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## (54) Angled irradiation of a tiltable surface

(57) The apparatus comprises two radiators, preferably infrared radiators 6,7, present in a housing 3 which is parallel to and preferably above a tiltable surface 1. The radiators are arranged mirror-symmetrically about a vertical plane 9 which passes through the axis of rotation of the tiltable surface so that the beams of radiation intersect at point on the vertical plane 8. Several pairs of radiators may be used. The apparatus allows uniform irradiation of a tilted surface and is intended for use in paediatric care.

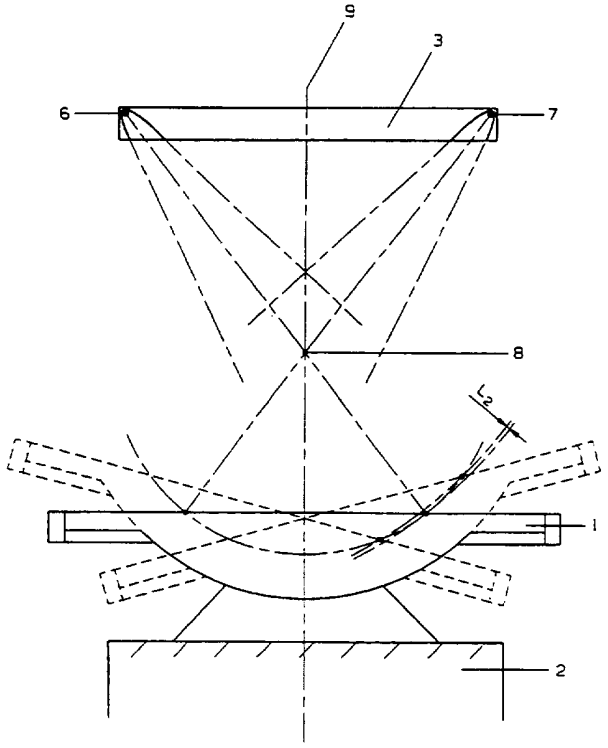


Fig.2

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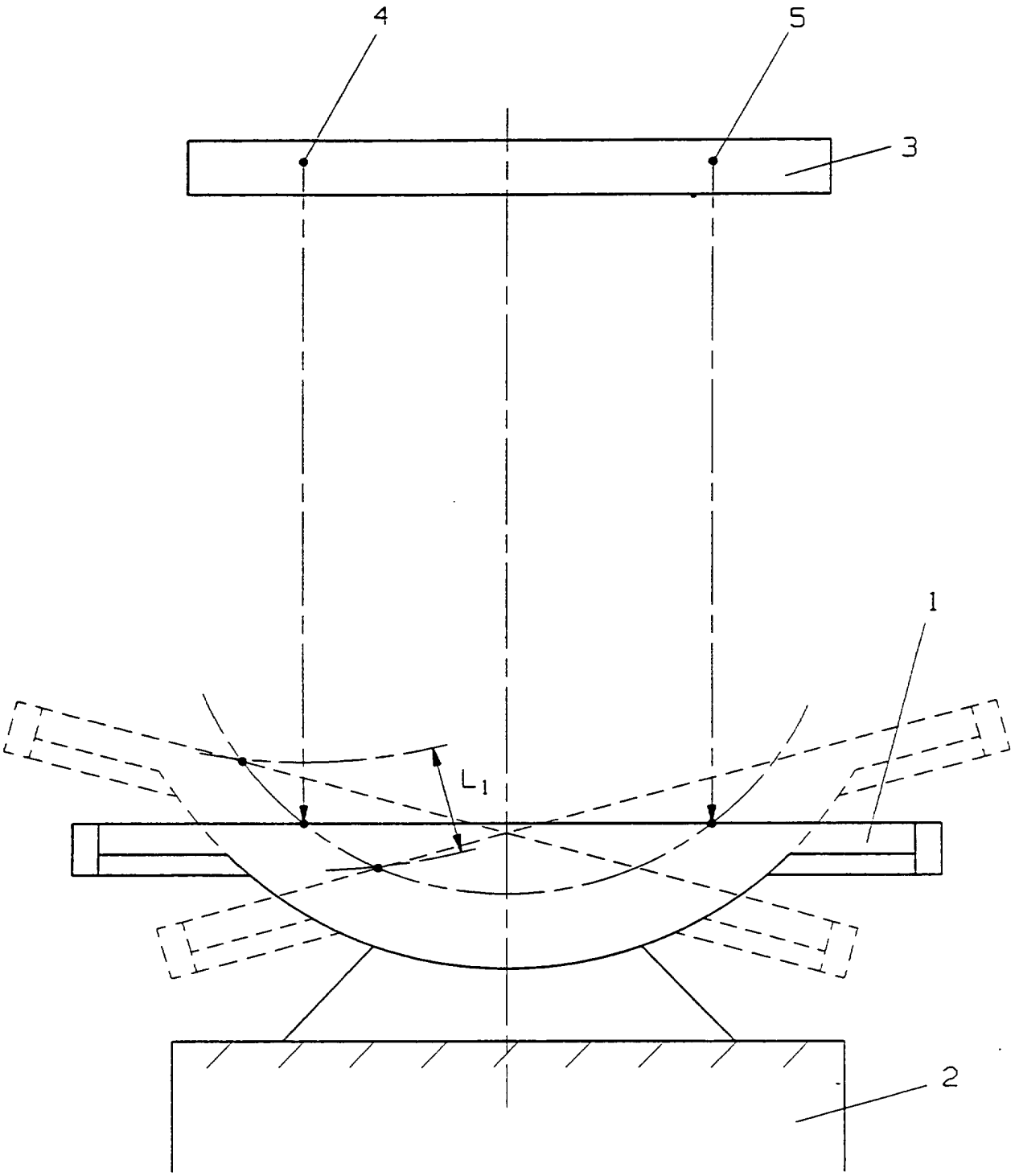


Fig. 1

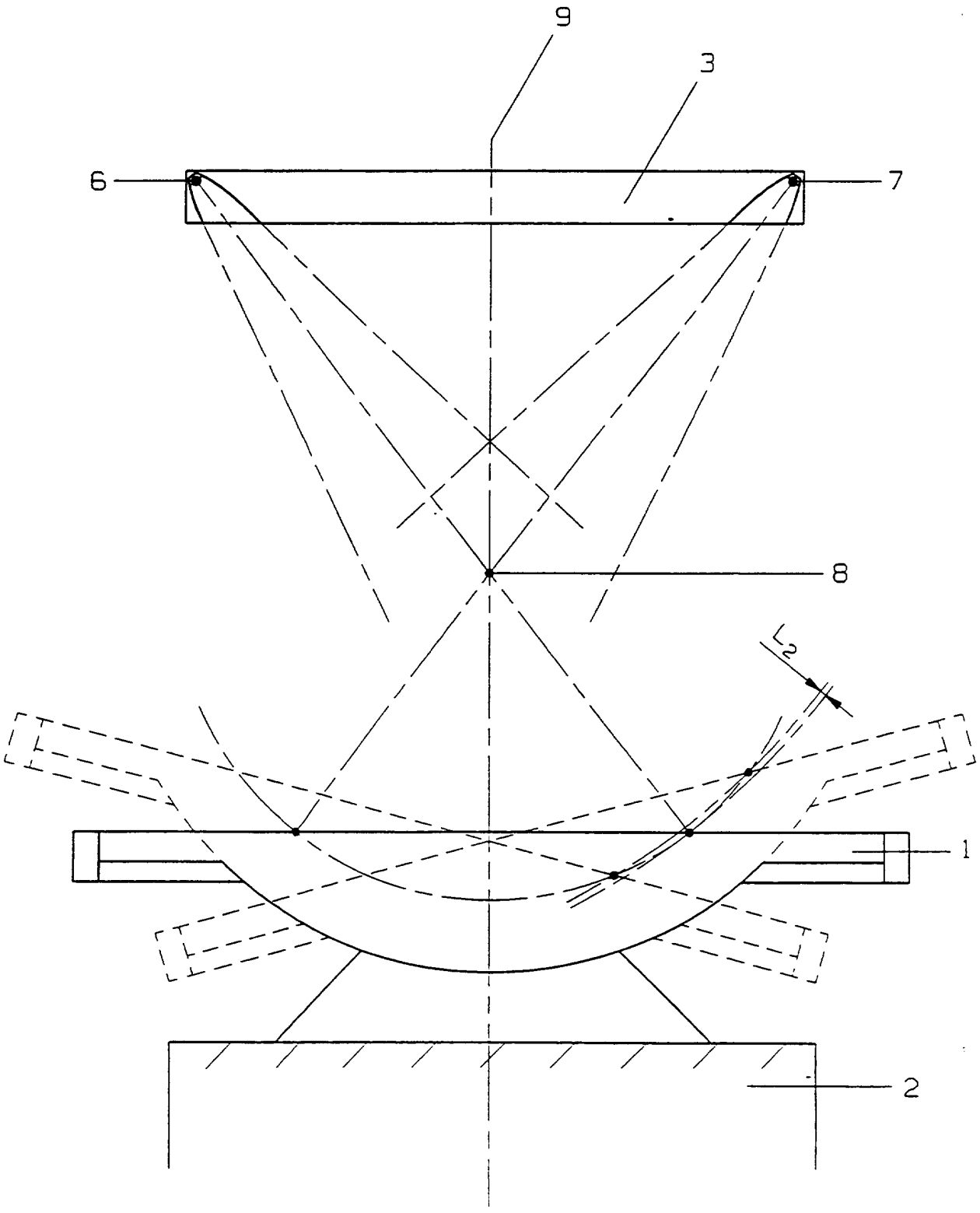


Fig.2

## Irradiation of a surface

The invention relates to the irradiation of a tiltable surface by means of radiators and more particularly, but not exclusively, is concerned with the infra-red irradiation of a flat, tiltable support surface during the care of patients.

For the care and treatment of premature babies, infants and small children it is advantageous, and sometimes even essential, to supply heat continuously and uniformly to these patients whilst they are on a normally rectangular support surface which is often a part of a nursing unit. Generally the heat is supplied by means of one or more infrared lamps which radiate essentially parallel heat rays onto the support surface.

An arrangement for heat radiation of an infant care combination is known from the German patent application DE-A-15 14 331. This arrangement has one or more infrared radiators whose rays strike the field to be heated. Below the infrared radiator an area free from infrared rays is provided to prevent radiation of the nursing personnel during the nursing and care of the infant. In standard paediatric nursing, infrared radiation heating devices are fitted above the support surface so that the patients are uniformly irradiated and heated from above by a substantially homogenous radiation field. In specific medically-indicated cases of nursing or therapy it is desirable to incline the support surface in the longitudinal direction by up to 20 degrees in either direction and to leave it there for long periods of time. During this time the temperature of the patient on the support surface should be kept as constant as possible. With known arrangements of infrared radiators this is not

guaranteed because the distance between the one or more radiators and the support surface changes to a greater or lesser extent due to the tilting of the surface.

According to the invention there is provided an apparatus for irradiating a flat support surface tiltable about an axis of rotation, wherein at least two radiators are arranged mirror-symmetrically about a vertical plane passing through said axis of rotation, the radiators having radiation axes intersecting substantially at the said axis of rotation.

This apparatus provides a simple arrangement for obtaining a more uniform radiation of a tiltable support surface. When used with infra-red radiators it provides an even heating of the support surface.

According to another aspect of the invention there is provided a method for irradiating a flat support surface tiltable about an axis of rotation, which comprises projecting at least two beams of radiation onto the support surface so that the beams are arranged mirror-symmetrically about a vertical plane passing through the axis of rotation, with the radiation axis of each beam substantially through the axis of rotation.

An advantage of the invention is that an almost uniform radiation of the support surface can be obtained even for different tilt positions, using only the geometric arrangement of the radiators with respect to the tilt support surface. There is no need for expensive measurement and control apparatus based, for example, on the control of one or more infrared radiators depending on the temperatures measured on the support surface.

The invention is based on the fact that beams of radiation coming from the centre of rotation of the tiltable support surface travel the same distances to the support surface even when there is a change in the

tilt angle. As the radiation intensity varies as the square of the distance from the radiation source, with the normal arrangement the radiation produces a significant temperature differential across the support surface in its tilted position. An arrangement where the beams come directly from one or more radiators arranged at the point of rotation of the support surface is not generally possible because of lack of space. The invention provides a practical arrangement whereby the radiation extends along a path to the support surface through the centre of rotation.

In an embodiment radiators are arranged in pairs above the central longitudinal axis of the support surface. The radiation axes of the beams emanating from the radiators ideally intersect at the point of rotation or in practice, near to it. This symmetrical arrangement ensures that the radiation intensity on the support surface in front of and behind the central transverse plane of the support surface at the same distance from this plane is essentially the same for different tilt positions of the surface.

It has been shown in practice that good results are achieved with a radius of rotation of the support surface of 300 to 500 mm and a distance of the radiator plane from the support surface in its horizontal, non-rotated position of about 600 to 800 mm. The maximum spacing of a pair of radiators is the length of the support surface, preferably somewhat smaller, in order to achieve the highest possible radiation intensity at the surface. The support surface is preferably rectangular.

The invention can be utilised not only for heat radiation but also for application of other electromagnetic radiation such as, for instance, visible light for the uniform illumination of the patient or for therapeutic radiation, for instance with

UV radiation.

An embodiment of the invention is now described, purely by way of example, with reference to the drawings in which:

Figure 1 is a vertical section through the longitudinal axis of an apparatus according to a comparative example and

Figure 2 is a vertical section through the longitudinal axis of an embodiment of the invention.

To explain the prior art, Figure 1 shows schematically a rectangular flat support surface 1 in the horizontal position in a vertical section through the longitudinal axis. Such support surfaces are used in paediatrics for standard patient care. The support surface 1 is used, for instance, for receiving an infant or small child, this support surface being tiltably mounted and connected to a base 2. Located parallel to, and above, the central longitudinal axis of the support surface 1 are one or more infrared radiators 4, 5 in a housing 3. Each radiator has a radiation axis (i.e. the central axis of the radiation beam emitted by the radiator) and the radiation axes of the radiation are roughly parallel and strike the support surface vertically. The beams hit the support surface over its whole surface to heat it and the patient lying on it evenly. Two different tilt positions of the support surface 1 are shown by dashed lines in Figure 1. It can be seen immediately that the spacing between the left-hand heat radiator 4 and the support surface 1 is greater in one tilt position and smaller in the other compared to the horizontal position. The relationships with respect to the right-hand radiator 5 are complementary to this. When the support surface 1 is tilted, the radiation intensity varies between the front and rear areas of the support surface 1 since the intensity varies inversely with the

square of the distance of the support surface 1 from the radiation source 4, 5. $L_1$ indicates the maximum difference in the distance between the support surface 1 and the left-hand infrared radiator 4 in Figure 1. The same difference occurs with the right-hand radiator 5.

Figure 2 shows an arrangement according to the invention in a vertical section through the longitudinal axis. In this example the support surface 1 has a length of 750 mm. The support surface is tiltable as shown in the Figure; the tilting occurs about a lateral axis of rotation. In this case the heater comprises a housing 3 with two identical infrared radiators 6 and 7 located above, and parallel to, the central longitudinal axis of the support surface. The radiators 6 and 7 are provided with suitable reflectors so that the radiation axes of the radiators extend through the point of rotation 8 of the support surface 1. The beams strike the support surface 1 with the same intensity because the radiators are mirror-symmetrically arranged with respect to the central vertical plane 9 passing through the axis of rotation 8.

Although the two infrared radiators 6 and 7 do not lie directly on the axis of rotation 8 there is a minimal difference $L_2$ of the distance from radiator to the support surface at the different tilt positions shown in full and broken lines. This corresponds to a very small difference in intensity. In practice the tilt angle of the support surface 1 can be varied by ± 10-20° at most. The smaller the angle the smaller the spacing difference $L_2$. However, the arrangement of the invention has the effect that for the two different tilt positions of the support surface 1, shown here by dashed lines, there is an essentially uniform irradiation of the areas of the surface 1 lying

equidistant from the central vertical plane 9 when the infrared radiators 6 and 7 are arranged respectively in pairs and also at the same height and same distance from the central vertical plane 9.

Instead of a pair of radiators 6, 7 several pairs can also be fitted along the longitudinal axis of the housing 3. To irradiate the support surface 1 laterally of its central longitudinal axis, i.e. at locations not in the plane of the figure, pairs of radiators can also be arranged laterally of the longitudinal axis of the housing. Several such pairs can be arranged, each pair being arranged symmetrically about the central vertical plane 9 and with the two radiators of each pair arranged along a line parallel to the central longitudinal axis of the support surface 1.

In the embodiment shown the spacing of the two infrared radiators 6, 7 is 500 mm and the spacing of the housing 3 from the horizontal support surface is 780 mm, although a range of 600 to 800 mm was also found to work satisfactorily. The support surface 1 was arranged at a distance, from the rotation axis, of 320 mm, a range of 300 to 500 mm being satisfactory.

Claims

1. Apparatus for irradiating a support surface tiltable about an axis of rotation, wherein at least two radiators are arranged mirror-symmetrically about a vertical plane passing through said axis of rotation, the radiators having radiation axes intersecting substantially at said axis of rotation.

2. An apparatus according to claim 1 in which the support surface has a central longitudinal axis, at least two of the said radiators being arranged above the central longitudinal axis.

3. An apparatus according to claim 1 or 2, in which a plurality of pairs of radiators are provided, the two radiators in each pair being arranged mirror-symmetrically about the said vertical plane.

4. An apparatus according to any preceding claim, in which the spacing of the radiators from the support surface is 600 to 800 mm and the maximum spacing between the radiators is 500 mm.

5. An apparatus according to any preceding claim in which the radiators are infra-red radiators.

6. A method for irradiating a support surface tiltable about an axis of rotation, which comprises projecting at least two beams of radiation onto the support surface so that the beams are arranged mirror-symmetrically about a vertical plane passing through the axis of rotation, with the radiation axis of each beam passing substantially through the axis of rotation.

7. A method according to claim 6, in which the radiation is infra-red radiation.

8. A method according to claim 6 or 7, in which a plurality of pairs of said beams is provided, each pair being arranged mirror-symmetrically about the said vertical plane.

9. A method according to any of claims 6 to 8, in which at least two of said beams are arranged above a central longitudinal axis of the support surface.

10. An irradiating apparatus substantially as hereinbefore described with reference to and as illustrated in Figure 2 of the accompanying drawings.

11. A method for irradiating a support surface in accordance with claim 6 substantially as hereinbefore described.

The Patent Office

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**Claims searched:** 1-11 **Date of search:** 29 November 1996

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A5R (REHR, RHFR), H5R (RAL, RBL, REP)

Int Cl (Ed.6): A61N 5/06, 5/08, 5/10

Other: ONLINE: WPI

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| P/A | WO 95/30451 A1 | (MARCHESI F) page 3 lines 14-15; page 13 line 31-page 14 line 6; Claim 9; Figures 18 & 19 | 1, 2, 4-7 & 9 |
| A | US 3708664 | (BOCK J *et. al.*) column 2 lines 36-42; column 4 lines 22-31; column 5 lines 34-45; Figure 1 | 1, 2, 4, 6 & 9 |

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