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(54) **Camera unit for surveying a railway track**

(57) A camera unit for surveying a railway track (1,2) is described, which comprises a housing (3), a camera positioned therein and lighting means for lighting the railway. The camera is a matrix camera and the lighting means comprise light emitting diodes. Preferably a number of cameras, for example nine, are provided in said housing (3) which are positioned along a line extending substantially transversally to the railway track to be surveyed.

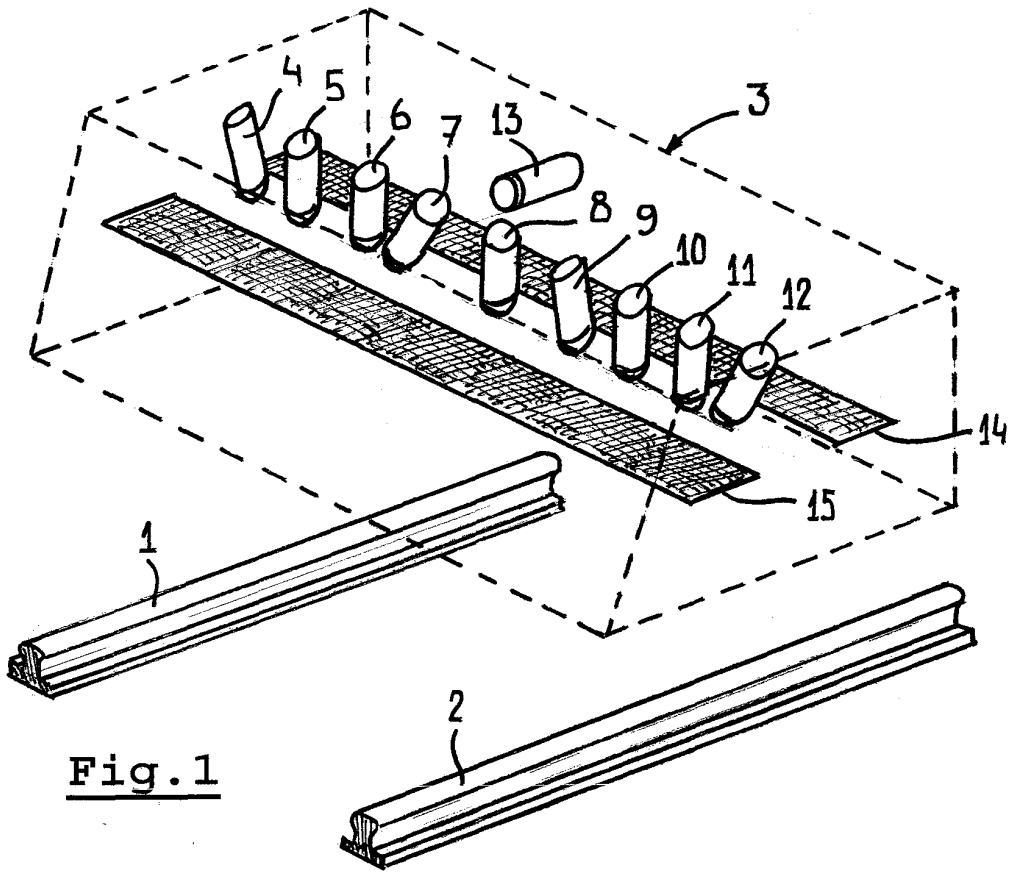

Fig.1

EP 1 970 279 A1

Description

[0001] The invention relates to a camera unit for surveying a railway track, comprising a housing, a camera positioned therein and lighting means for lighting the railway,

[0002] A known camera unit of this type is provided with a line camera which scans the entire width of the railway track line by line, and is carried by a railway vehicle.

[0003] There is a constant need for increasing the velocity with which a railway track can be surveyed without adversely influencing the surveying quality. The use of a line camera, however, does not or hardly allow such an increase of the surveying velocity. High surveying velocities (thus moving the camera unit with a high speed along the railway track) would lead to frame rates of the line camera which are almost impossible to achieve. Further, if such high frame rates would be possible, an extremely large amount of data would have to be processed every second, which also imposes large difficulties on the system.

[0004] Thus, it is an object of the present invention to provide an improved camera unit which offers the possibility of surveying at a high speed and with sufficient quality.

[0005] In accordance with the present invention, a camera unit of the type referred to above is characterised in that the camera is a matrix camera and in that the lighting means comprise light emitting diodes (LEDs).

[0006] A matrix camera does not scan or survey the railway track one-dimensionally (line by line) as is the case with the state of the art line camera, but makes two-dimensional images. As a result, for surveying or scanning a railway track with high velocity only frame rates are needed which can be achieved without any problem. Moreover, using light emitting diodes (LEDs) as lighting means makes it possible to achieve the required illumination of the railway track for making the images without an excessive power consumption.

[0007] Preferably, a number of cameras are provided in said housing which are positioned along a line extending substantially transversally to the railway track to be surveyed. Together these cameras will cover the entire width of the railway track, thus surveying latter in an appropriate manner.

[0008] In a preferred embodiment of the camera unit, some of the cameras are directed vertically downwards, whereas other cameras are directed inclined downwards. Cameras directed vertically downwards are fit best for surveying horizontally extending surfaces of parts of the railway track, whereas the cameras directed inclined downwards also can be used for surveying surfaces of parts of the railway track extending vertically or inclined (such as for example the sides of the rails).

[0009] In a specific embodiment, nine cameras are positioned along said line, with a central camera directed vertically downwards and positioned in a vertical plane of symmetry of the railway track and with, at each side of the central camera, a first inner pair of cameras comprising a camera directed vertically downwards and a camera directed inclined downwards and outwards, and a second outer pair of cameras comprising a camera directed vertically downwards and a camera directed inclined downwards and inwards, wherein a vertical plane extending through each of the rails of the railway track extends between the corresponding first and second pairs of cameras.

[0010] The central camera and the vertically downwards directed cameras of the first inner pairs of cameras together survey the section of the railway track between the rails. The two cameras of the first inner pairs of cameras directed inclined downwards and outwards will scan the two side faces of the rails facing towards each other, whereas the two cameras of the second outer pairs of cameras directed inclined downwards and inwards will scan the side faces of the rails facing away from each other. Finally the two cameras of the second outer pairs of cameras directed vertically downwards survey the outer parts of the railway track, outside of the rails.

[0011] Further it is advantageous, when the camera unit in accordance with the present invention also is provided with a camera directing substantially forward in a direction in parallel to the railway track. 'Forward' means in the direction of movement of the railway vehicle supporting the camera unit. Such a forward directing camera can be used for surveying or scanning structures surrounding the railway track.

[0012] When the position of at least some of the cameras is adjustable, the camera unit can be adapted to changing circumstances.

[0013] Further, it is preferred that the LEDs are positioned into arrays extending in parallel to and at both sides of the line of cameras. In such an arrangement of the LEDs and optimised illumination of the railway track may be obtained.

[0014] Underneath the cameras and LEDs transparent cover plates may be provided, protecting the camera(s) and LEDs against environmental influences (incoming fluids, dust etcetera).

[0015] The illumination-effect of the LEDs further may be improved by providing the housing with inner reflector means for reflecting the light emitted by the LEDs. For example, two spaced and inclined reflector plates extending substantially in parallel to the arrays of LEDs could be provided.

[0016] In a special embodiment, the camera unit comprises control means for controlling the matrix camera(s) with a frame rate in a range of 40-120 frames/sec., preferably 80 frames/sec. Such a frame range generally will allow a surveying velocity (velocity of the railway vehicle) which is sufficiently high.

[0017] Whereas in a state of the art camera unit the lighting means generally operate continuously, in accordance with the present invention it is preferred that the LEDs are intermittently activated, with an activation time

equivalent to the shutter time of the camera(s). This further reduces the power need.

[0018] Preferably the LEDs, which could be of a novel improved type such as the Lumiled™ type, are overpowered during activation. Such an overpowering of the LEDS leads to a further improved illumination, however because of the reduced activation time which is equivalent to the shutter time of the camera(s), the LEDs are not overloaded or damaged.

[0019] In a specific embodiment, the shutter time of the camera(s) is in a range of 20-40 μs, preferably 30 μs.

[0020] It has been found, that when the image of a matrix camera covers an area of substantially 50 cm wide and 40 cm long, in combination with the above mentioned frame rate surveying velocities well over 100 km/hr may be employed.

[0021] Finally, the camera unit might comprise data storage means for storing the images recorded by the matrix camera(s). When the survey has been completed, the data stored on said data storage means can be retrieved for further processing. However, it also is possible that the images captured by the matrix camera(s) are directly transmitted to external means by means of a transmitter/receiver assembly.

[0022] The camera unit in accordance with the present invention is extremely fit for connection to a railway vehicle. The housing, in which all parts of the camera unit are housed, then may be provided with appropriate means for attaching the camera unit to such a railway vehicle.

[0023] Hereinafter the invention will be elucidated while referring to the drawing, in which an embodiment of a camera unit in accordance with the present invention is illustrated.

Figure 1 shows extremely schematically and in a perspective view an embodiment of a camera unit in accordance with the present invention;
figure 2 shows, again schematically, the camera unit of figure 1 in a frontal view;
figure 3 shows, with more details but still schematically, a cross section of the camera unit illustrated in figure 1, and
figure 4 shows a bottom view of the camera unit illustrated in figure 3.

[0024] Firstly referring to figure 1, part of a railway track comprising two rails 1 and 2 is illustrated.

[0025] A housing 3 which comprises the camera unit for surveying the railway track, is, in a manner not shown further, connected to a railway vehicle (not shown either) which will move along the rails 1, 2. The housing 3, which is open at its base, only has been indicated schematically in dotted lines.

[0026] Within the housing nine cameras 4-12 are provided which are positioned along a line extending substantially transversally to the rails 1, 2. On top of the housing 3 a camera 13 is provided directed substantially forward in a direction in parallel to the rails 1, 2 (i.e. in the direction of movement of the railway vehicle supporting the camera unit).

[0027] Cameras 5, 6, 8, 10 and 11 are directed vertically downwards. Camera 8 is centrally positioned and will survey a central section of the railway track. Cameras 5 and 6 will survey sections of the railway track on opposite sides of rail 1, whereas cameras 10 and 11 will survey sections of the railway track on opposite sides of rail 2.

[0028] Cameras 7 and 9 are directed inclined downwards and outwards, such as to survey the inner sides of rails 1 and 2 facing towards each other. Likewise, cameras 4 and 12 are directed inclined downwards and inwardly, such a to survey the outer sides of the rails 1 and 2 facing away from each other.

[0029] Top camera 13 can be used to survey structures surrounding the railway track and may give a general impression thereof.

[0030] The housing 3 further comprises two arrays 14 and 15 of LEDs, which are facing downwards and emit light towards the railway track. The two arrays 14, 15 of LEDS extend substantially in parallel to and at both sides of the line of cameras 4-12. Each array 14, 15 may comprise tens of thousands of LEDs.

[0031] Figure 2 shows in a frontal view the camera unit discussed in figure 1. From figure 2 the different orientations of the cameras 4-12 and 13 discussed above appear clearly. Further it becomes clear, that an imaginary vertical plane extending through rail 1 (schematically indicated by a dotted line P1) would extend between the inner pair of cameras 6,7 and the outer pair of cameras 4, 5. The same applies for rail 2 and cameras 9, 10 and 11, 12 respectively (vertical plane P2).

[0032] Now reference is made to figure 3. A housing 3 is shown schematically and in a cross section. At its frontal side the housing 3 is provided with a cover 16 which may be opened to make the inner parts of the housing 3 readily accessible. The lower side of the housing 3 is open.

[0033] Two mounting plates 17 connected to the housing 3 carry the two arrays 14 and 15 of LEDs. The mounting plates 17 are interconnected by bridges 18 extending vertically and carrying the cameras 4-13. In figure 3 the bridge 18 is provided with slots 19 cooperating with mounting means 20 (bolts, screws etc.) for a camera, such that the position of the camera is adjustable. It is noted, that such an adjustment could occur in any direction, and not only in the plane of the drawing.

[0034] From figure 3 it further appears, that the arrays 14 and 15 of LEDs extend at a lower level than the cameras 4-13. Further, two spaced reflector plates 21 and 22 are shown which are helpful in reflecting the light emitted by the diodes towards the railway track. Between the reflector plates 21, 22 a transparent cover plate 23 is provided protecting the arrays of LEDs 14, 15 and cameras 4-13 from environmental influences (such as for example water, dust etc.).

[0035] At the top of the housing 3 a passage 24 may be provided for passing through cables 25, such as for example for connecting the arrays of LEDs 14, 15 and the cameras 4-13 with appropriate equipment.

[0036] Finally, in figure 3 schematically connecting means 26 have been illustrated which may be used for connecting the housing 3 to a unit by means of which the assembly may be supported by a railway vehicle, such as the buffers thereof.

[0037] Within the housing 3 there is sufficient room for housing several equipment, such as data storage means, power means, transmitter/receiver means etcetera.

[0038] Figure 4 again shows the camera unit illustrated in figure 3, as shown from below. The cover plate 23, however, has not been illustrated here. Specifically, said part of the camera unit has been illustrated which is provided with cameras 9-12.

[0039] It is noted, that in figure 4 only a small part of the array 14 of LEDs has been represented with its LEDs indicated; one should realise, however, that the entire extent of said arrays 14, 15 is provided with such LEDs.

[0040] A preferred LED for application in the camera unit is the LED of the Lumiled™ type, which is marketed by Lumileds lighting, LLC of San José, California, U.S.A.

[0041] The invention is not limited to the embodiment described before, which may be varied widely within the scope of the invention as defined the appending claims.

Claims

1. Camera unit for surveying a railway track, comprising a housing, a camera positioned therein and lighting means for lighting the railway, **characterized in that** the camera is a matrix camera and **in that** the lighting means comprise light emitting diodes (LEDs).

2. Camera unit according to claim 1, wherein a number of cameras are provided in said housing which are positioned along a line extending substantially transversally to the railway track to be surveyed.

3. Camera unit according to claim 2, wherein some of the cameras are directed vertically downwards, whereas other cameras are directed inclined downwards.

4. Camera unit according to claim 3, wherein nine cameras are positioned along said line, with a central camera directed vertically downwards and positioned in a vertical plane of symmetry of the railway track and with, at each side of the central camera, a first inner pair of cameras comprising a camera directed verticaly downwards and a camera directed inclined downwards and outwards, and a second outer pair of cameras comprising a camera directed vertically downwards and a camera directed inclined downwards and inwards, wherein a vertical plane extending through each of the rails of the railway track extends between the corresponding first and second pairs of cameras.

5. Camera unit according to claim 4, wherein the vertically directed cameras of the corresponding first and second pairs of cameras are positioned adjacent to each other.

6. Camera unit according to one of the claims 2-5, wherein there is also provided a camera directing substantially forward in a direction in parallel to the railway track.

7. Camera unit according to any of the claims 2-6, wherein the position of at least some of the cameras is adjustable.

8. Camera unit according to any of the claims 2-7, wherein the LEDs are positioned in two arrays extending in parallel to and at both sides of the line of cameras.

9. Camera unit according to claim 8, wherein the arrays of LEDs are positioned at a lower level than the cameras.

10. Camera unit according to any of the previous claims, wherein underneath the camera(s) and LEDs transparant cover plates are provided.

11. Camera unit according to any of the previous claims, wherein the LEDs are of the Lumiled™ type.

12. Camera unit according to any of the previous claims, wherein the housing further is provided with inner reflector means for reflecting the light emmited by the LEDs.

13. Camera unit according to claim 12 and claim 8, wherein the reflector means comprise two spaced and inclined reflector plates extending substantially in parallel to the arrays of LEDs.

14. Camera unit according to any of the previous claims, comprising control means for controlling the matrix camera(s) with a frame rate in the range of 40 - 120 frames/sec.

15. Camera unit according to claim 14, wherein the frame rate depends upon the velocity with which the camera unit is moved along the railway track.

16. Camera unit according to claim 14 or 15, wherein the LEDs are intermittently activated, with an activation time equivalent to the shutter time of the camera (s).

17. Camera unit according to claim 16, wherein the LEDs are overpowered during activation.

18. Camera unit according to claim 16 or 17, wherein the shutter time of the camera(s) is in the range of 20 - 40 μs.

19. Camera unit according to any of the previous claims, wherein the image of a matrix camera covers an area of substantially 50 cm wide and 40 cm long.

20. Camera unit according to any of the previous claims, wherein data storage means are provided for storing the images recorded by the matrix camera(s).

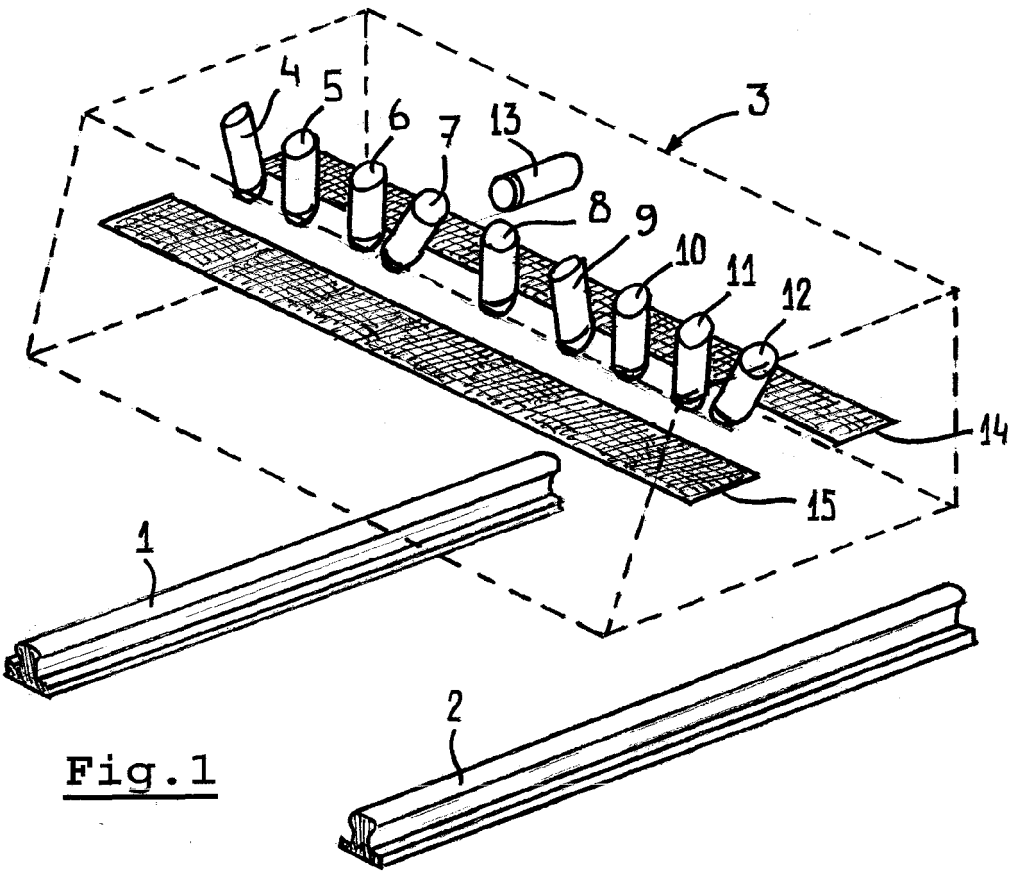

Fig.1

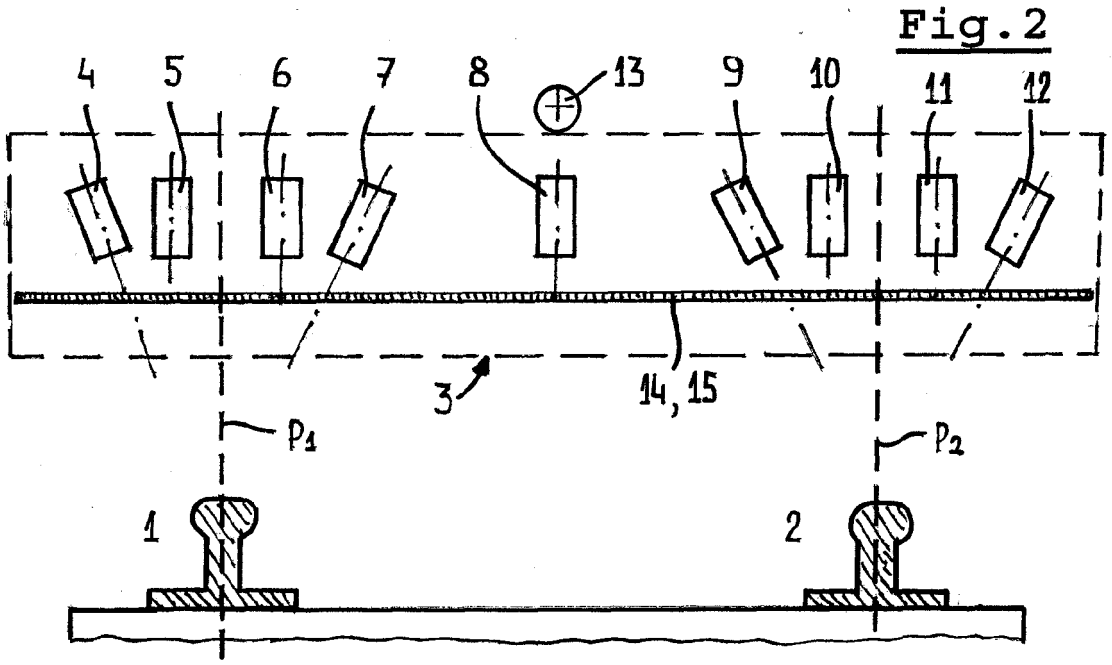

Fig.2

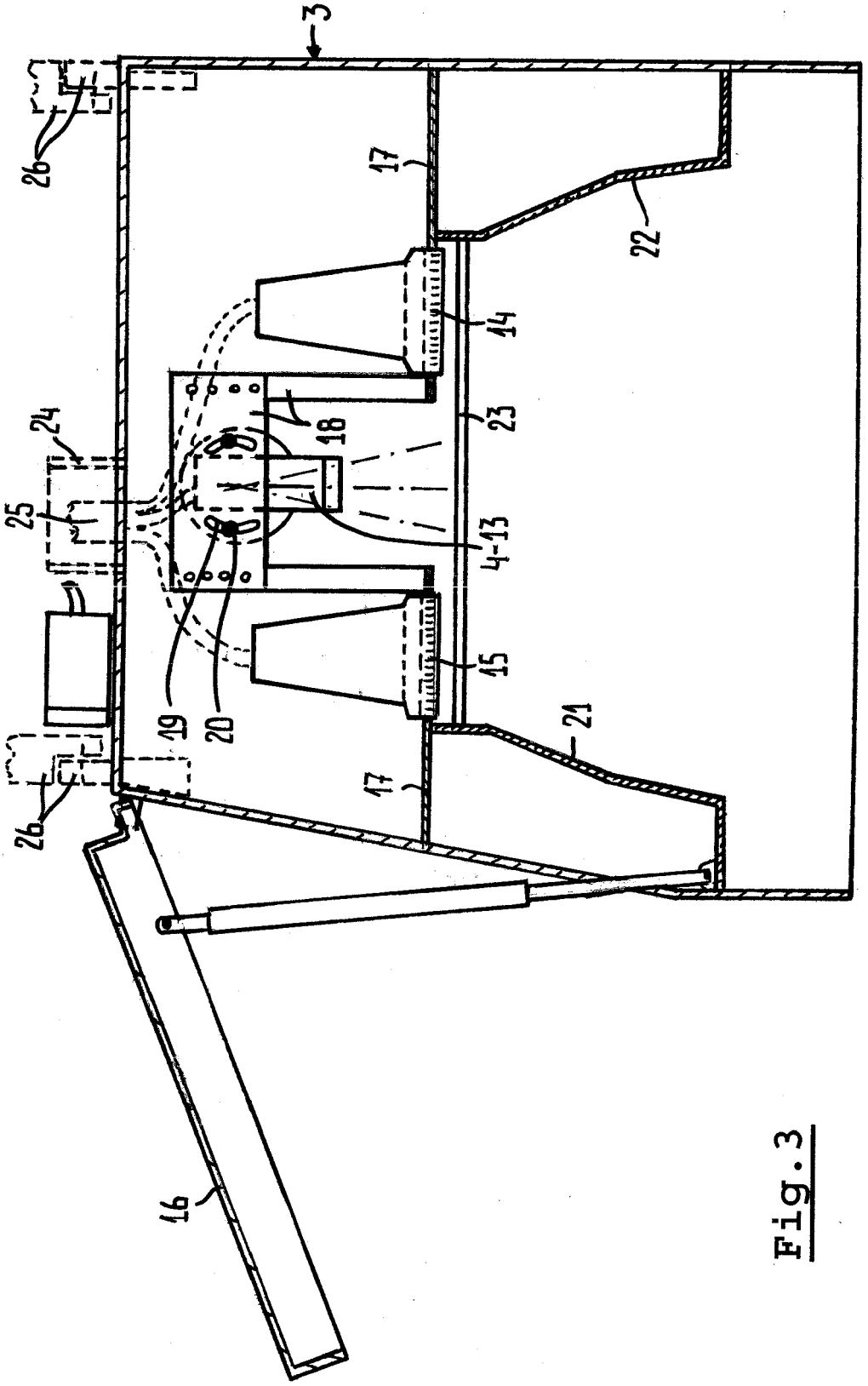

Fig.3

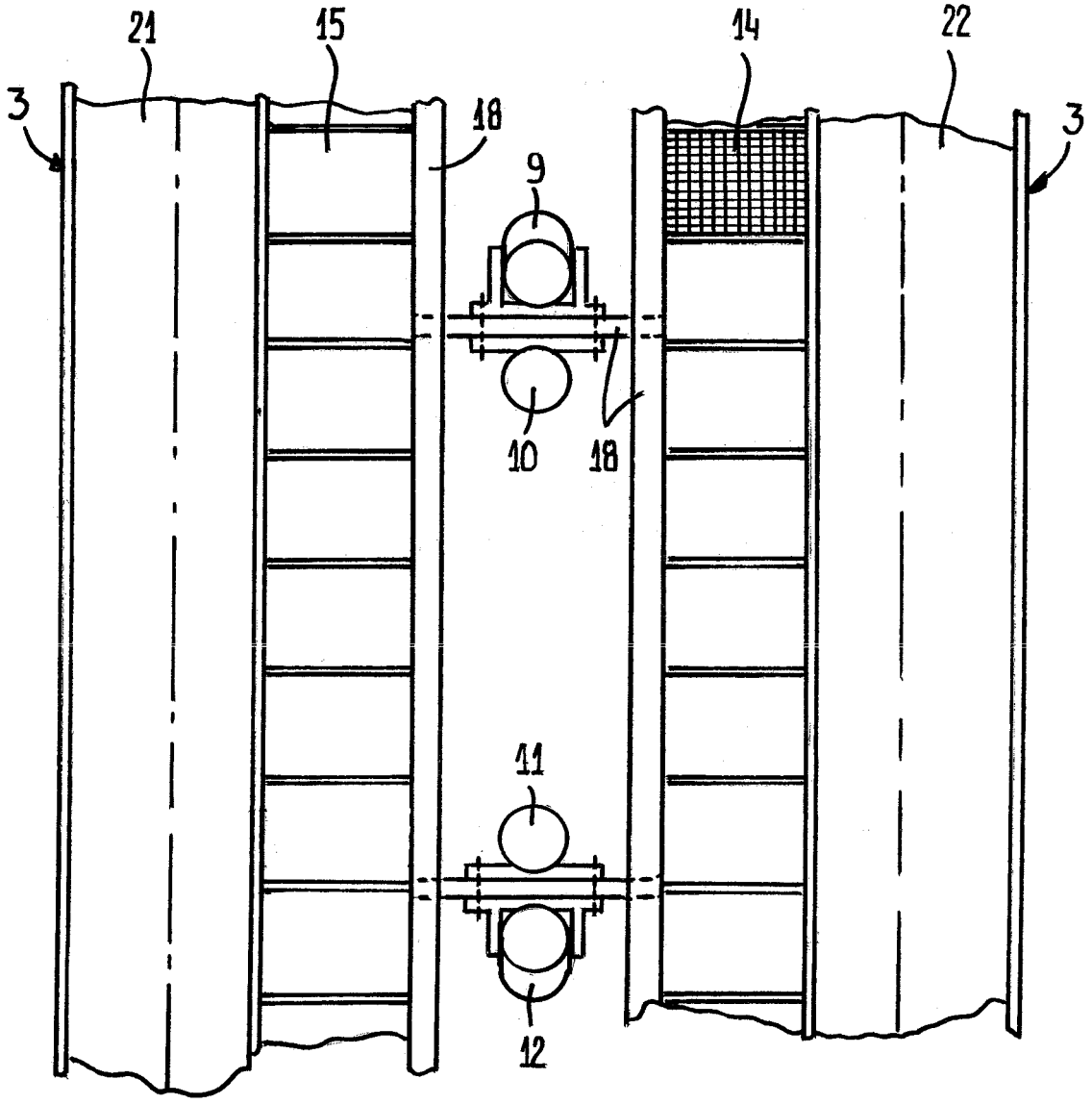

Fig.4

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EUROPEAN SEARCH REPORT

Application Number
EP 07 10 3903

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 1 236 634 A (DIGITAL IMAGE RES LTD [GB]) 4 September 2002 (2002-09-04) * paragraphs [0114], [0115], [0119], [0138], [0139], [0172] - [0174]; figures 5,11 *	1,2,16, 20	INV. B61K9/08
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TECHNICAL FIELDS SEARCHED (IPC)

B61K
B61L
E01B
G01B
G01N
F21V
F21K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	25 July 2007	Chlosta, Peter

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 10 3903

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25-07-2007

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82