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## (54) A method of manufacturing an electric heating film.

(57) A method of manufacturing an electric heating film including steps of preparing a mixture by fusing together metallic oxides and adding 1-10% of impurities in weight into said mixture, mixing and stirring well said mixture with a medium material at a proportion of 20-60% in weight to form a liquid material which is then filtered so as to remove undesired matters, dispose a base material into a heating furnace and heated for activating surface thereof, mixing said liquid material with air and spraying them into said heating furnace by means of a compressor at an air pressure of 2.0 kg/cm$^3$ hence atomizing and dissolving said liquid material into ions, and letting said ions be accumulated and evenly coated on said base material thereby forming an electric heating film on said base material.

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## BACKGROUND OF THE INVENTION

It has been found that the conventional way to change electric energy into heat is simply achieved by passing electric current through an electric heater wound with resistance wires or a P.T.C. Nevertheless, the resistance wire is expensive and difficult to wind on the heater thereby increasing the cost of the electric heater. Further, such an electric heater will burn with flames in use hence wasting a lot of electric energy and consuming much oxygen. Furthermore, the electric heater will be oxidized and become useless after having used for a certain period of time. In addition, the shape of the electric heater is confined to a small one with regular surface.

Therefore, it is an object of the present invention to provide a method of manufacturing an electric heating film which can obviate and mitigate the above-mentioned drawbacks.

## SUMMARY OF THE INVENTION

This invention relates to a method of manufacturing an improved electric heating film.

It is the primary object of the present invention to provide a method of manufacturing an electric heating film which can spray an electric heating film on a base material.

It is another object of the present invention to provide a method of manufacturing an electric heating film which is especially useful when it is required to coat an electric heating film on a base material with irregular surfaces.

It is still another object of the present invention to provide a method of manufacturing an electric heating film which is relatively low in cost.

It is still another object of the present invention to provide a method of manufacturing an electric heating film which has a heat efficiency of more than 90 %.

It is still another object of the present invention to provide a method of manufacturing an electric heating film of which the thickness and/or proportion of the constituents can be modified in accordance with the required power output.

It is still another object of the present invention to provide a method of manufacturing an electric heating film which is economical to carry out.

It is still another object of the present invention to provide a method of manufacturing an electric heating film which is durable in use.

It is still another object of the present invention to provide a method of manufacturing an electric heating film which will be rapidly cooled when the power supply is switched off thereby preventing accidents.

Other objects and merits and a fuller understanding of the present invention will be obtained by those having ordinary skill in the art when the following detailed description of the preferred embodiment is read in conjunction with the accompanying drawings wherein like numerals refer to like or similar parts.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a manufacturing flow chart of the present invention;

FIG. 2 shows a rectangular product coated with the present invention;

FIG. 3 shows a beehive-shaped product coated with the present invention;

FIG. 4 illustrates the temperature gradient of the present invention;

FIG. 5 illustrates the relationship between the power and the temperature; and

FIG. 6 illustrates the relationship between the refractive index and the wave length.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

For purpose of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings. Specific language will be used to describe same. It will, nevertheless, be understood that no limitation of the scope of the invention is thereby intended, such alternations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated herein being contemplated as would normally occur to one skilled in the art to which the invention relates.

The method of manufacturing an electric heating film according to the present invention mainly comprises steps of preparing a mixture 10 by mixing a plurality of compounds, mixing the mixture with medium materials to form a liquid material, cleaning and drying the base material, atomizing the liquid material, and coating the base material 12. The steps of the manufacturing method will be described in detail hereinafter.

First, prepare a mixture for the electric heating film by fusing together metallic oxides such as gold oxide, silver oxide, indium oxide, molybdenum oxide, vanadium oxide, cadmium oxide, and antimony oxide or their organic oxides, silicon oxide, phosphorous oxide, or sulfur oxide. Tin oxide is the easiest to obtain and lowest in cost and so it is used as the main material. As we all know, oxides are non-conductive substances and will become semi-conductors when incorporated of certain impurities. In this preferred embodiment, 1-10% of

impurities in weight has been added into the oxides so as to modify the resistivity of the mixture thereby controlling the heat evolved from the mixture.

Secondly, mix and stir well the mixture with a medium material at a proportion of 20-60% in weight to form a base material. The medium material may be water, methyl alcohol, ethyl alcohol, hydrochloric acid, ethylamine, ...etc. The mixture and the medium material are stirred well to form a liquid material which is then filtered so as to remove the undesired matter therein.

Thirdly, the base material 12 is to coated with the electric heating film according to the present invention. The base material 12 may be in the shape of a tube, a panel, or a beehive 21 shown in FIG. 3. In addition, the base material 12 may be conveniently made of quartz, glass, porcelain, mica or similar material with high temperature resistance and low expansion coefficient. Moreover, the base material 12 must be inspected, washed with clean soft water and dilute hydrochloric acid, and dried before use.

Fourthly, dispose the base material into a heating furnace (not shown) and heated to 400-800 degrees centigrade for 5-10 minutes so as to activate the surface of the base material. Then, mix the liquid material with air at a certain proportion and spray them into the heating furnace by means of a compressor at an air pressure of 2.0 kg/cm$^3$ hence atomizing and dissolving the liquid material into ions. Thereafter, let the ions be accumulated and evenly coated on the base material 12 to a thickness of 3-300μ thereby providing the base material 12 with a layer of electric heating film according to the present invention. Thereafter, the base material in the shape of a beehive is coated with a layer of silver glue 21 with a temperature resistance of higher than 850 degrees centigrade and a resistance lesser than 0.3 ohm.

The general time for atomizing the liquid material is about 10-30 minutes and depends on the thickness of the film designed to be coated on the base material and the power of the heating furnace. As the electric heating film coated on the base material 12 is very thin, the electric current consumed is very small and the heat energy is transmitted from inside to outside, the temperature difference between the inside and outside will be small and it is unnecessary to worry about explosion. According to the experimental results, the temperature evolved from the electric heating film can reach 700 degrees centigrade. Further, no obvious flame will be produced when the temperature is lower 500 degrees centigrade. In addition, the electric heating will consume less than 70 per cent of electricity required by the prior art.

Now, a preferred experiment of the present invention is described as follows:

At first, mix 100g of tin oxide, 2g of antimony oxide, 10c.c. of hydrochloric acid, and 50c.c. of water together and stir them well to prepare a liquid material. The proportion of the constituents of the liquid material may be modified as per the temperature required to be obtained. According to the experimental result, electric heating film has a property of 20-30 ohms/□ and has both the high temperature characteristic of the resistance filament and the property of the P.T.C. The characteristics of the electric heating film are shown in FIGS. 4 and 5. When in use, it is only necessary to mount two electrodes 20 on the present invention (see FIGS. 2 and 3).

Looking now at FIG. 3, the temperature of the electric heating film will soar to 500 degrees centigrade in 30 seconds. FIG. 5 illustrates the relationship between the power and the temperature of the present invention. The power consumption of the present invention is much lower than that required by the prior art. FIG. 6 shows the relationship between the refractive index and the wave length of the present invention. As shown, the heat energy of the present invention includes far infrared energy and radiating energy and 80% of the heat energy comes from the far infrared energy.

The invention is naturally not limited in any sense to the particular features specified in the forgoing or to the details of the particular embodiment which has been chosen in order to illustrate the invention.

Consideration can be given to all kinds of variants of the particular embodiment which has been described by way of example and of its constituent elements without thereby departing from the scope of the invention. This invention accordingly includes all the means constituting technical equivalents of the means described as well as their combinations.

## Claims

**1.** A method of manufacturing an electric heating film comprising steps of:

preparing a mixture by fusing together metallic oxides and adding 1-10% of impurities in weight into said mixture;

mixing and stirring well said mixture with a medium material at a proportion of 20-60% in weight to form a liquid material which is then filtered so as to remove undesired matters;

dispose a base material into a heating furnace and heated for activating surface thereof;

mixing said liquid material with air and spraying them into said heating furnace by means of a compressor at an air pressure of 2.0 kg/cm$^3$ hence atomizing and dissolving

said liquid material into ions; and

letting said ions be accumulated and evenly coated on said base material thereby forming an electric heating film on said base material.

2. The method of manufacturing an electric heating film as claimed in Claim 1, wherein said medium material is water, methyl alcohol, ethyl alcohol, hydrochloric acid, or ethylamine.

3. The method of manufacturing an electric heating film as claimed in Claim 1, wherein said base material is made of quartz, glass, porcelain, or mica.

4. The method of manufacturing an electric heating film, wherein said electric heating film has a thickness of 3-300μ.

5. The method of manufacturing an electric heating film, said base material is heated to 400-800 degrees centigrade for 10-30 minutes.

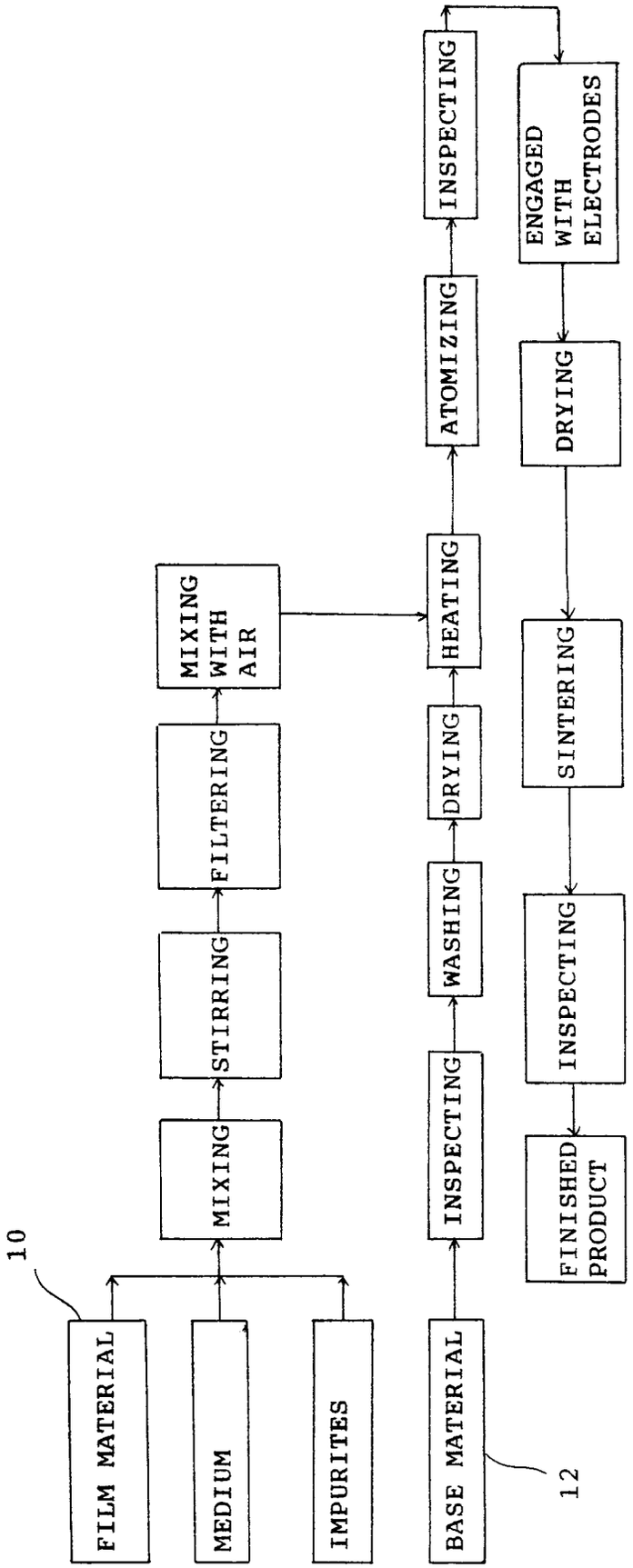

10
FILM MATERIAL
MEDIUM
IMPURITES
MIXING
STIRRING
FILTERING
MIXING WITH AIR
BASE MATERIAL
INSPECTING
WASHING
DRYING
HEATING
ATOMIZING
INSPECTING
12
ENGAGED WITH ELECTRODES
DRYING
SINTERING
INSPECTING
FINISHED PRODUCT

FIG. 1

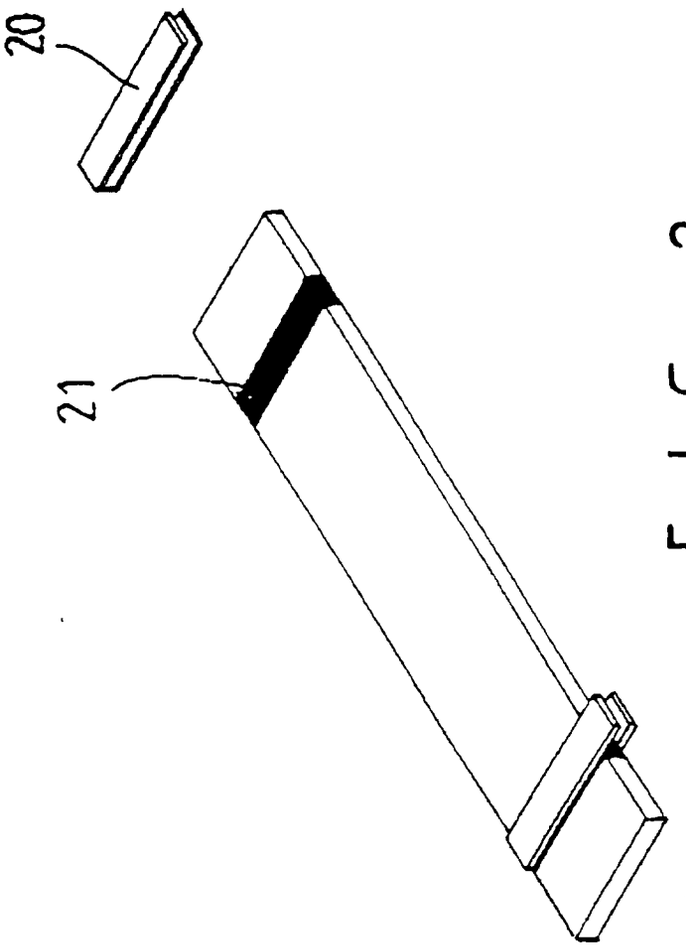



FIG. 2

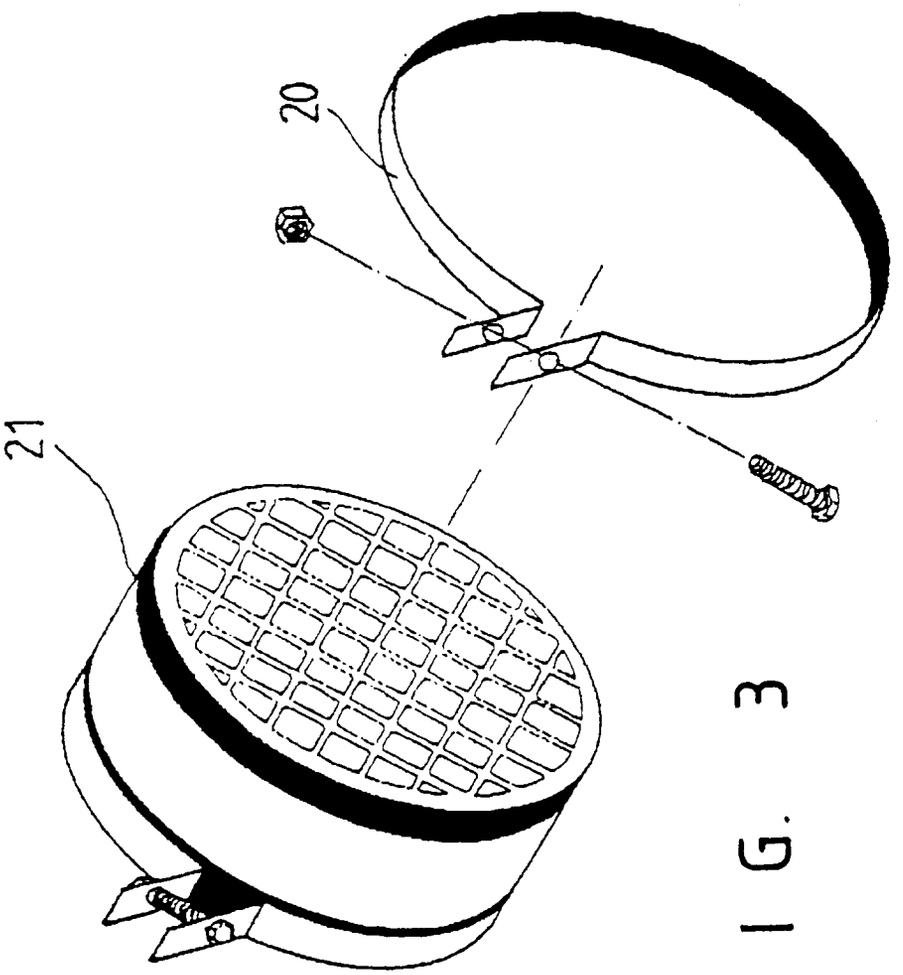
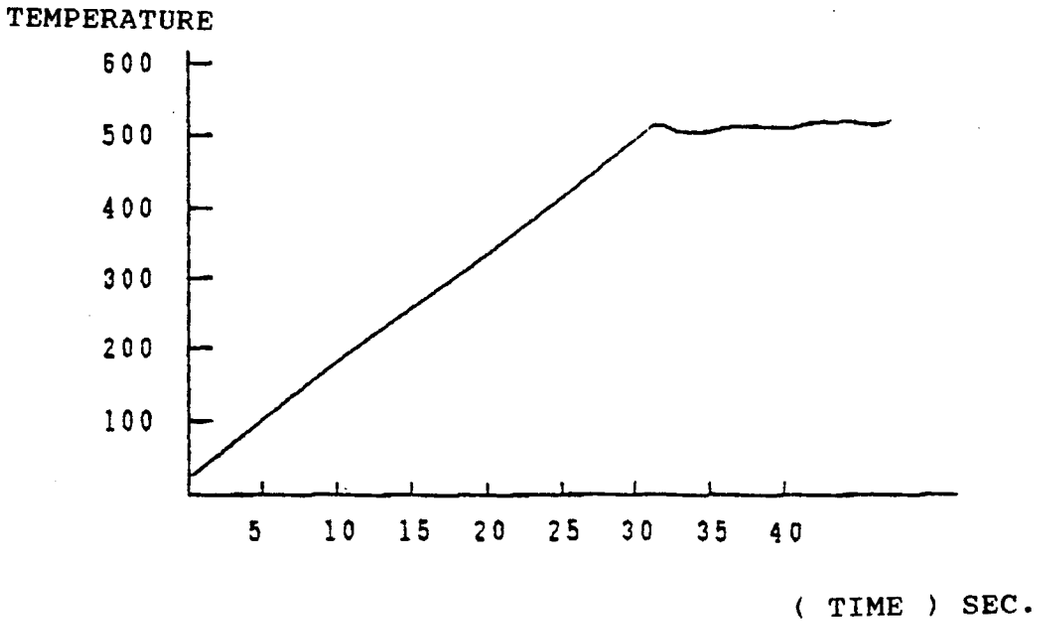



FIG. 3


TEMPERATURE
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500
400
300
200
100
5
10
15
20
25
30
35
40
( TIME ) SEC.

FIG. 4

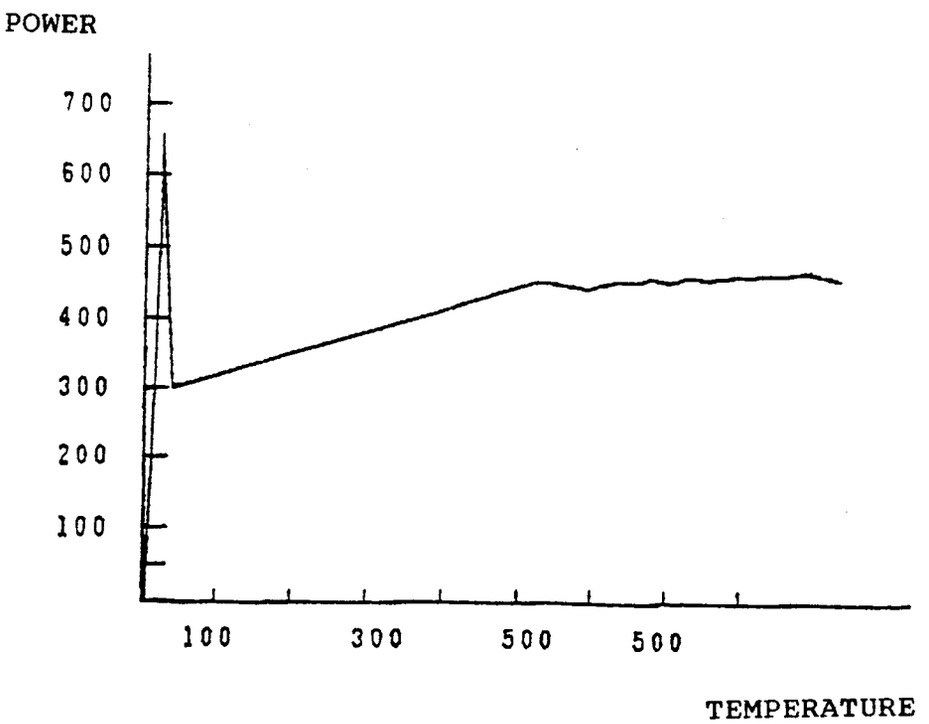
POWER
700
600
500
400
300
200
100
100
300
500
500
TEMPERATURE

FIG. 5

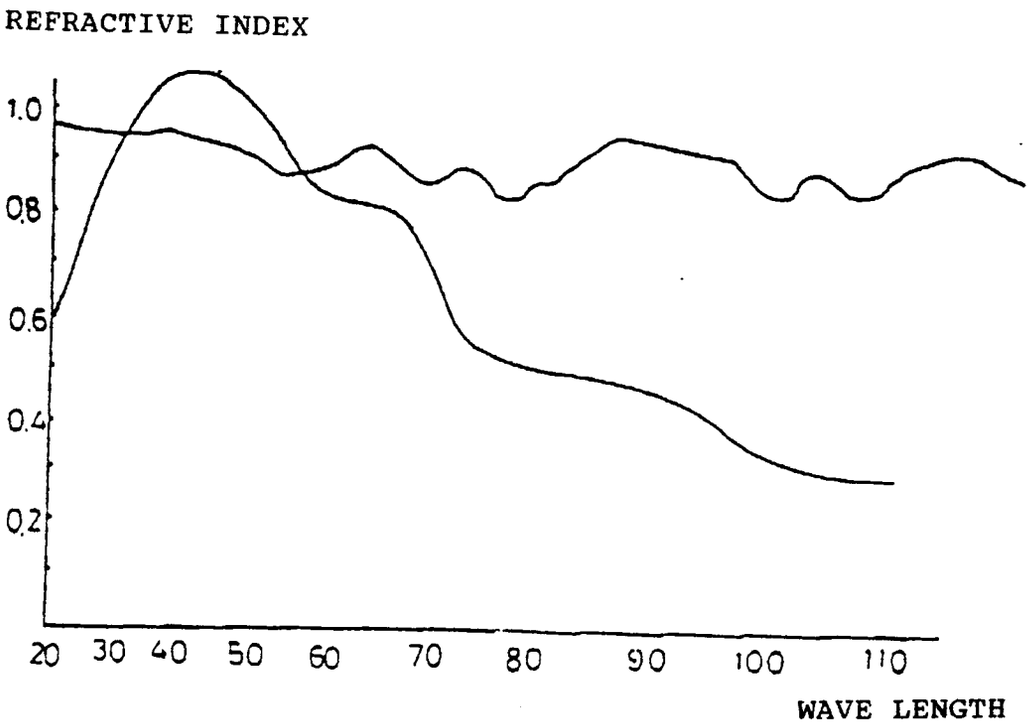
REFRACTIVE INDEX
1.0
0.8
0.6
0.4
0.2
20
30
40
50
60
70
80
90
100
110
WAVE LENGTH

FIG. 6

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 93 81 0818

## 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) |
|---|---|---|---|
| X | EP-A-0 280 362 (PHILIPS PATENTVERWALTUNG GMBH)<br>* column 3, line 57 - column 4, line 15; claims 1,7-10 * | 1-3,5 | H05B3/26<br>H05B3/12 |
| X | DE-C-908 882 (CORNING GLASS WORKS)<br>* page 3, right column, line 95 - line 115 *<br>* page 4, left column, line 26 - line 31 * | 1-3,5 | |
| X | FR-A-2 640 803 (NEIMAN)<br>* page 2, line 19 - page 3, line 6; claims 1-3 * | 1 | |
| A | EP-A-0 208 808 (HANXIONG ZHU) | | |
| A | EP-A-0 302 589 (J. BOARDMAN) | | |
| A | DE-A-21 21 319 (M-G. ROCHOLL) | | |

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 | 13 April 1994 | De Smet, F |

CATEGORY OF CITED DOCUMENTS

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