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(71) Applicant:
Automotive Lighting Italia Spa
10078 Venaria Reale (Torino) (IT)

(72) Inventors:
- **Costa, Nadia**
  10092 Beinasco (IT)
- **Esposito, Cataldo**
  10026 Santena (IT)
- **Zattoni, Sergio**
  10070 Cafasse (IT)

(74) Representative:
Cerbaro, Elena, Dr. et al
STUDIO TORTA S.r.l.,
Via Viotti, 9
10121 Torino (IT)

Remarks:
Amended claims in accordance with Rule 86 (2) EPC.

(54) A reflector having a complex surface for an illumination device of a vehicle

(57) A reflector (1) having a complex surface for an illumination device of a vehicle, mountable on the illumination device with its optical axis (3) substantially parallel to a motion plane (4) on which the vehicle moves: the complex reflecting surface (2) of the reflector (1) is constituted by a plurality of elementary sectors (5) having respective elementary reflecting surfaces (6) adjacent one another and joined together along respective adjacent sides (10) to constitute the said complex reflecting surface (2): in the preferred embodiment the elementary sectors (5) are of polygonal shape with four sides (10) and are orientated in such a way that the sides (10) are not parallel to the motion plane (4) but have a predetermined inclination with respect thereto: in comparison with known configurations of comparable dimensions improved photometric performance is obtained.

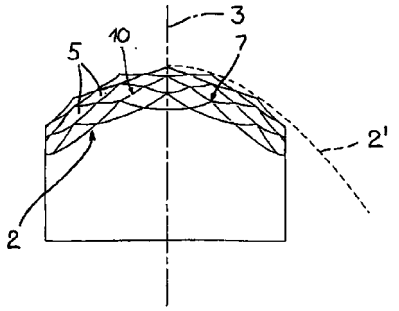

Fig. 4

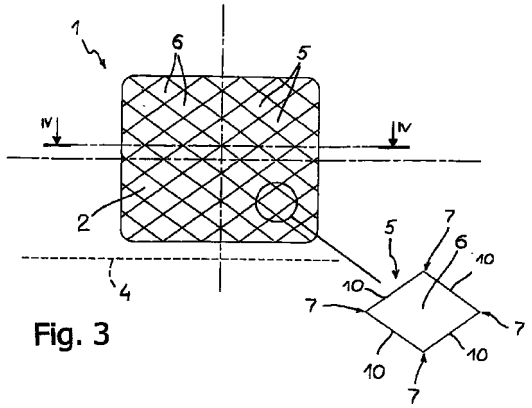

Fig. 3

EP 1 089 036 A1

Description

[0001] The present invention relates to a reflector having a complex surface for an illumination device of a vehicle; the reflector of the invention has reflecting surfaces of a new concept which make is possible to obtain, with respect to known configurations, improved photometric performance together with new aesthetic aspects, achieving this within extremely restricted dimensions.

[0002] As is known, illumination devices of vehicles (in particular headlamps and side lights) generally comprise a light source the beam of which is suitably directed and modified by a reflector which gives the beam the desired optical characteristics for each specific function. In particular, the use of the so-called "complex" surfaces has been widely used to date, being formed by different portions each having their own shape or geometry,

[0003] One known example of this type of reflector for illumination devices for motor vehicles is illustrated in the attached Figures 1 and 2, which are, respectively, a front view and a sectional view (taken on the line II-II of Figure 1) of a reflector 1a of the type having a known complex surface configuration. The reflector 1a has a complex reflecting surface 2 with a predetermined optical axis 3 and is intended, in use, to be mounted on an associated illumination device of the vehicle in such a way that the optical axis 3 is substantially parallel to the motion plane on which the vehicle moves, schematically represented by the broken line 4 in Figure 1 (which represents the motion plane). The complex reflecting surface 2 is constituted by a plurality of sectors 5 of square shape (or rectangular in a variant which is also known) lying adjacent one another and mutually joined along respective adjacent sides: the reflector 1a is mounted on the vehicle in such a way that each of the square or rectangular elementary reflecting surfaces has a first pair of opposite sides parallel to the motion plane on which the vehicle moves, that is to the ground, and a second pair of opposite sides orthogonal thereto.

[0004] Reflectors having complex surfaces of the type briefly outlined here have the disadvantage of providing relatively poor photometric performance: in particular, the luminous intensity is relatively low with respect to the luminous power emitted by the source.

[0005] On the other hand it is known that the adoption of complex surfaces serves also to obtain aesthetic solutions which cannot be achieved with traditional optics. The use of elementary reflecting surfaces of square or rectangular form strongly limits the possibility of obtaining aesthetic aspects of a particular effect.

[0006] It is an object of the present invention to provide a reflector, which while being simple and economic to produce, has, for the same dimensions as known reflectors, particularly high characteristics of efficiency and luminous intensity, at the same time allowing aesthetic aspects of a particular effect to be achieved.

[0007] This object is achieved by the invention, which relates to a reflector having a complex surface for an illumination device of a vehicle, the reflector having a base surface with predetermined optical axis and a complex reflecting surface with an optical axis substantially coinciding with the said optical axis of the base surface, the said complex reflecting surface comprising a plurality of elementary sectors of predetermined shape supporting on the said base surface and provided with respective elementary reflecting surfaces, the said elementary sectors being of polygonal form and being positioned adjacent one another and mutually connected along respective adjacent sides to constitute the said complex reflecting surface, the reflector being mountable upon the said illumination device with the said optical axis substantially parallel to or convergent with a surface on which the vehicle moves: the reflector being characterised in that the said elementary sectors are of polygonal form with a number of sides equal to or greater than four: if the said polygonal elementary sectors have four sides the said elementary sectors being orientated in such a way that the said sides are not parallel to the said motion plane but have a predetermined inclination with respect thereto: in the case of polygonal elementary sectors which have more than four sides, the said elementary sectors being in any case inclined with respect to the said motion plane.

[0008] In this way the reflector according to the invention, while being simple and economical to produce and of extremely limited dimensions, has characteristics of particularly high luminous intensity, greater than conventional reflectors of comparable dimensions, and moreover makes it possible to achieve new aesthetic aspect of particular effect.

[0009] Further characteristics and advantages of the present invention will become more clearly apparent from the following description of a non-limitative embodiment thereof, with reference to the figures of the attached drawings in which;

Figure 1 is a schematic front view of a complex surface reflector of known type;

Figure 2 is a sectional view taken on the line II-II of Figure 1;

Figure 3 is a schematic front view of a complex surface reflector according to the present invention, with a detail enlarged for clarity;

Figure 4 is a sectional view taken on the line IV-IV of Figure 3; Figures 5 and 6 are two photometric diagrams (in iso candles) of the values of luminous intensity detected in experimental tests on the reflector of Figure 3 (according to the invention) detected respectively on a square window of angular width of 30° and on a rectangular window of angular width 20° by 10°, in accordance with the international regulations on the subject;

Figures 7 and 8 are two diagrams corresponding to those of Figures 5 and 6 and illustrate the efficiency

of luminous intensity of the (known) reflector of Figure 1 having dimensions comparable with the reflector of the invention.

[0010] With reference to Figures 3 and 4 (in which the same reference numerals indicate the same or similar details as those already used in Figures 1 and 2) a reflector 1 for an illumination device (known and not illustrated for simplicity) of a vehicle, in particular a motor vehicle, has a complex reflecting surface 2 with a predetermined optical axis 3: the reflector 1 is intended, in use, to be mounted on an associated illumination device of the vehicle in such a way that the optical axis 3 lies substantially parallel to or convergent to a motion plane on which the vehicle moves, schematically represented by the broken line 4 in Figure 1 (representing the plane of advance).

[0011] The reflector 1 can be shaped in any way and the complex reflecting surface 2 can consequentially have a different shape: in any case, it is possible to identify a base surface 2' which represents the general form of the reflector 1' the base surface 2' can be a surface of revolution or translation which can be described with a relatively simple equation, but can also be one which cannot be described in simple mathematical terms. In the non-limitative specific example illustrated the base surface 2' has a curvature and predetermined concavity and moreover has an optical axis substantially coincident with the optical axis 3 of the complex reflecting surface 2.

[0012] The reflector 1 comprises a plurality of elementary sectors 5 of predetermined shape, provided with respective elementary reflecting surfaces 6 with predetermined curvature: in particular, the elementary sectors 5 are of polygonal shape with four corners 7 and four sides 10, lying adjacent one another and joined together along respective adjacent sides 10 and supported on the base surface 2', by their corners 7 and/or by their sides 10 in such a way as to constitute the complex reflecting surface 2 which, in the specific example, is a surface having a predetermined concavity: the elementary sectors 5 lie alongside one another and are connected to one another with a predetermined inclination to constitute the complex reflecting surface 2 in such a way that respective adjacent sides of each pair of contiguous elementary sectors 5 are joined together and have a predetermined inclination with respect to the other to constitute an edge.

[0013] According to the invention the elementary sectors 5 are of polygonal shape with the number of sides equal to or greater than four: in the case of elementary sectors 5 having four sides 10, as illustrated in Figures 3 and 4, the elementary sectors 5 are orientated in such a way that their sides 10 are not parallel to the motion plane 4 on which the vehicle moves, but instead have a predetermined inclination with respect to it: at least one pair of sides 10 of each elementary sector 5 (in the specific example all the sides (10) are therefore inclined with respect to the motion plane 4 on which the vehicle moves (the horizontal plane).

[0014] In the non-limitative example illustrated in Figures 3 and 4, the elementary sectors 5 have a rhomboidal shape and have respective lower vertices 7 facing the plane 4.

[0015] In the preferred embodiment illustrated the elementary reflecting surfaces 6 are in turn curved surfaces, and can have a concavity opposite to or in concordance with the concavity of the complex reflecting surface 2: the elementary reflecting surfaces 6, whatever their configuration, are joined along the sides of the respective elementary sectors 5.

[0016] The superior photometric performance of the reflector according to the invention with respect to a conventional reflector of equivalent dimensions and overall shape, but utilising known reflecting surfaces, is illustrated in Figures 5 to 8: in particular Figures 5 and 6 are two photometric diagrams (in iso Candles) which plot the values of luminous intensity detected in experimental tests conducted (in a manner prescribed by ECE regulations) on the reflector 1 of the invention having elementary sectors 5 of the previously-described form and illustrated in Figures 3 and 4, respectively measured on a square frame of angular dimensions 30° by 30° and on a rectangular window of angular dimensions 20° by 10°, Figures 7 and 8 are the corresponding measurements of luminous intensity for the reflector 1a having generally similar conformation and equivalent dimensions to the reflector 1 of the invention, but formed of elementary reflecting surfaces of known type in the specific example of square form with pairs of sides parallel to the motion plane on which the vehicle moves (as illustrated in Figures 1 and 2).

[0017] The results of the experimental tests show that the reflector according to the invention has, with respect to the known reflector and in otherwise equivalent conditions, a superior output both on a 30° x 30° window and on a 20° x 10° window (which among other things, is the field of measurement envisaged by the international regulations): in particular, the output of a side light equipped with the reflector of the invention, with respect to a side light provided with a conventional reflector, is greater by more than 6% as measured on a 30° x 30° window and by more than 40% if measured on a 20° x 10° window, thanks to the innovative geometry of the complex surface and in particular to the form and disposition of the elementary reflecting surfaces of which it is composed.

[0018] It is, therefore, clear that the reflector described and illustrated here can have numerous modifications and variations introduced thereto without by this departing from the ambit of the present invention.

[0019] For example, elementary reflecting surfaces 6 of different shape from that indicated can be utilised: in particular, elementary reflecting surfaces 6 of polygonal shape, still with four sides, can be utilised, for example square or rectangular surfaces, as long as the sides

10 of the elementary sectors 5 are inclined and not parallel with respect to the plane of advance of the vehicle: each elementary sector 5 has, therefore, in any event, its sides 10 inclined with respect to the plane parallel to the motion plane 4 on which the vehicle moves and passing through that elementary sector (for example through a lower corner 7 facing towards the plane 4): the improvement effect on the performance of the reflector 1, in fact, is due mainly to the fact that at least some of the edges along which the elementary reflecting surfaces 6 are connected, which together form the complex reflecting surface 2, are inclined, that is with respect to the motion plane 4. In other words, according to the invention, the superior luminous yield of the reflector 1 is obtained if at least some of the sides 10 of the elementary sectors 5 are inclined with respect to the motion plane 4 of the vehicle, that is with respect to the optical axis 3 of the reflector 1 itself.

[0020] The same result, with a similar improvement of the photometric performance, can be obtained also by using elementary sectors 5 orientated in any way with respect to the plane 4, as long as it has a polygonal shape with a number of sides greater than four: in fact, with elementary sectors 5 of polygonal shape with more than four sides (for example hexagon, octagon etc), each elementary sector 5 whatever its orientation, including the case in which at least some of its sides are parallel to the plane 4 of advance of the vehicle, has at least some sides inclined with respect to a plane parallel to the motion plane 4 of the vehicle and passing through a corner of the elementary sector 5: this causes, according to the invention, a better distribution of the luminous flux with respect to the use of conventional or square or rectangular elementary sectors 5 with sides parallel to the motion plane 4.

Claims

1. A reflector (1) having a complex surface for an illumination device of a vehicle, the reflector having a base surface (2'), which is a curved surface having a predetermined concavity and a predetermined optical axis (3), and a complex reflecting surface (2), which has an optical axis substantially coinciding with the said optical axis (3) of the base surface (2'), the said complex reflecting surface (2) comprising a plurality of elementary sectors (5) of predetermined shape supported by the said base surface (2') and provided with respective elementary reflective surfaces (6), the said elementary sectors (5) being of polygonal shape, lying adjacent one another and being joined together along respective adjacent sides (10) to constitute the said complex reflecting surface (2), the reflector being mountable on the said illumination device with the said optical axis (3) substantially parallel to or convergent with a motion plane (4) on which the motor vehicle moves; the reflector being **characterised in that**:

i) the said elementary sectors (5) are of polygonal shape having four sides (10) and are orientated in such a way that none of the said sides (10) is parallel to the said motion plane (4) of the vehicle, all said sides (10) having a predetermined inclination with respect to the said motion plane (4); and

ii) the said elementary reflecting surfaces (6) are curved surfaces having a concavity opposite the concavity of the said base surface (2').

2. A reflector according to Claim 1, characterised in that the said base reflecting surface (2') is a convex surface, the said elementary reflecting surfaces (6) being concave surfaces.

3. A reflector according to Claim 2, characterised in that the said elementary sectors (5) are positioned adjacent to one another and joined together along the said sides (10), the said elementary sectors (5) being supported, at least by their corners (7), on the said base surface (2').

4. A reflector according to Claim 3, characterised in that the said elementary sectors (5) have a rhomboidal form and are oriented in such a way as to present respective corners (7) towards the said motion plane (4), none of the said sides (10) being parallel to the said motion plane (4).

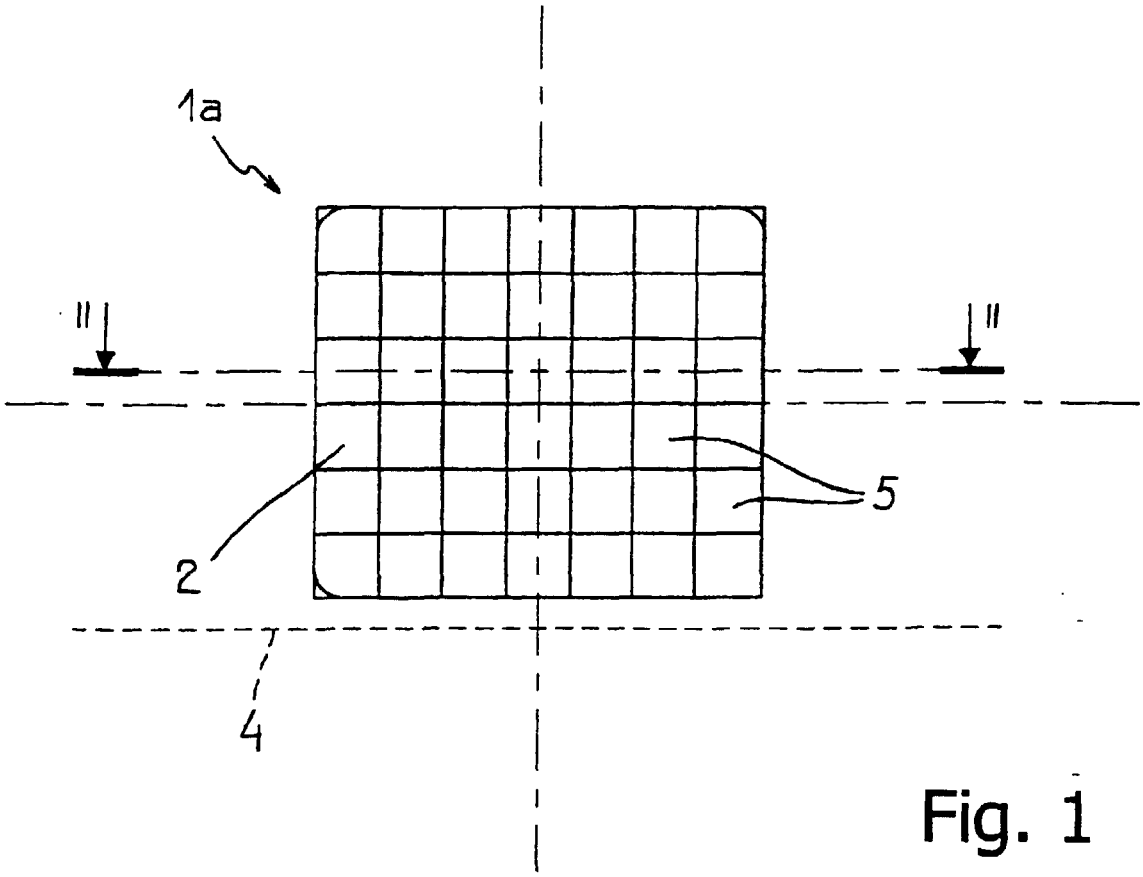

Fig. 1

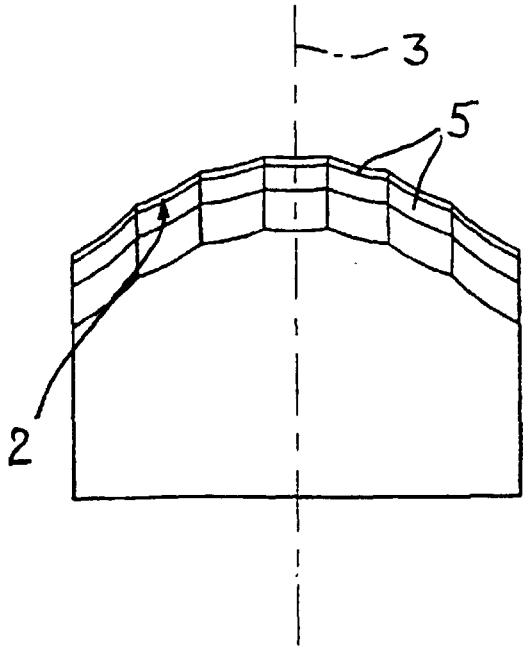

Fig. 2

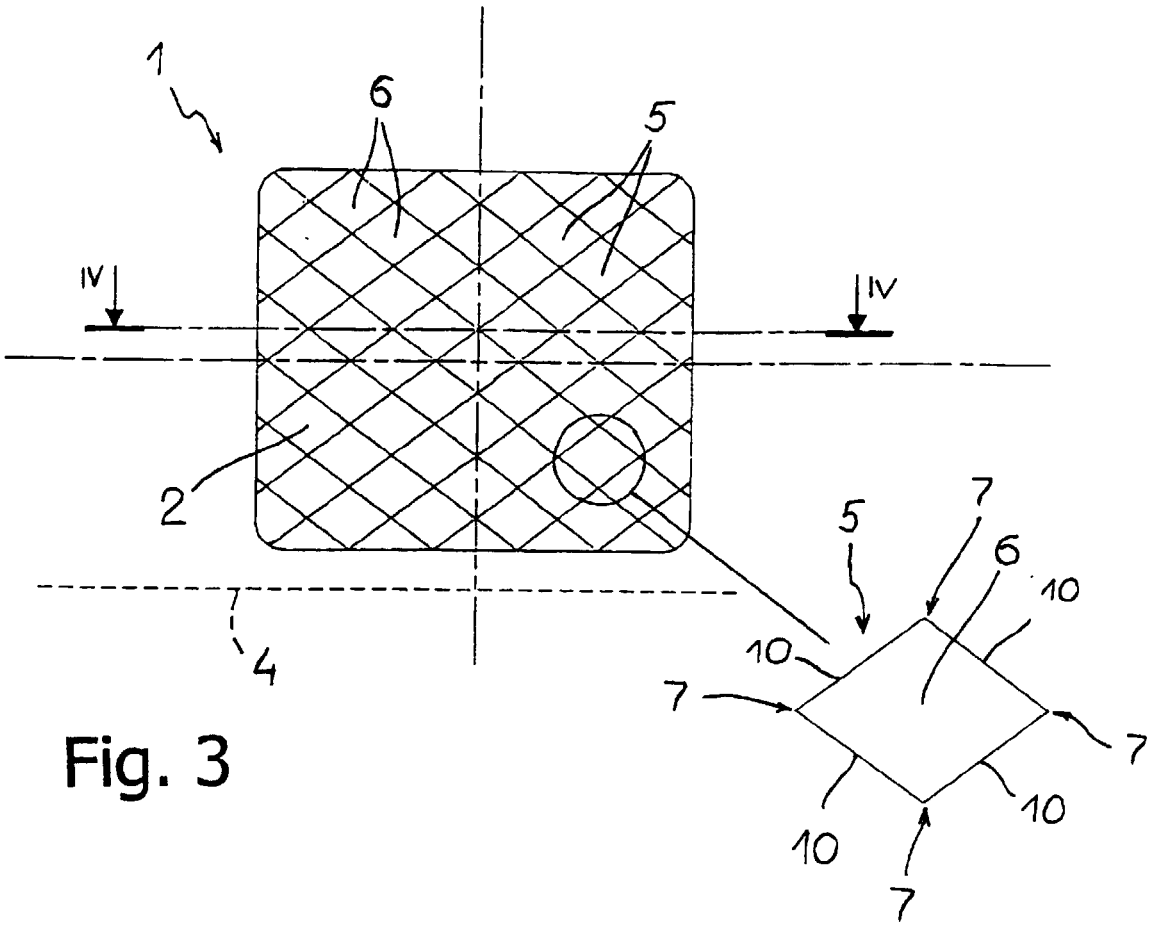

Fig. 3

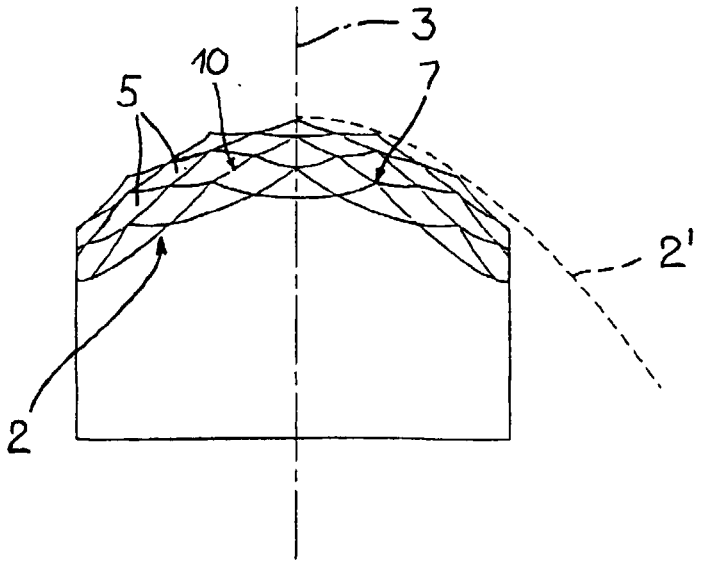

Fig. 4

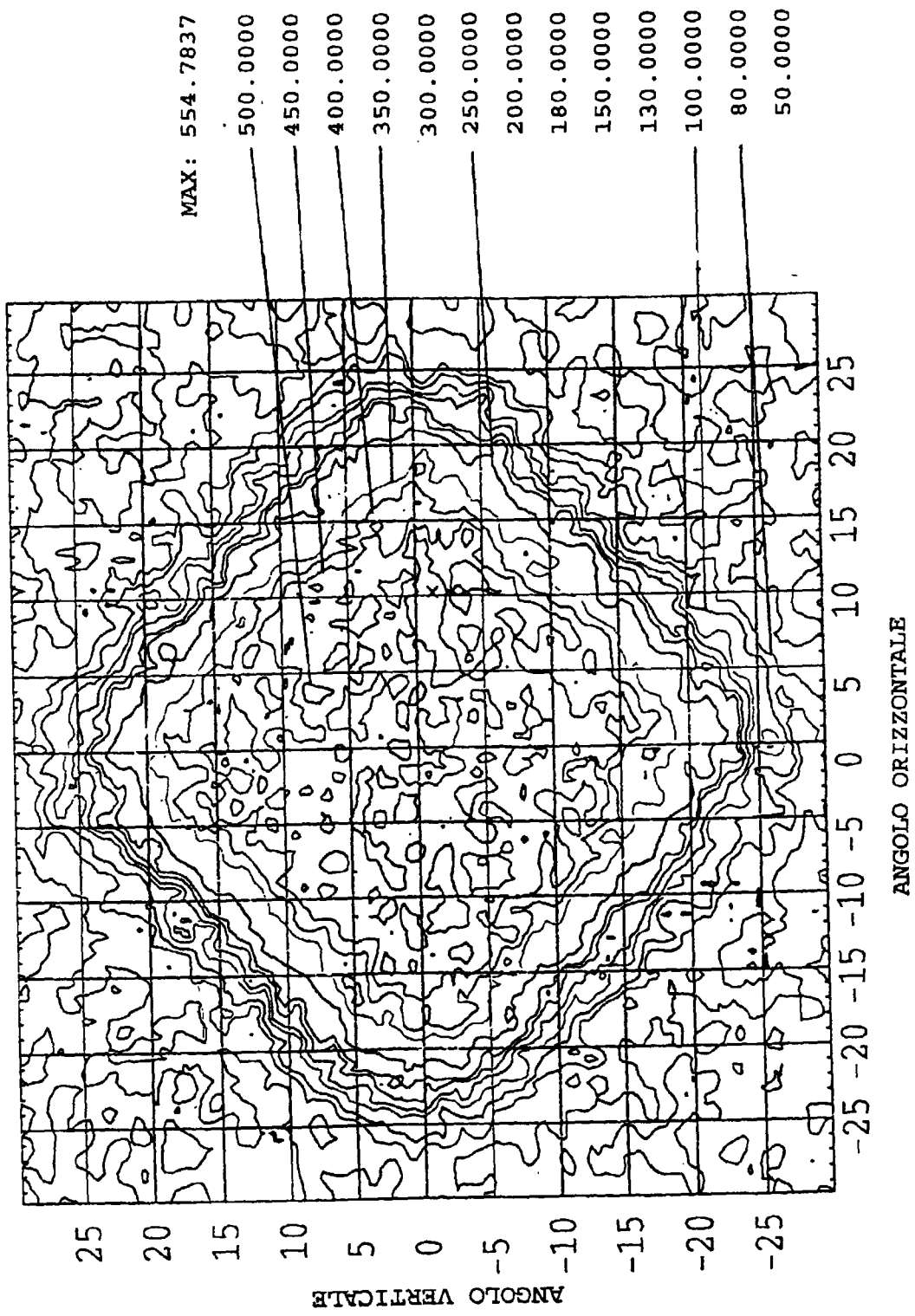
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Fig. 5

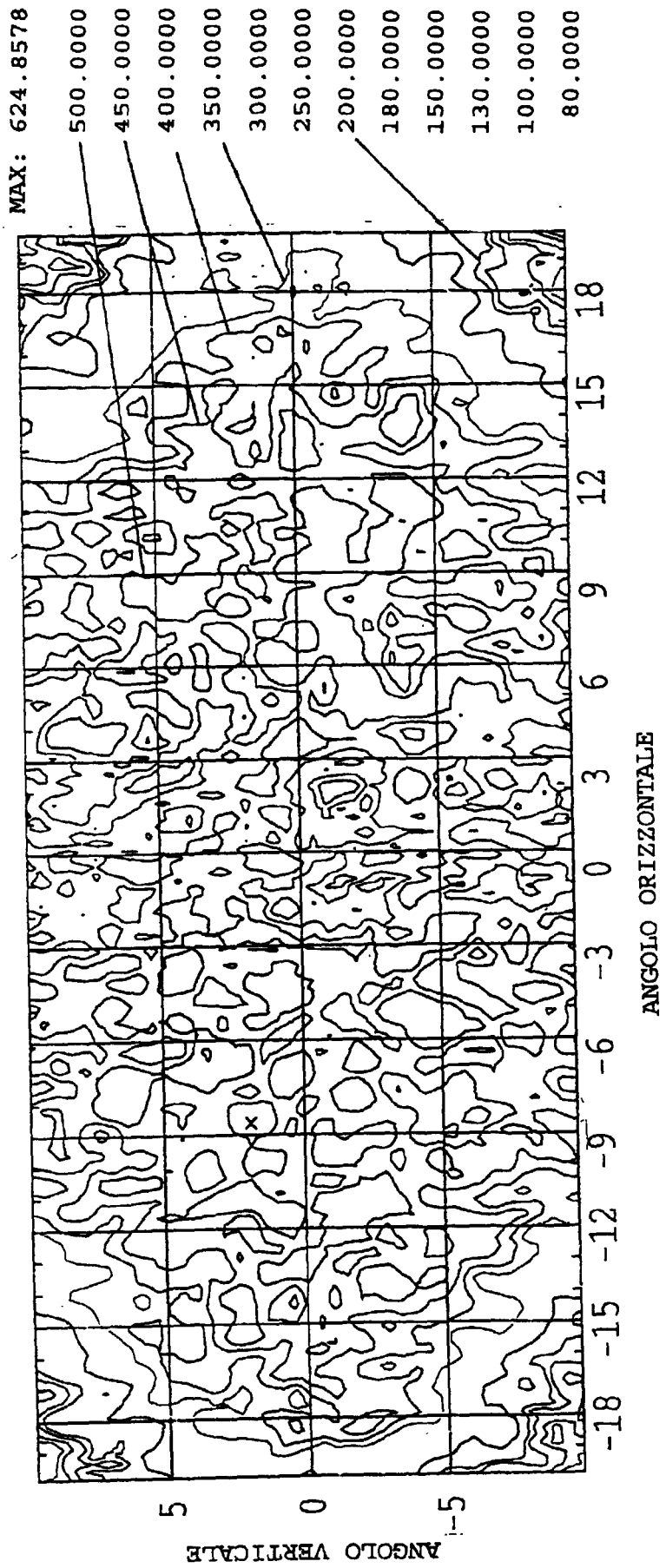
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Fig. 6

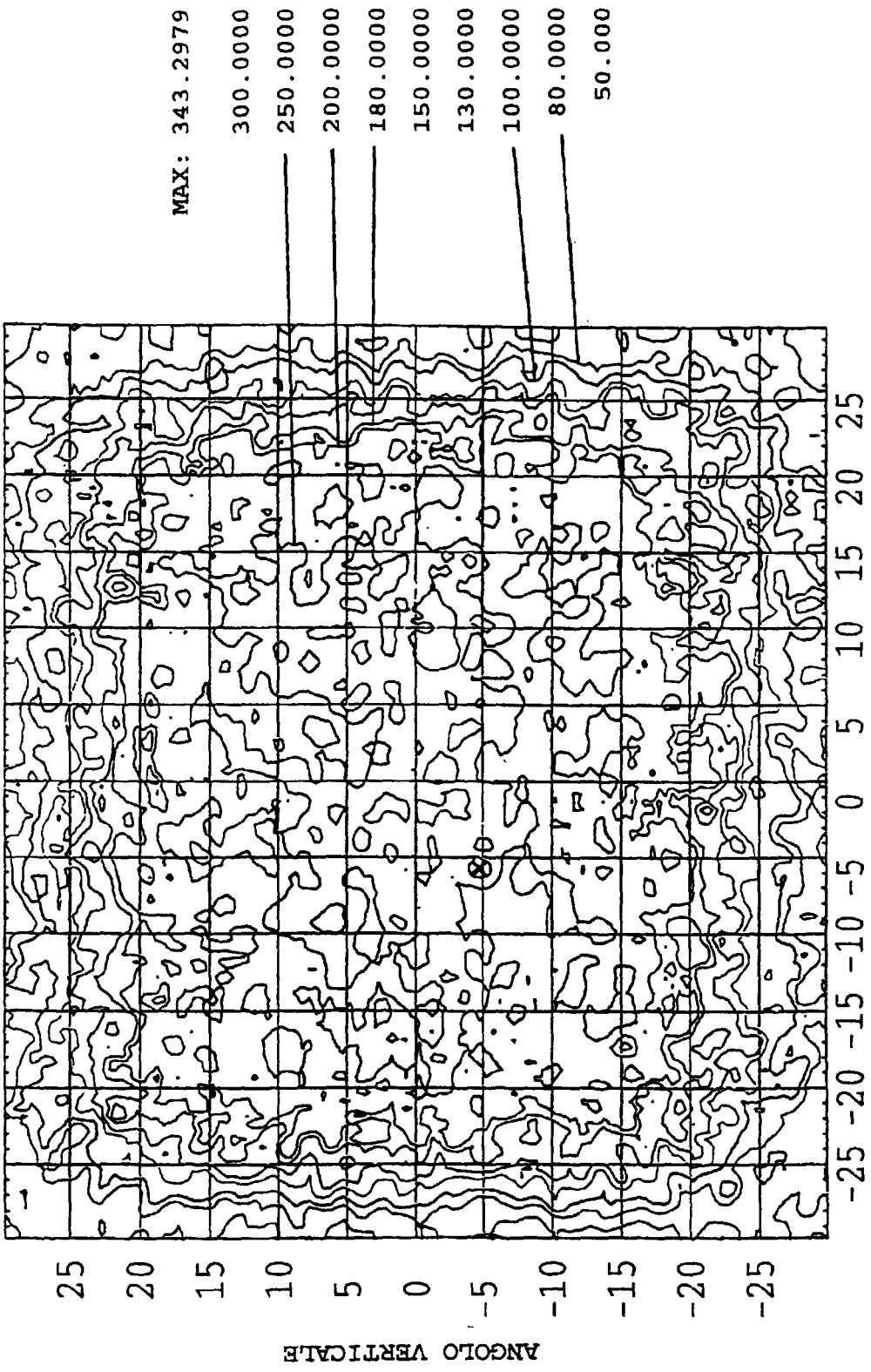
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Fig. 7

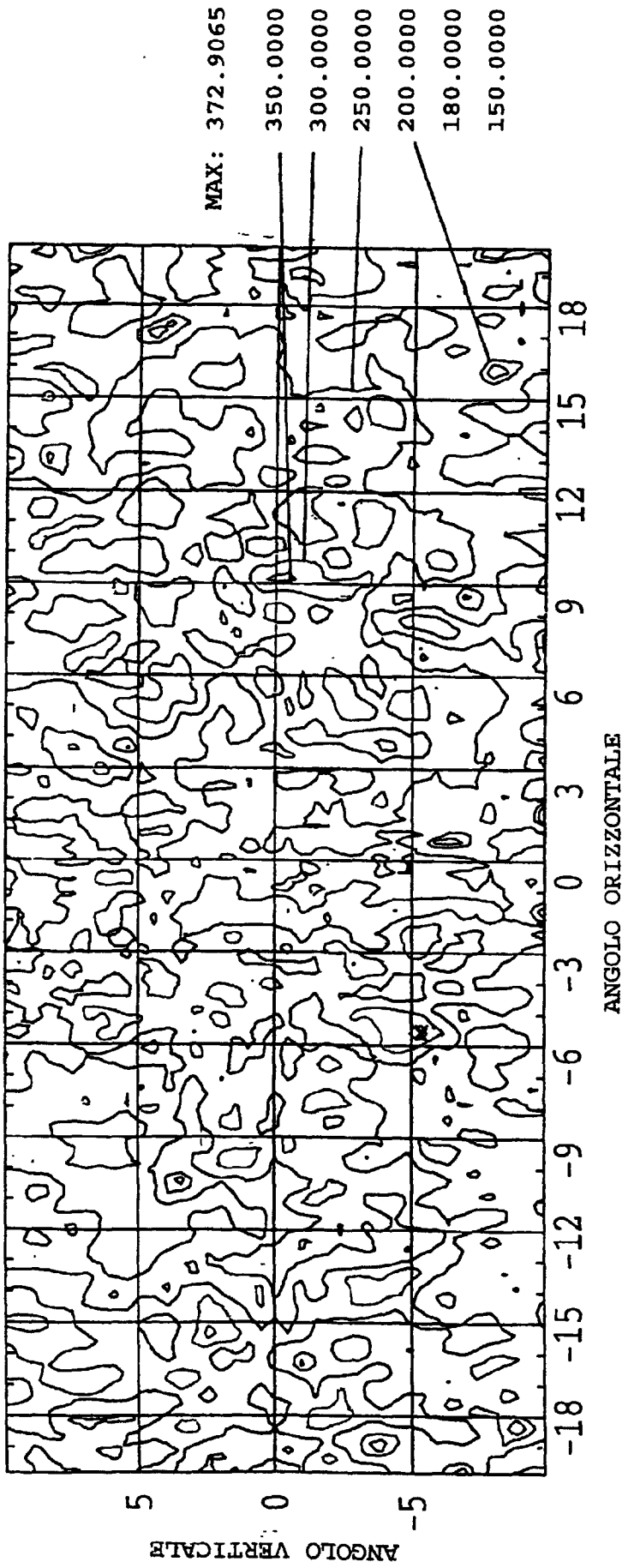
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Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 99 83 0615

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.7)
X	US 1 670 837 A (L. BLACKMORE) 22 May 1928 (1928-05-22) * page 1, line 38 - line 64 * * figures 1-3 *	1-4,6	F21V7/09 F21W101/02
Y		5	
Y	US 3 511 983 A (DORMAN WILLIAM H) 12 May 1970 (1970-05-12) * column 2, line 19 - line 25 * * column 3, line 21 - line 30 * * figures 1-4 *	5	
X	EP 0 678 703 A (SEIMA ITALIANA SPA) 25 October 1995 (1995-10-25) * column 7, line 29 - line 41 * * column 8, line 10 - line 26 * * column 9, line 24 - line 36 * * figures 2,4-6 *	1-3	
A		4-6	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F21M
F21V
F21Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 January 2000	Cosnard, D

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