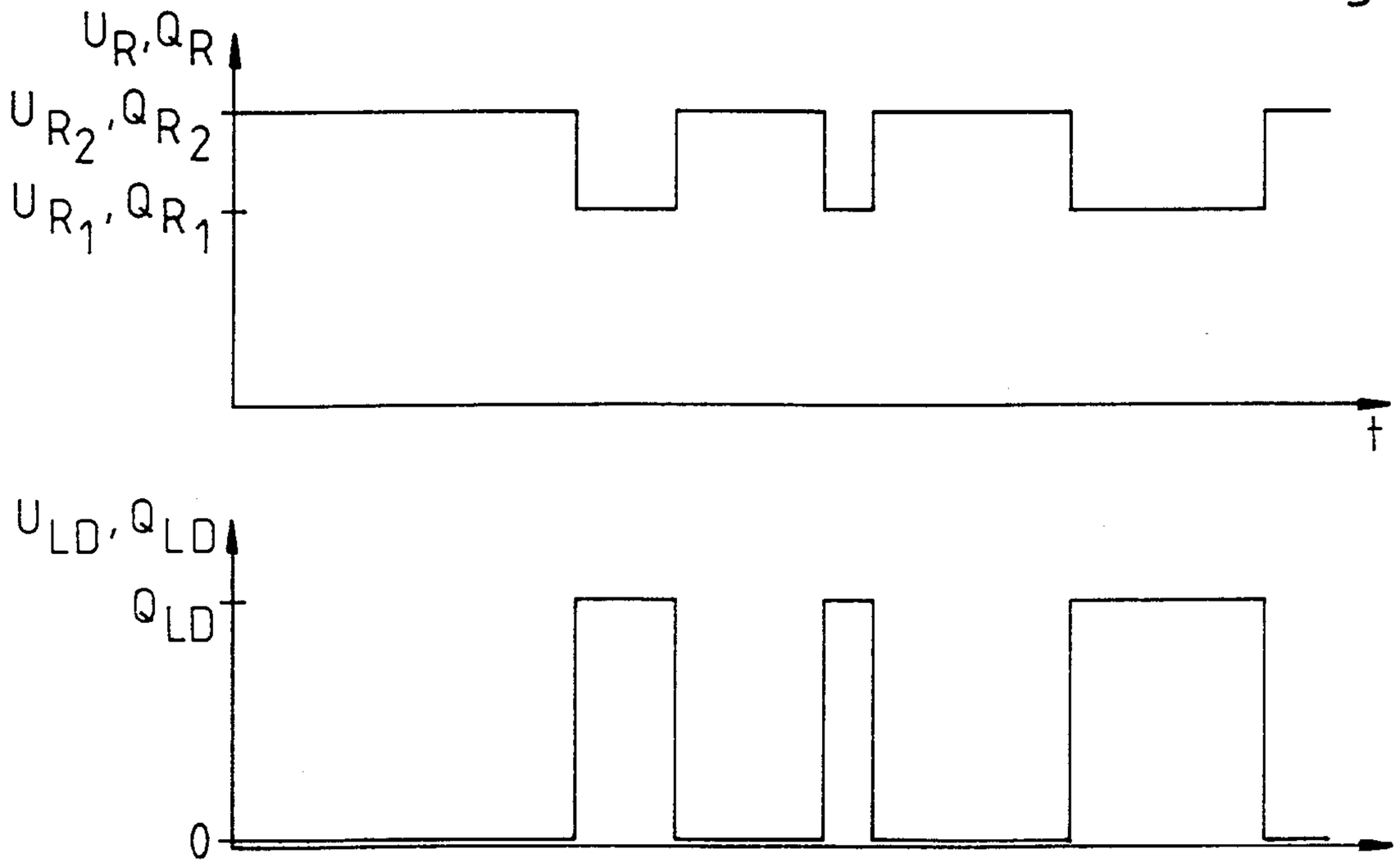
Fig.4


U_R, Q_R
U_{R_2}, Q_{R_2}
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LIST OF REFERENCE NUMERALS

1 imaging device
2 plate cylinder
4 printing plate
5 imaging unit
6 optical focusing system
8 optical light conductor
10 laser diode unit
12 control unit
14 housing
16 carrier body
18 heating element
20 arrow
22 arrow
30 electronic circuit
32 power/voltage source
34 power transistor
35 controllable resistor
36 power transistor
37 controllable resistor
38 Schmitt trigger switch

V preheat phase
B imaging phase