

Industria y Comercio
SUPERINTENDENCIA

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 07-002270- -00005-0000

Fecha: 2008-06-17 16:37:52 Dep 2020 NUECREACION
Ira 3 MODELO Eve 1 REGDEPOSITO
Act 400 OPOSIOBSERVIER Folios 84

FORMULARIO UNICO DE OPOSICIÓN

1. OPOSICIÓN A:

- | | |
|--|---|
| ☐ Patente de invención | ☐ Marca Colectiva |
| ☒ Patente de Modelo de Utilidad | ☐ Marca de Certificación |
| ☐ Diseño Industrial | ☐ Lema Comercial |
| ☐ Esquema de Trazados para Circuitos Integrados | |
| ☐ Marcas de Productos o Servicios | |

2.	Número de Expediente: 07-002270
	Solicitante: DANIEL ADOLFO MAYA JIMENEZ
	Apoderado: _____
	Título de la nueva creación o denominación del signo: UNIDAD DE CUIDADOS ESPECIALES INTERMEDIO PARA NEONATOS Gaceta: 591 DE ABRIL 30 DE 2008, BAJO EL NP 28

SOLICITUD
PUBLICADA

3. OPOSICIÓN PRESENTADA POR

SOLICITANTE	Nombre: FUNDACION CARDIOVASCULAR DE COLOMBIA Dirección CALLE 155A No. 23-58 EL BOSQUE Nacionalidad o Domicilio FLORIDABLANCA, SANTANDER, COLOMBIA Lugar de Constituci FLORIDABLANCA, SANTANDER, SANTANDEF COLOMBIA Teléfono _____ Fax _____ E-mail: _____	IDENTIFICACION C.C. ☐ NIT ☒ C.E. ☐ Otro ☐ Cual _____ Número: 890,212,568-0
	Nombre: CARLOS ORLANDO MAYA RODRIGUEZ Dirección: Cr. 13 A No 28-38, Mz 2 Bufete 245. Parque Central Bavaria Teléfono 3419841 Fax 3368592 E-mail: carlos.tamayo@tmtamayo.net	IDENTIFICACION C.C. ☒ NIT ☐ C.E. ☐ Otro ☐ Cual _____ Número: 17.117.818 TP: 17.402

4. FUNDAMENTOS DE LA OPOSICIÓN:

Causal Artículos 16, 81, 42 de la Decisión 486 de la C.A.N.,

Signo opositor: _____

Justificación: Se encuentra en documento adjunto.

5.

Comprobante de pago No.

08-47103
08-48210

Fecha

JUNIO 12/2008
JUNIO 17/2008

6. Anexos

☒

Comprobante de pago de la tasa.

☒

Poderes, si fuere el caso.

☒

Pruebas de los fundamentos de la oposición

☐

Documentos que acrediten el legítimo interés, si fuere el caso.

☒

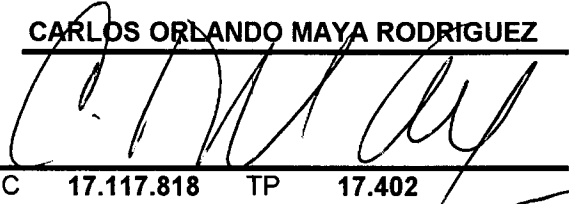
Documento que acredita la existencia y representación legal de las partes, cuando sean personas jurídicas.

7.

NOMBRE:

CARLOS ORLANDO MAYA RODRIGUEZ

FIRMA:



C.C 17.117.818 TP 17.402



TM TAMAYO & ASOCIADOS
INTERNATIONAL PATENT AND TRADEMARK OFFICE

Trademark	Marcas
Patent	Patentes
Health Permit	Registros Sanitarios
Software	Soporte Lógico
Commercial Name	Nombres Comerciales
Design	Diseños

CARLOS ORLANDO MAYA RODRÍGUEZ, mayor de edad, vecino de esta ciudad, identificado con la cédula de ciudadanía número 17.117.818 de Bogotá, Abogado en ejercicio y portador de la Tarjeta Profesional N°.17.402 del C.S.J., obrando en calidad de apoderado de la FUNDACIÓN CARDIOVASCULAR DE COLOMBIA S, atentamente manifiesto a usted que dentro del término legal Presento

I.- PETICIÓN:

Solicito a su despacho negar el beneficio patentario a la solicitud radicada bajo el expediente 07-002.270, por no cumplir con los requisitos de los artículos 16 y 81 de la Decisión 486 de la Comunidad Andina de Naciones, con base en los fundamentos de hechos y derecho que se exponen a continuación.

II.- LEGITIMO INTERÉS

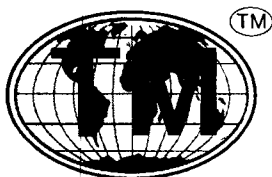
A mi representada la sociedad **FUNDACIÓN CARDIOVASCULAR DE COLOMBIA S.A.**, le asiste legítimo interés para presentar ésta oposición, ya que la eventual concesión de la solicitud del expediente citado, impedirían tanto a mi representada como a otros hospitales usar las incubadores de calor radiante; humidificador; cámara de control de temperatura y esterilización bajo UV; tratamiento de fototerapia para la ictericia; generador de iones negativos, así como la pesa para bebé, el que carece de novedad, en detrimento de sus legítimos intereses comerciales y de la libre competencia, lo anterior basados en los artículos 23 de la Constitución Política de Colombia y Art. 5° del C.C.A.

III.- FUNDAMENTOS DE LA OPOSICIÓN

CON RESPECTO DE LA NOVEDAD:

La solicitud del expediente No.07-002.270 que se encuentra actualmente en trámite y que se refiere a: "UNIDAD DE CUIDADOS ESPECIALES INTERMEDIOS PARA NEONATOS" que consiste en la unión de varios equipos utilizados en el área de atención en neonatología, este contiene los siguientes sub-equipos

- Incubadora de Calor Radiante, manteniendo así la temperatura del bebe estable.
- Humidificador con control de temperatura, evitando el enfriamiento del niño por la baja temperatura del oxígeno suministrado.
- Cámara con control de temperatura y Esterilización bajo UV, manteniendo asépticos y con una temperatura estable los elementos de apoyo y ayuda clínica tales como cobijas, guantes y elementos de procedimiento.
- Tratamiento de Fototerapia, para el tratamiento de Ictericia en niños con bajo peso al nacer.
- Generador de Iones Negativos, que ayudan a mejorar la calidad de aire reduciendo el efecto de partículas dispersas en el aire que causan enfermedades respiratorias y alergias ocasionadas por: virus, bacterias, polen, polvo y humo.
- Pesa Bebe, llevando un monitoreo del peso del bebe para evaluar el mejoramiento o decaimiento del mismo.



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Commercial Name	Nombres Comerciales
Design	Diseños

No cumple con los requisitos necesarios para otorgársele el privilegio de patente de Modelo de Utilidad, tal y como se argumenta a continuación.

La patente de Modelo de Utilidad, solicitada con el expediente 07-002270, no cumple con el requisito de Novedad por cuanto antes de la fecha de solicitud 11 de enero de 2007, ya existían en el estado de la técnica y en el mercado todos los aparatos que pretende reivindicar el Modelo de utilidad, por:

1. La Patente US6,845,217 publicada en mayo 20 de 2004 revela las lámparas de calor radiante usadas en las incubadoras (ver anexo 1)
2. La patente US7,217,936 publicada en agosto 11 de 2005 enseña un método y aparato para esterilización usando una fuente de luz ultravioleta (ver anexo 2)
3. la patente US6,703,785 publicada en enero 2 de 2003 revela un generador de iones negativos (ver anexo 3)
4. la patente 6, 464, 715 publicada en agosto 15 de 2000 revela el tratamiento y aparato de fototerapia para la ictericia, (ver anexo 4)
5. Tanto el Humidificador como la pesa bebé son de dominio público en Colombia.

Todo lo reivindicado por el solicitante ya existía en el estado de la técnica al momento de la solicitud, por lo tanto no cumple con el requisito de novedad del Art. 16 de la decisión 486, que a la letra dice:

“Artículo 16.- Una invención se considerará nueva cuando no está comprendida en el estado de la técnica.

El estado de la técnica comprenderá todo lo que haya sido accesible al público por una descripción escrita u oral, utilización, comercialización o cualquier otro medio antes de la fecha de presentación de la solicitud de patente o, en su caso, de la prioridad reconocida.

Sólo para el efecto de la determinación de la novedad, también se considerará dentro del estado de la técnica, el contenido de una solicitud de patente en trámite ante la oficina nacional competente, cuya fecha de presentación o de prioridad fuese anterior a la fecha de presentación o de prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido esté incluido en la solicitud de fecha anterior cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40.”



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Software	Soporte Lógico
Commercial Name	Nombres Comerciales
Design	Diseños

CON RESPECTO DE LA DEFINICIÓN DE MODELOS DE UTILIDAD:

"DE LOS MODELOS DE UTILIDAD

Artículo 81.- *Se considera modelo de utilidad, a toda nueva forma, configuración o disposición de elementos, de algún artefacto, herramienta, instrumento, mecanismo u otro objeto o de alguna parte del mismo, que permita un mejor o diferente funcionamiento, utilización o fabricación del objeto que le incorpore o que le proporcione alguna utilidad, ventaja o efecto técnico que antes no tenía. (SUBRAYADO PARA DESTACAR)*

Los modelos de utilidad se protegerán mediante patentes"

Aunque puede cumplir con la primera parte "nueva forma o configuración", no cumple con: "que permita un mejor o diferente funcionamiento" porque el funcionamiento es exactamente igual al funcionamiento de los antecedentes mencionados y por lo tanto no cumple con la definición de Modelo de Utilidad dada por el Art. 81 de la decisión 486.

7.- FUNDAMENTOS DE DERECHO

Fundamento mis argumentos en los artículos 16 y 81 (requisitos de patentabilidad), el artículo 42, en concordancia con el artículo 85, de la Decisión 486 de la Comunidad Andina, Artículos 23 de la Constitución Política de Colombia y Art. 5º del C.C.A. y demás normas concordantes.

10- PETICIÓN DE PRORROGA PARA APORTAR PRUEBAS.

De conformidad con el artículo 42, Inciso 2º de la Decisión 486 de la Comisión de la Comunidad Andina, atentamente solicito prórroga por el término de 30 días para presentar pruebas, que sustentan la Oposición.

Anexo con este el recibo de pago No. 08-48,210 fecha Junio 17/2008.

8.- PRUEBAS

Ruego a su Despacho tener como pruebas, sin perjuicio de las que se presentaran antes del vencimiento de prórroga solicitada y de las que su Despacho oficiosamente considere, las siguientes:

- Anexo 1. Lámpara de calor radiante, aparato y método para producir rayos infrarrojos, US6,845,217



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INTERNATIONAL PATENT AND TRADEMARK OFFICE

Trademark	Marcas
Patent	Patentes
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Commercial Name	Nombres Comerciales
Design	Diseños

- Anexo 2.- Sistema y método para esterilizar usando rayos ultravioleta, US7,217,936.
- Anexo 3.- Generador de iones negativos, US6,703,785
- Anexo 4.- Tratamiento Intensivo de Fototerapia para la ictericia en neonatos, US6,464,715

9- ANEXOS

- 1.- Poder para actuar
- 2.- Certificado de existencia y representación legal
- 3.- Copia de la oposición para traslado
- 4.- Recibo por concepto de la tasa correspondiente a la oposición
- 5.- Recibo por concepto de prórroga para sustentar la oposición.
- 6.- Las pruebas relacionadas. En el párrafo anterior

11.- NOTIFICACIONES

La solicitante y su apoderado en la dirección por ellos indicada en la solicitud de registro.

Mi representado y yo, recibiremos notificaciones en la secretaría de su despacho y/o en mi oficina ubicada en la Carrera 13A No. 28-38 Ofc. 245 Parque Central Bavaria.

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 07-002270- -00005-0000

Fecha: 2008-06-17 16:37:52 Dep. 2020 NUECREACION
Tra. 3 MODELO Eve: 1 REGDEPOSITO
Act. 400 OPOSIOBSERVIER Folios: 84

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 08 - 47.103
FECHA : JUNIO 12 DE 2008

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PAGO	Vr. PAGO
CARLOS TAMAYO Y ASOCIADOS	CONSIGNACION	BANCO DE BOGOTA	062754387	3434712	12/06/2008	1,550,500.00

***** CONCEPTO *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-04	PRESENTACION DE OBSERVACIONES	12 MARCAS Y LEMAS COMERCIALES
			266,000.00
		TOTAL :	\$ 266,000.00

SON: DOSCIENTOS SESENTA Y SEIS MIL PESOS

RESPONSABLE : _____

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 07-002270- -00005-0000

Fecha: 2008-06-17 16:37:52 Dep. 2020 NUECREACION
Ira. 3 MODELO Eve: 1 REGDEPOSITO
Act. 400 OPOSIOBSERVIER Folios: 84

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176085

RECIBO OFICIAL DE CAJA : 08 - 48.210
FECHA : JUNIO 17 DE 2008

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PAGO	Vr. PAGO
CARLOS TAMAYO Y ASOCIADOS	CONSIGNACION	BANCO DE BOGOTA	062754387	3434631	17/06/2008	1,392,500.00

***** CONCEPTO *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-08	PRORROGA DE TERMINOS	75,000.00
		TOTAL :	\$ 75,000.00

SON: SETENTA Y CINCO MIL PESOS

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

PODER

Yo, **VICTOR RAUL CASTILLO MANTILLA**, mayor de edad, domiciliado en **BUCARAMANGA** identificado con cedula de ciudadanía No. 19.288.515 expedido(a) en BOGOTA, actuando como Representante legal de la Sociedad Comercial **FUNDACIÓN CARDIOVASCULAR DE COLOMBIA**, como consta en el Certificado de Existencia y Representación Legal, por medio del presente confiero poder ESPECIAL pero amplio y suficiente a los abogados CARLOS ORLANDO MAYA RODRÍGUEZ y/o GUSTAVO CALDERON ROSERO y/o CARMEN GRACIELA FLOREZ y/o BLANCA LUCILA TAMAYO en su orden, identificados con las Cédulas de Ciudadanía No. 17.117.818 de Bogotá, 17.119.352 de Bogotá, 63.325.304 de Bucaramanga, 46.666.992 de Duitama y portadores de las Tarjetas Profesionales Nos. 17.402, 31.984, 14.557, 97.983, 95.722, del C.S.J. respectivamente, domiciliados en la Carrera 13 A No. 28-38, Mz. 2 Buffeté 245, Parque Central Bavaria, Bogotá, Colombia, para solicitar por ante las oficinas y autoridades correspondientes: A **OPOSICIÓN DE LA SOLICITUD DE PATENTE DE INVENCION CON EXPEDIENTE 07-2270**

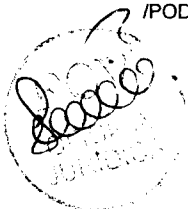
En consecuencia, mis apoderados quedan facultados para dar ante dichas autoridades todos los pasos necesarios en cumplimiento del objeto indicado, como son: Elevar solicitudes, descripciones, protestas, declaraciones, reposiciones y apelaciones, presentar observaciones, oposiciones, reclamos, responder observaciones y/o oposiciones, Solicitar Renovaciones, modificaciones, afectaciones, cesiones, licencias de uso, abonar todos los impuestos y cuotas de cualquier otros pagos determinados por la Ley; Recibir todos los documentos presentados, solicitar testimonios, desistir y enmendar solicitudes, percibir para oponerse y protestar contra cualesquiera solicitudes, que a juicio de los apoderados pudieran prestarse a confusión o infringir o de cualquier modo perjudicar el derecho del Mandante. Al Mandatario se le otorga autorización amplia y bastante para contestar todos los reclamos y demandas presentadas ante autoridades administrativas y judiciales, desistir de procedimientos, transar conflictos, pudiendo así mismo sustituir este poder en todo o en parte y revocar dichas sustituciones, así como también cualquier otra diligencia relacionada con este proceso.

Del señor Jefe, atentamente,

VICTOR RAÚL CASTILLO MANTILLA.
Identificación No.: 19.288.515
De: Bogotá

DILIGENCIA DE PRESENTACIÓN PERSONAL
<i>Victor Raúl Castillo Mantilla</i> <i>ee F19 288 515 Bogotá</i> JUN 2014 <i>[Signature]</i> <i>[Signature]</i> <i>[Stamp: NOTARIAL DE BOGOTÁ]</i>

/PODERES/PD JURÍDICO PI (1)





CARTA	Código: DS-RG-01.5.0.0-27-06	Fecha: 23/08/07	Versión: 3	Pág. ____ de ____
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01.1.4.0

EL COORDINADOR DE LA OFICINA JURIDICA DE LA
SECRETARIA DE SALUD DEPARTAMENTAL

CERTIFICA:

Que habiéndose consultado los archivos de esta dependencia, se pudo establecer:

Que de conformidad con los Estatutos de la FUNDACION CARDIOVASCULAR DE COLOMBIA, con domicilio en el Municipio de Floridablanca (Sóder), el Director Ejecutivo es el Representante Legal de la Fundación.

Que en la actualidad el Doctor VICTOR RAUL CASTILLO MANTILLA, identificado con la cédula de ciudadanía número 19.288.515 expedida en Bogotá (Cund.), se encuentra ejerciendo el cargo de Director Ejecutivo de la Fundación.

Que mediante Resolución N° 08772 del 06 de Julio de 1990, el Ministerio de Salud-Oficina Jurídica, reconoció Personería Jurídica a la entidad sin ánimo de lucro denominada FUNDACIÓN CARDIOVASCULAR DEL ORIENTE COLOMBIANO

Que por Resolución N° 04162 del 21 de Mayo de 2003, la Gobernación de Santander, aprobó la Reforma de Estatutos por cambio de denominación de la Fundación, quedando la razón social FUNDACION CARDIOVASCULAR DE COLOMBIA, aprobada en la Asamblea General Extraordinaria de la Institución, el día 27 de marzo de 2003; con NIT N° 890.212.568-0, se encuentra funcionando en la Calle 155 A N° 23-58 Urbanización El Bosque - Floridablanca -Santander.

Que en el evento de existir documentación que registre información diversa a la aquí consignada, estamos en condiciones de revisar la presente Certificación.

Que se adhiere y anula Estampilla de Recaudo Departamental, por valor de \$35.420., según Recibo N° 02532356 del 02 de Mayo de 2008.

Que se expide a solicitud de la Ing. SONIA STELLA RAMÍREZ RIBERO, Directora Gral. de Operaciones de la Fundación, para fines Oficiales.

Expida en Bucaramanga, a los seis (06) días del mes de Mayo del año dos mil ocho (2008)

ADRIAN I. GONZALEZ JAIMES

Elaboró: Elsa B.



Gestión de
Contratación y Gestión
Financiera



Contracting
Management and
Financial
Management



Gobernación de Santander
Secretaría de Hacienda

Recaudo de Estampillas



00648598



00617544

Recibo N°

02532356

Trámite

Con destino a

CERTIFICACIÓN SOBRE EXISTENCIA Y/O REPRESENTACIÓN LEGAL DE PERSONAS
JURÍDICAS

Municipio

DEPARTAMENTO - GOBERNACIÓN

Estampillas

PRO HOSPITAL.....	15,400
PRO DESARROLLO.....	600
PRO ELECTRIFICACION.....	800
PRO CULTURA.....	7,700
PRO ANCIANO.....	7,700

Total Estampillas..... 32,200
ORDENANZA 012/05 y Decreto 005/06..... 3,220

Total a Pagar

\$35.420

Contribuyente

Tipo de Doc.

Número

Nombre

NIT

8902125680

Dirección

FUNDACION CARDIOVASCULAR DE COLOMIA Teléfono

Municipio

CLL 155A 23 58

Departamento

6392800

FLORIDABLANCA

SANTANDER



41500890200123560253235680200000000035420390020080531

ANULADO

Fecha de Expedición

02-May-2008

Fecha Limite de Pago

31-May-2008



Gobernación de Santander
Secretaría de Hacienda

Recaudo de Estampillas



00648598



00617544

Recibo N°

02532356

Trámite

Con destino a

CERTIFICACIÓN SOBRE EXISTENCIA Y/O REPRESENTACIÓN LEGAL DE PERSONAS
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Municipio

DEPARTAMENTO - GOBERNACIÓN

Estampillas

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PRO ANCIANO.....	7,700

Total Estampillas..... 32,200
ORDENANZA 012/05 y Decreto 005/06..... 3,220

Total a Pagar

\$35.420

Contribuyente

Tipo de Doc.

Número

Nombre

NIT

8902125680

Dirección

FUNDACION CARDIOVASCULAR DE COLOMIA Teléfono

Municipio

CLL 155A 23 58

Departamento

6392800

FLORIDABLANCA

SANTANDER



41500890200123560253235680200000000035420390020380531

Fecha de Expedición

02-May-2008

Fecha Limite de Pago

31-May-2008

ANEXO 1



US006845217B2

(12) **United States Patent**
Konishi

(10) **Patent No.:** **US 6,845,217 B2**
(45) **Date of Patent:** ***Jan. 18, 2005**

(54) **INFRARED RAY LAMP, HEATING APPARATUS AND METHOD OF PRODUCING THE INFRARED RAY LAMP**

5,628,859	A	5/1997	Janin et al.	156/273.3
6,041,164	A	3/2000	Hofius, Sr. et al.	392/407
6,057,532	A	* 5/2000	Dexter et al.	219/553

(List continued on next page.)

(75) **Inventor:** **Masanori Konishi, Takamatsu (JP)**

(73) **Assignee:** **Matsushita Electric Industrial Co., Ltd., Osaka (JP)**

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) **Appl. No.:** **10/615,442**

(22) **Filed:** **Jul. 8, 2003**

(65) **Prior Publication Data**

US 2004/0096202 A1 May 20, 2004

Related U.S. Application Data

(63) Continuation of application No. 09/890,115, filed as application No. PCT/JP00/08313 on Nov. 24, 2000, now Pat. No. 6,654,549.

(30) **Foreign Application Priority Data**

Nov. 30, 1999	(JP)	11-340784
Feb. 29, 2000	(JP)	2000-053838

(51) **Int. Cl.⁷** **F26B 3/30; H05B 1/00**

(52) **U.S. Cl.** **392/407; 392/422; 219/553; 219/541**

(58) **Field of Search** 392/407-408, 392/422, 432, 424; 219/553, 541, 546, 548, 550; 29/611; 313/110, 113; 362/217

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,127,112	A	3/1964	McCammon et al.	392/422
5,091,632	A	2/1992	Hennecke et al.	219/553

FOREIGN PATENT DOCUMENTS

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DE	4438871	5/1996
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GB	2233150	* 1/1991
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JP	61-7889	1/1986
JP	61-53884	4/1986
JP	62-74779	5/1987
JP	63-116804	7/1988
JP	63-45757	11/1988
JP	64-65790	3/1989
JP	2-140519	5/1990
JP	4-324277	11/1992
JP	7-230795	8/1995
JP	7-288175	10/1995
JP	9-42684	2/1997
JP	11-54092	2/1999
JP	11-214125	8/1999
JP	11-214126	8/1999
JP	2000-228271	8/2000
JP	2000-294362	* 10/2000

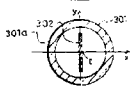
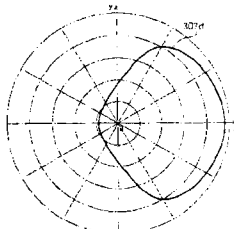
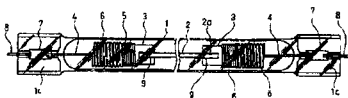
Primary Examiner—John A. Jeffery

(74) *Attorney, Agent, or Firm*—Pearne & Gordon LLP

(57) **ABSTRACT**

An infrared ray lamp having a structure wherein a groove is formed in the vicinity of each of both end portions of a substantially plate heating element formed of a carbon-based substance, a carbon-based adhesive is applied to a region including the groove, and the end portion of the heating element is inserted into a slit formed at the end portion of a heat-emitting block having high conductivity so as to be sandwiched; by forming a reflection film on the glass tube of the infrared ray lamp, an infrared ray lamp having a desired emission intensity distribution is provided; a heating apparatus using this infrared ray lamp and method of producing the infrared ray lamp are also provided.

20 Claims, 26 Drawing Sheets



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FIG. 1

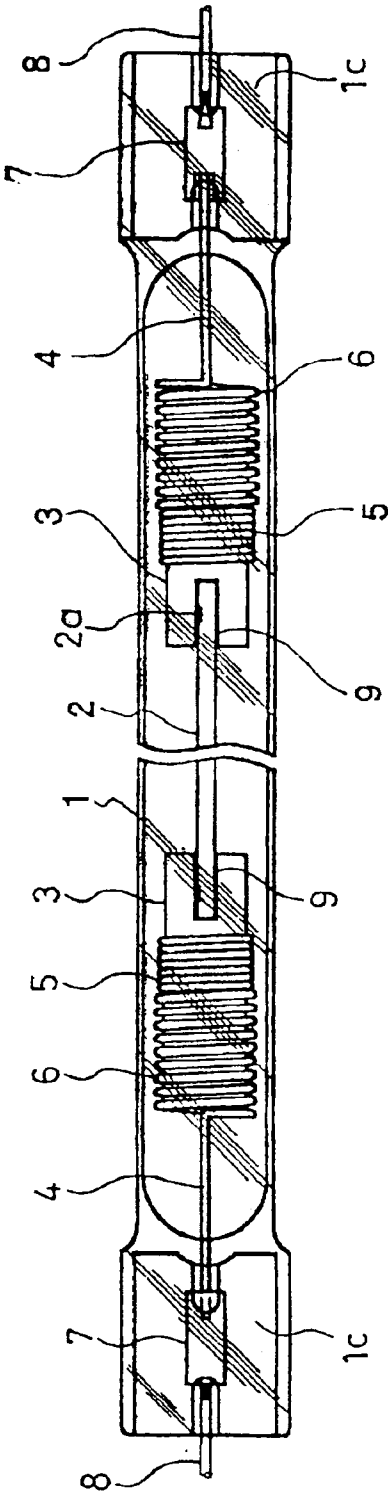


FIG. 2

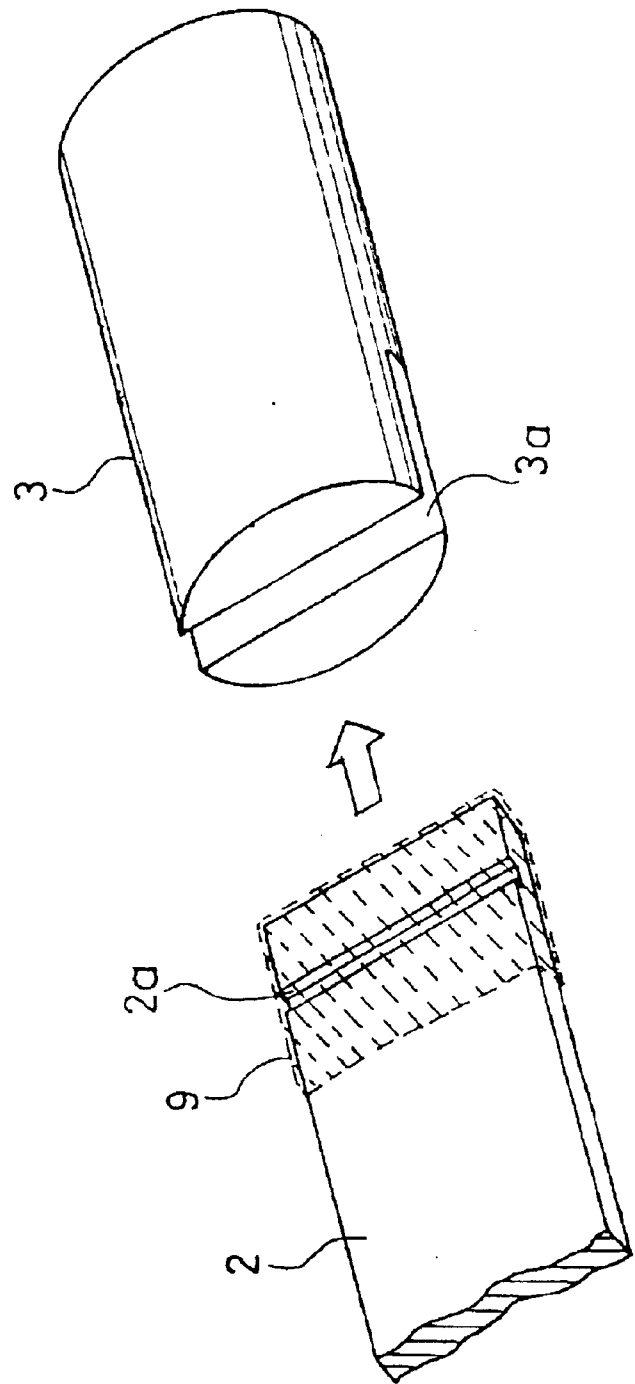


FIG. 3

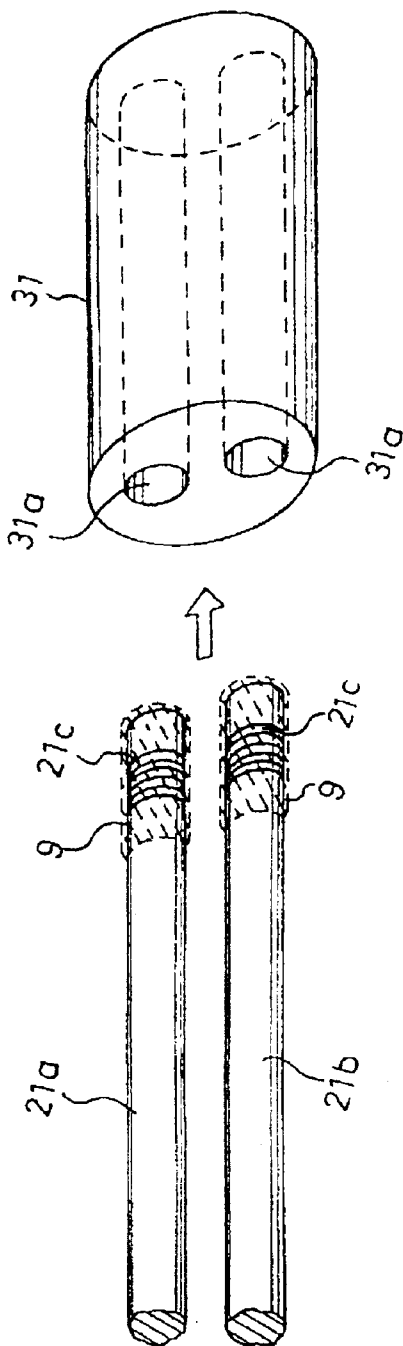


FIG. 4

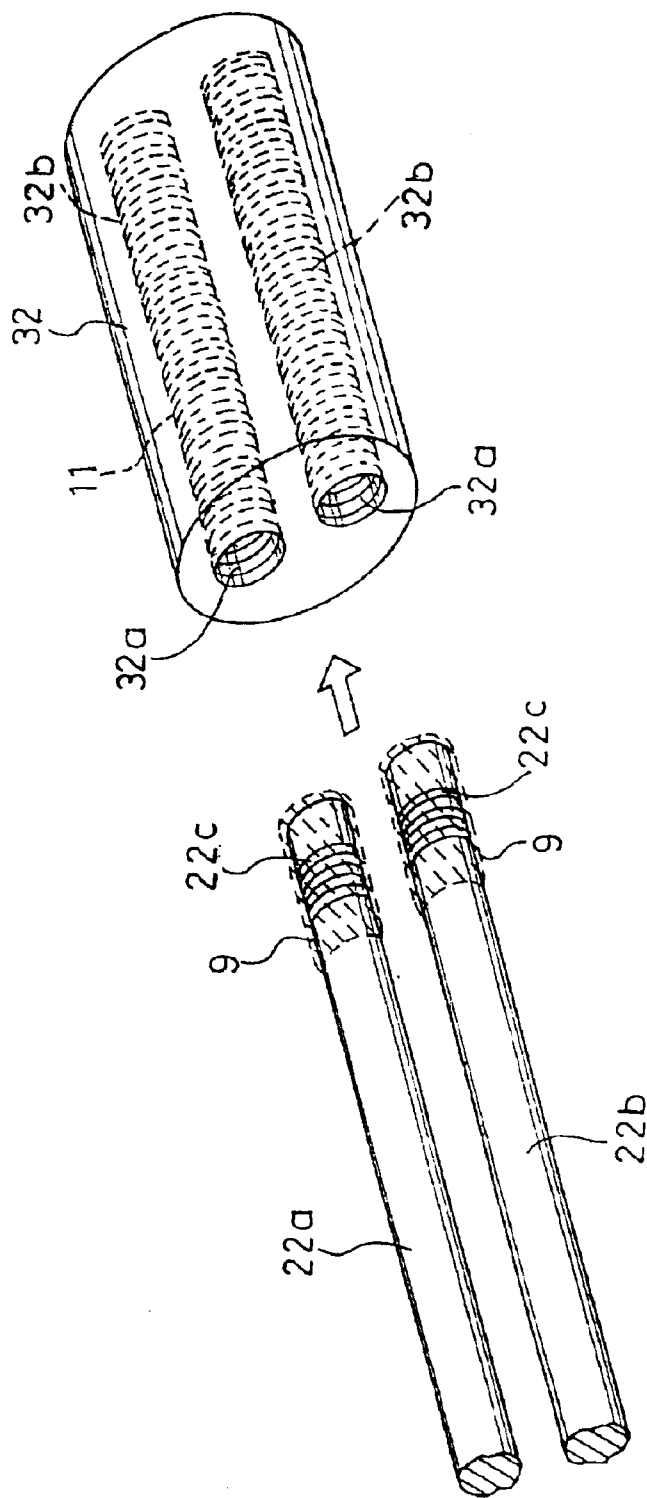


FIG. 5

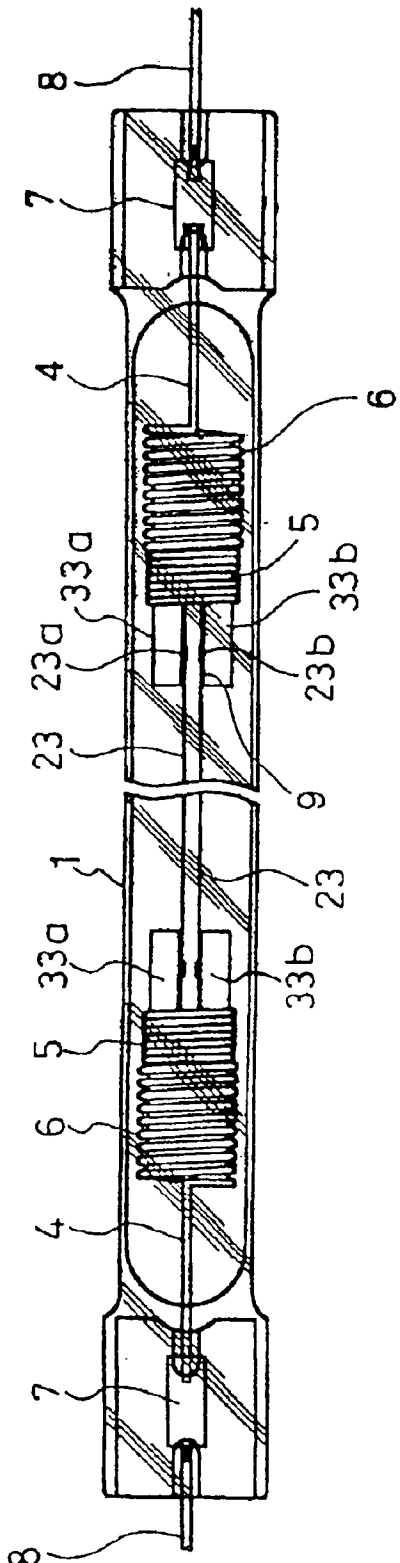


FIG. 6

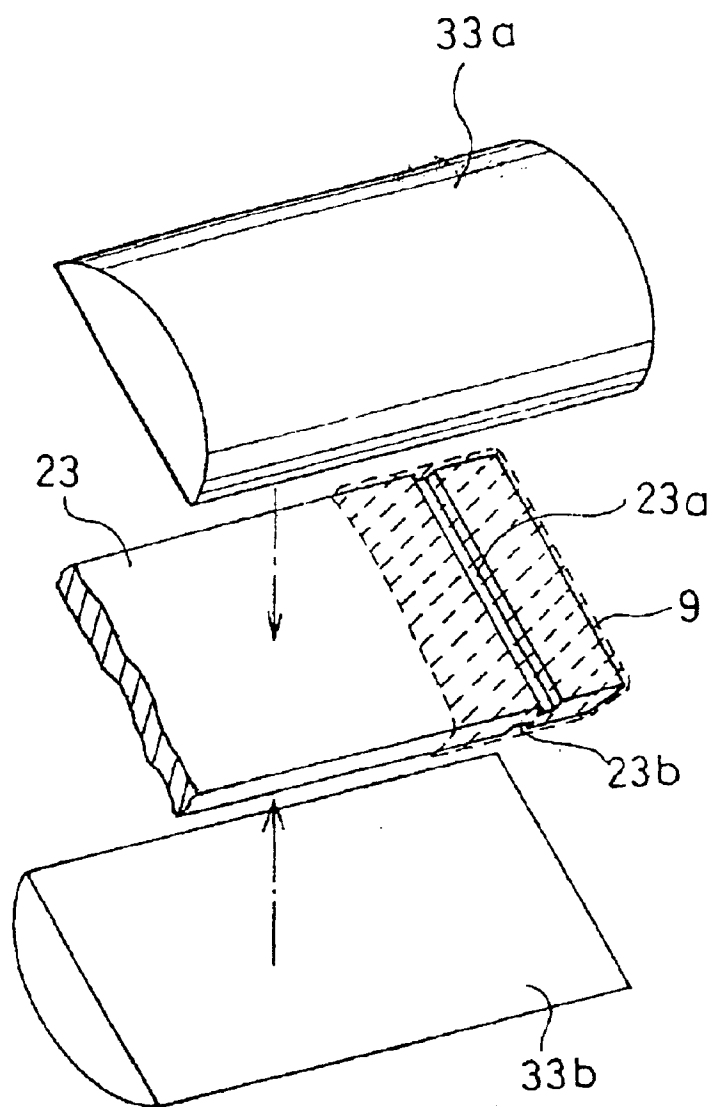


FIG. 7

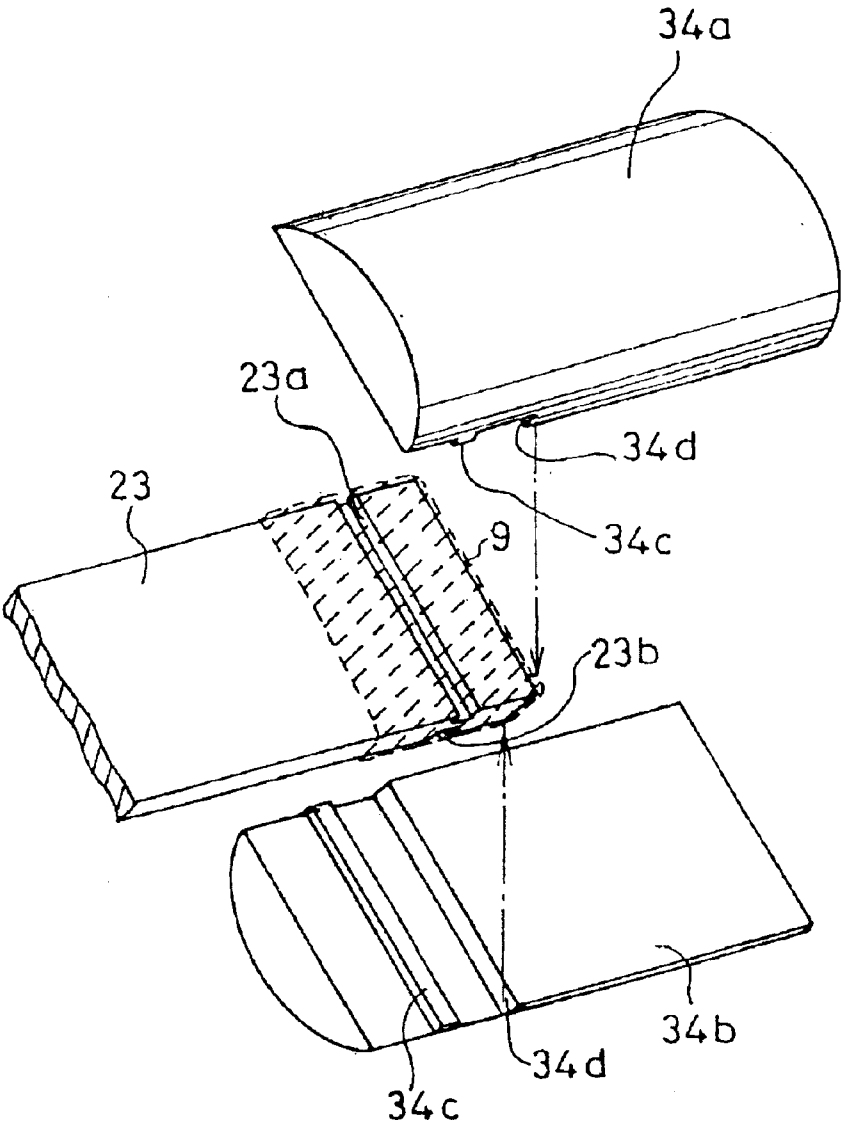


FIG. 8

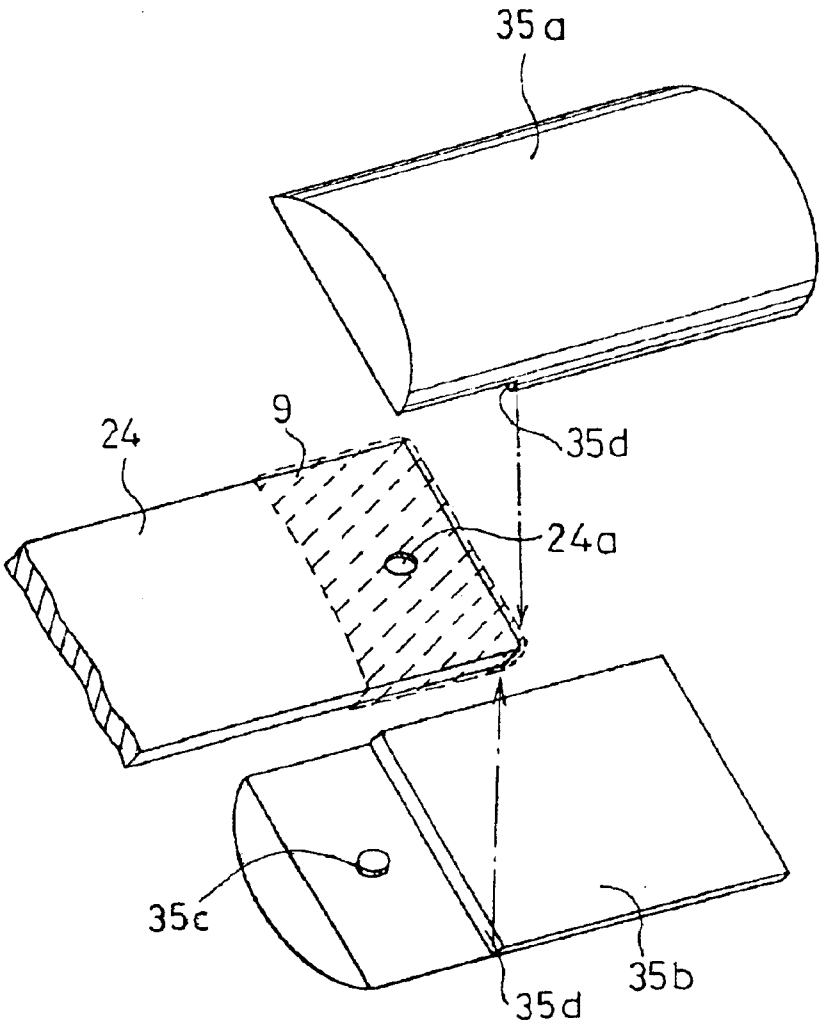


FIG. 9(a)

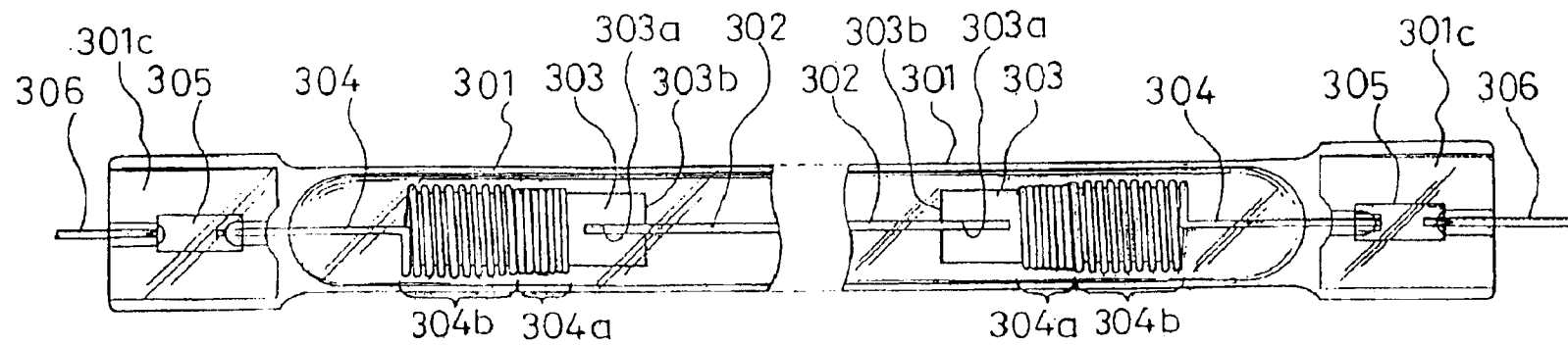


FIG. 9(b)

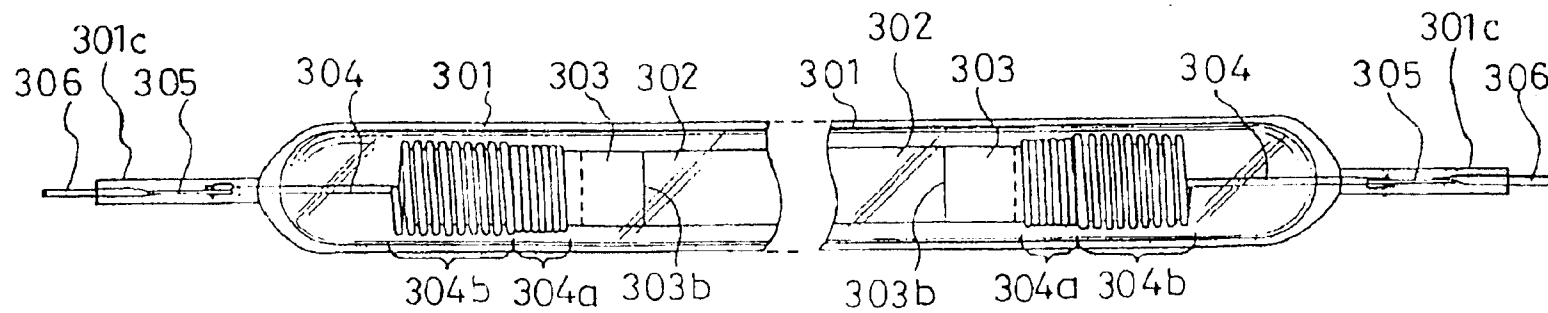


FIG. 10

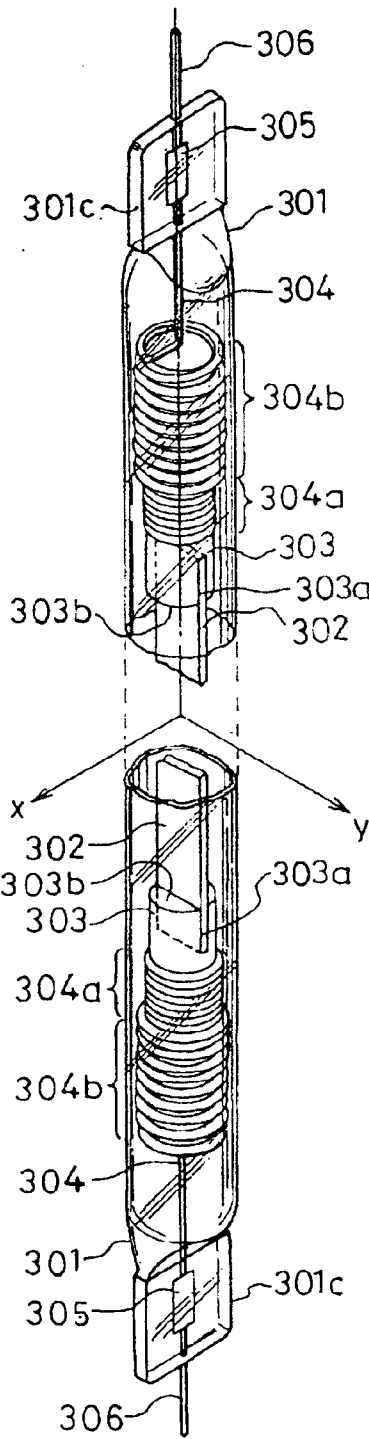


FIG. 11(a)

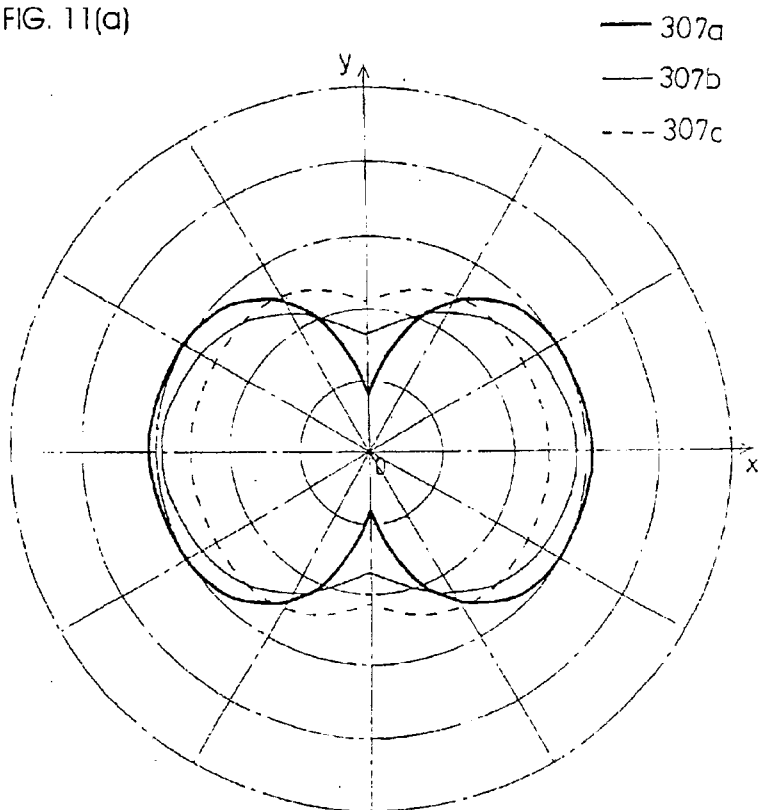


FIG. 11(b)

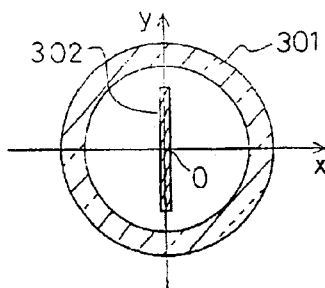


FIG. 12(a)

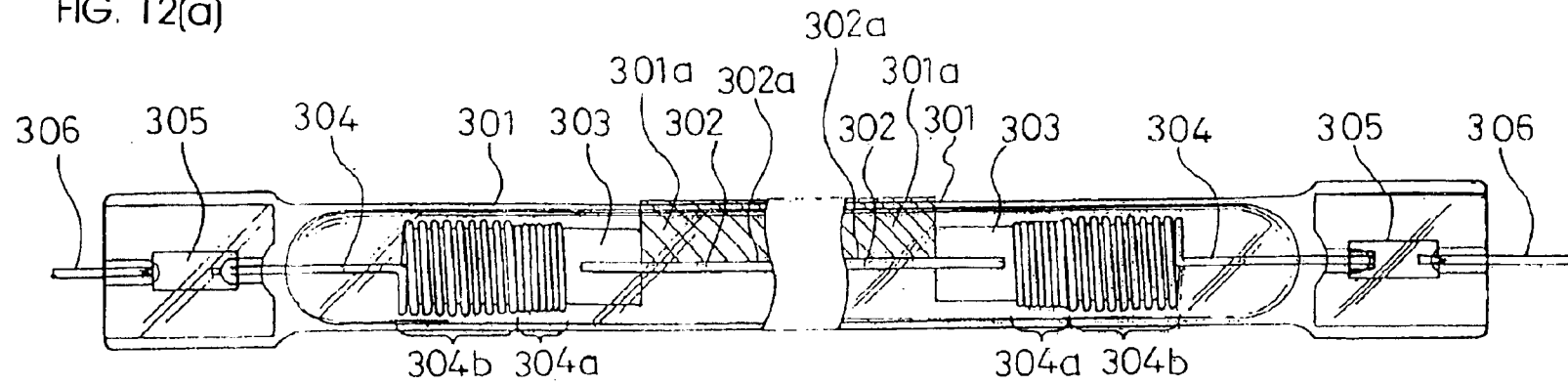


FIG. 12(b)

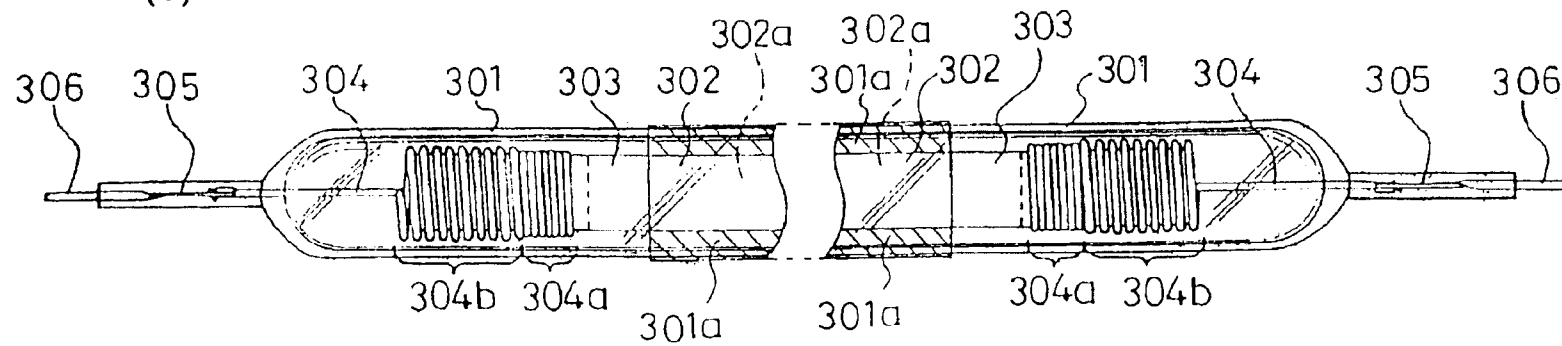


FIG. 13

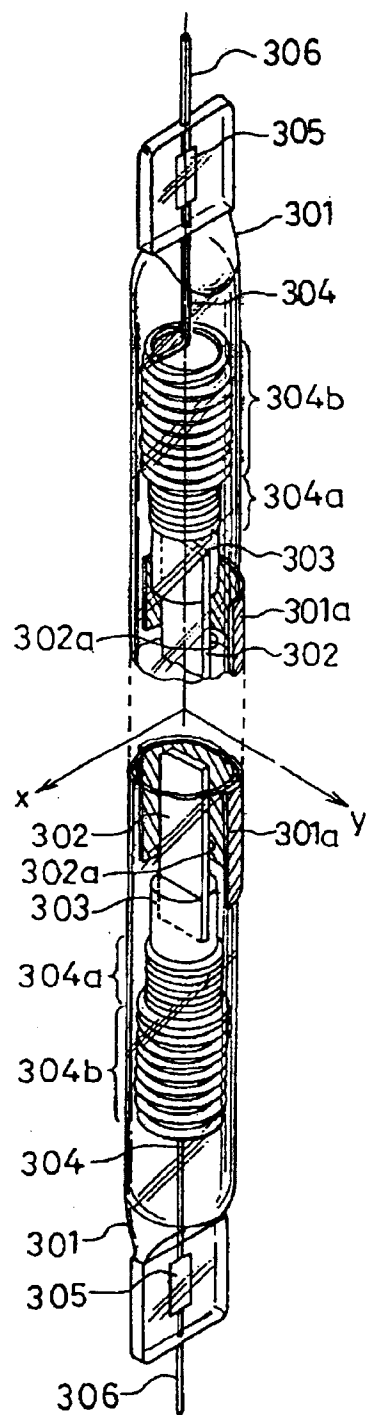


FIG. 14(a)

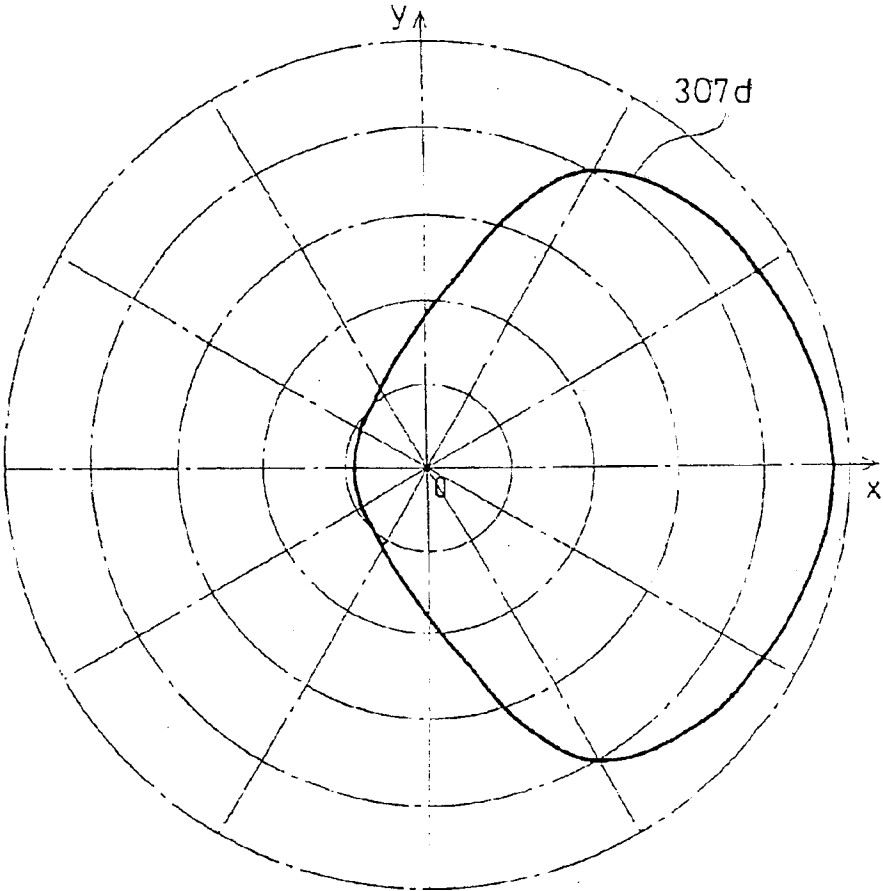


FIG. 14(b)

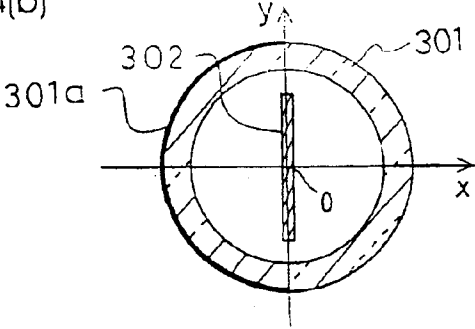


FIG. 15(a)

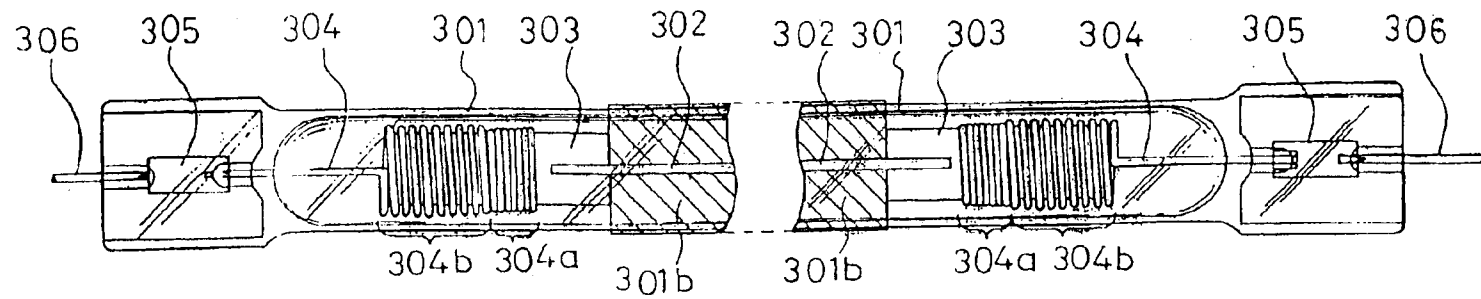


FIG. 15(b)

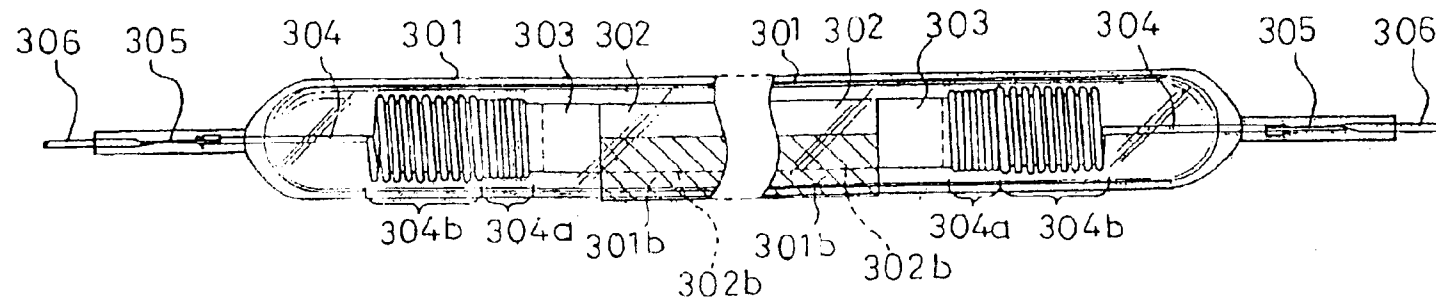


FIG. 16

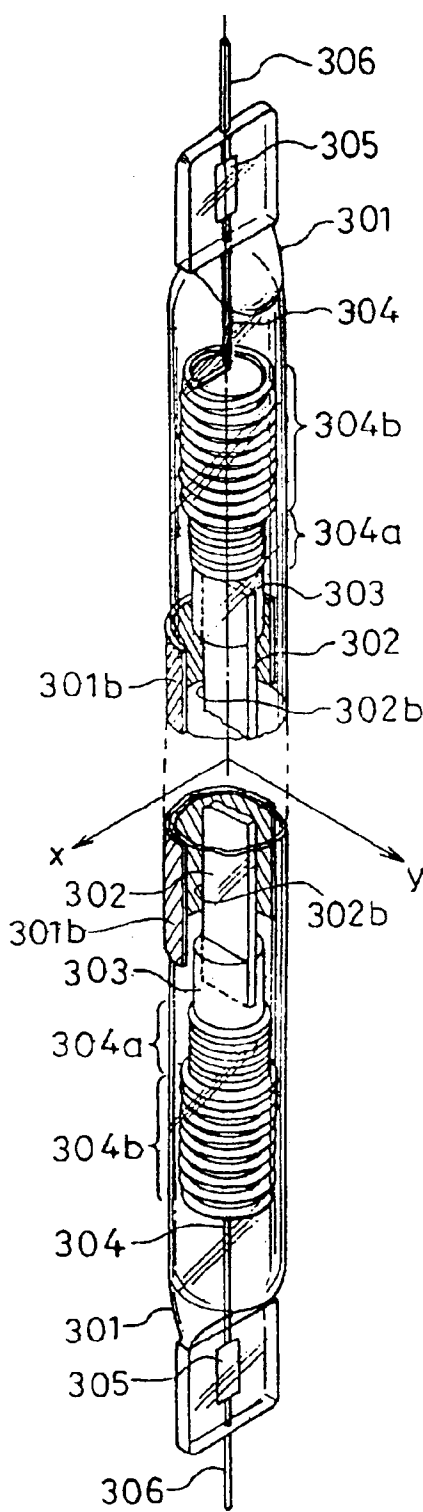


FIG. 17(a)

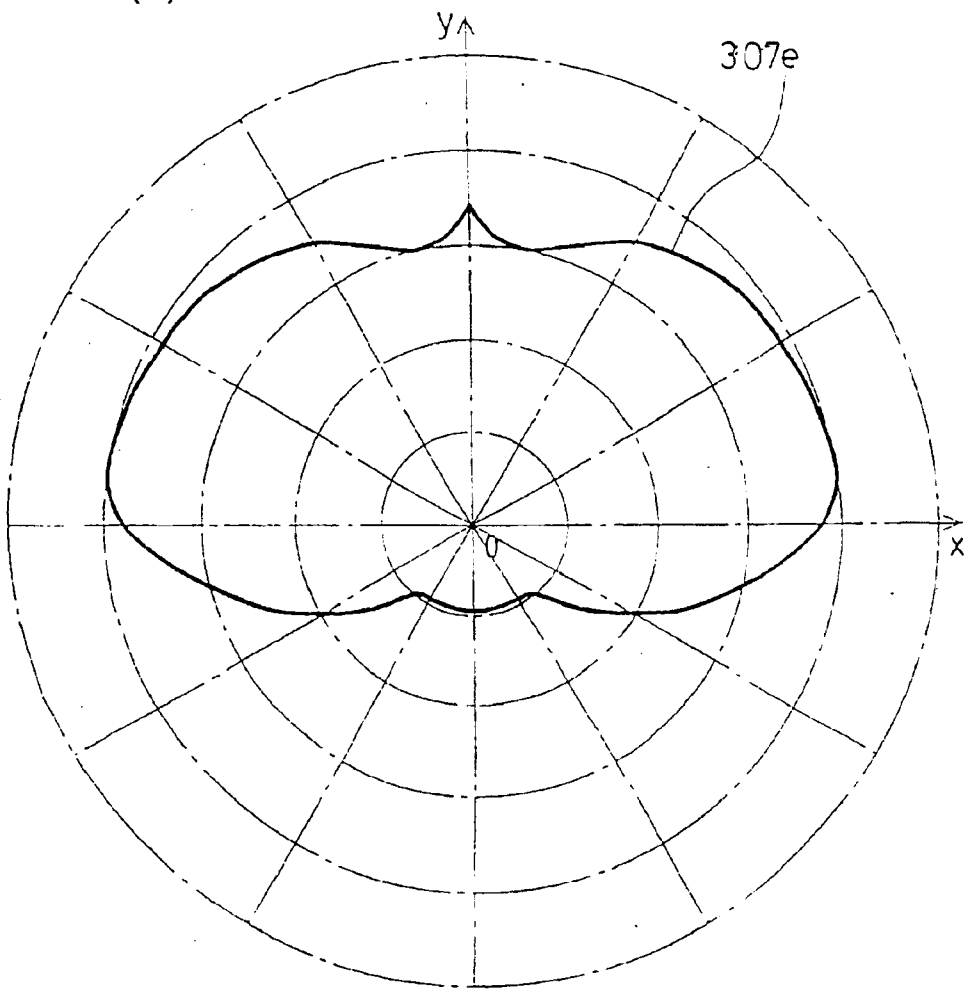


FIG. 17(b)

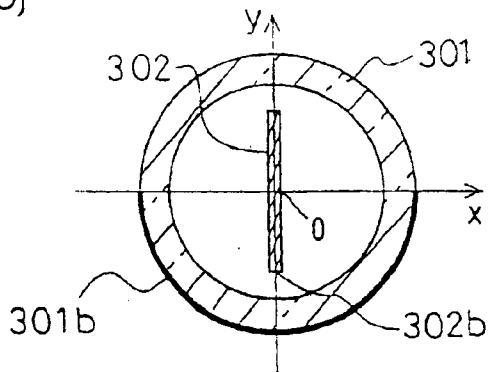


FIG. 18

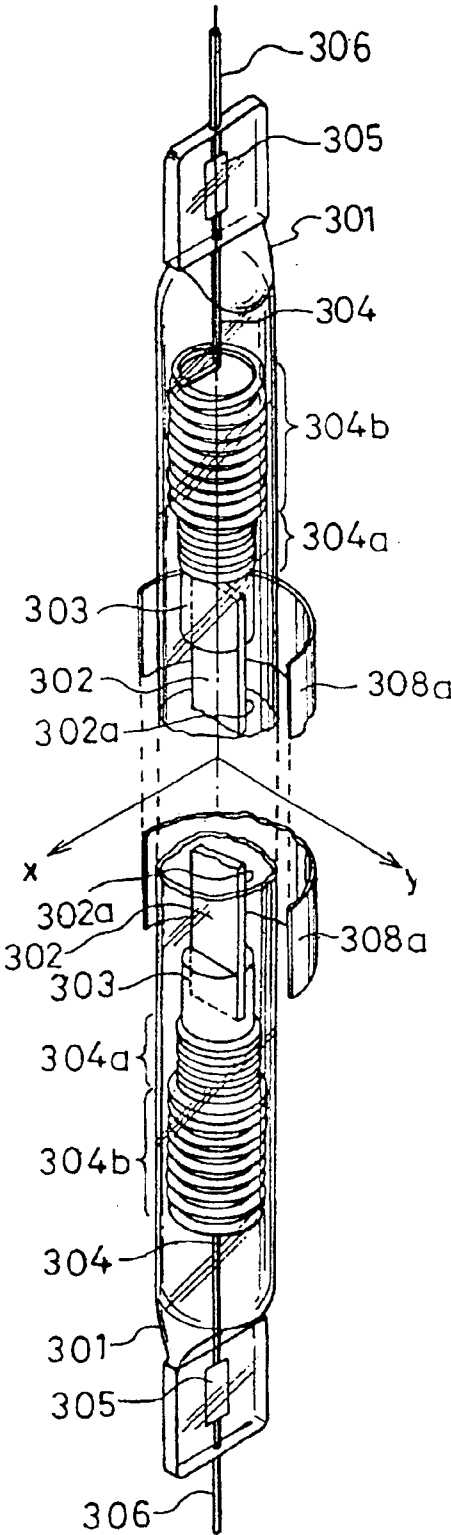


FIG. 19

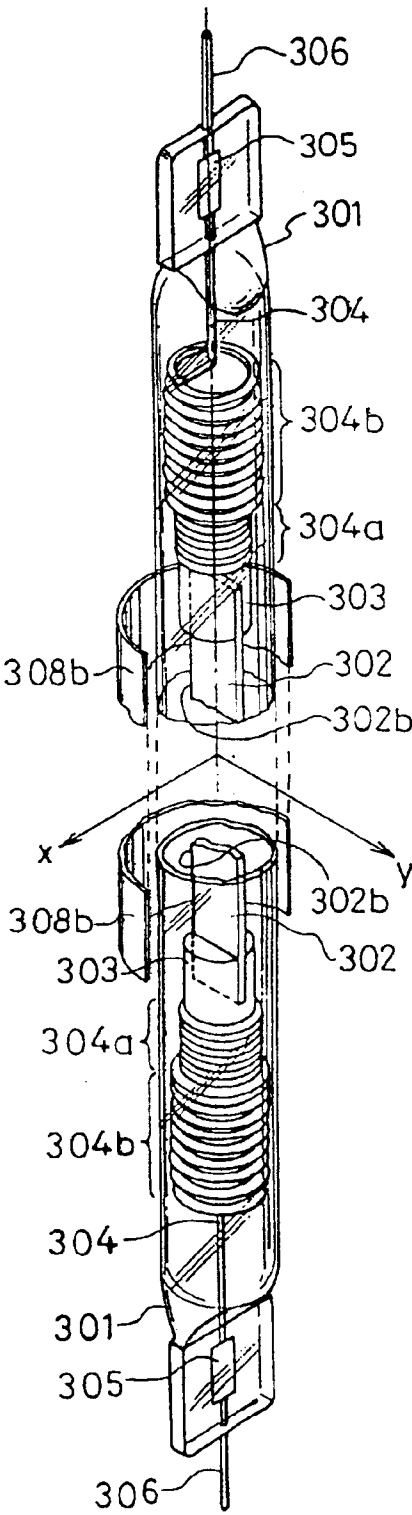


FIG. 20(a)

PRIOR ART

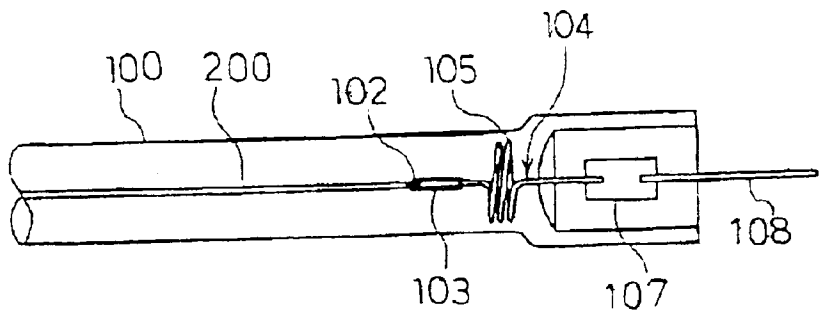


FIG. 20(b)

PRIOR ART

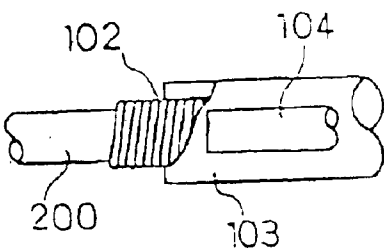


FIG. 21

PRIOR ART

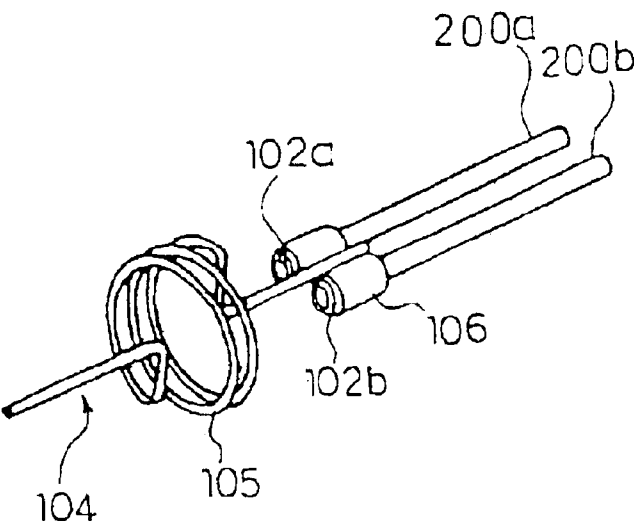


FIG. 22
PRIOR ART

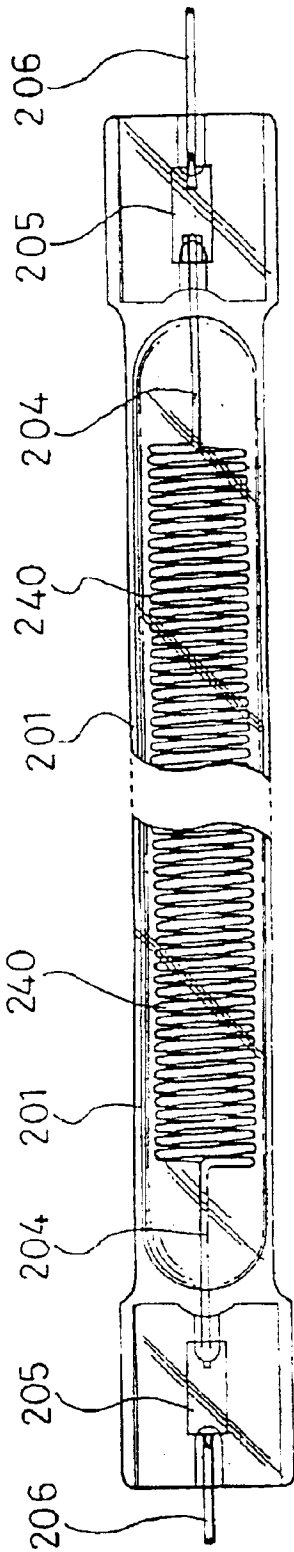


FIG. 23
PRIOR ART

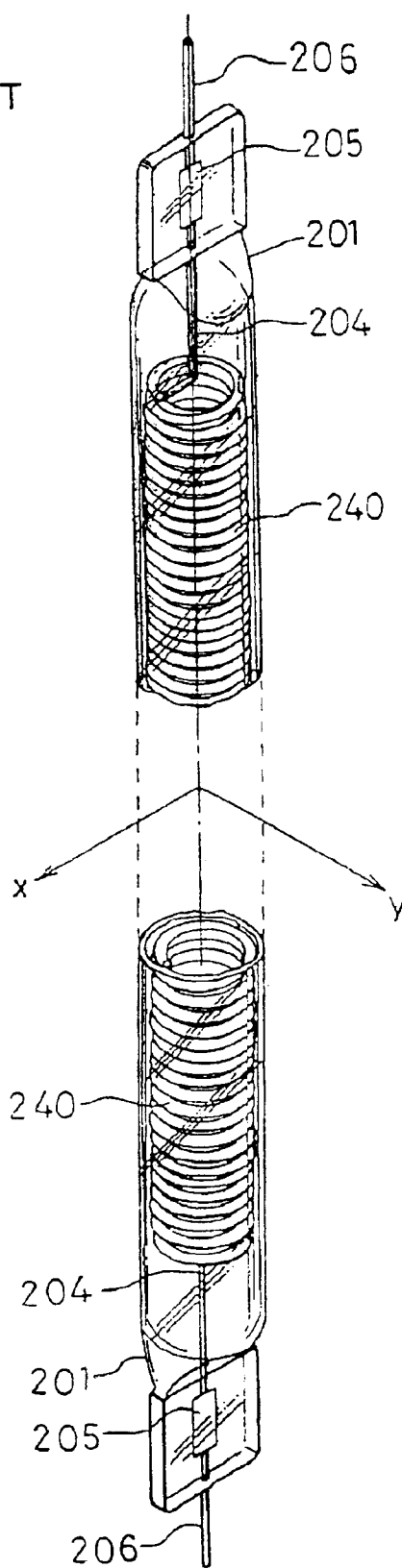


FIG. 24(a)
PRIOR ART

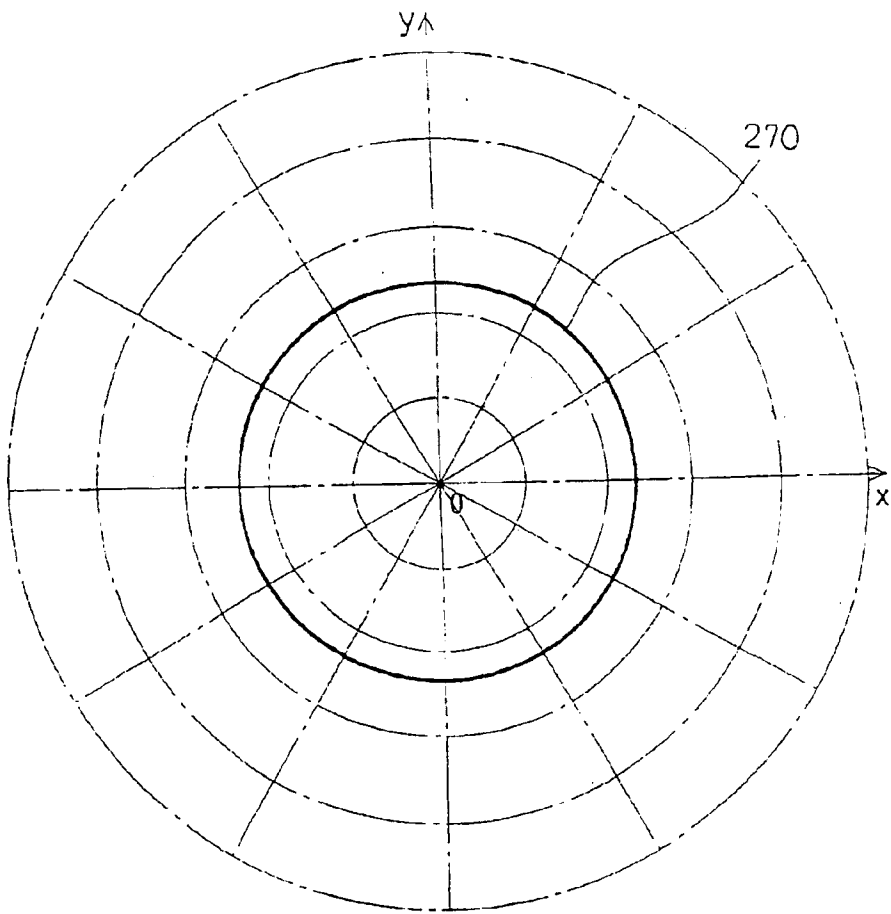


FIG. 24(b)
PRIOR ART

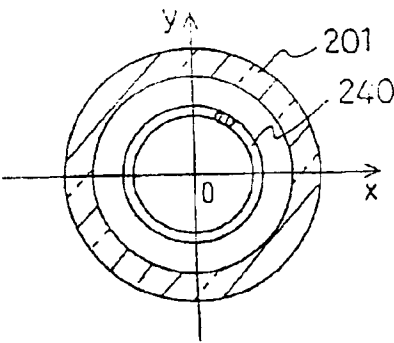


FIG. 25
PRIOR ART

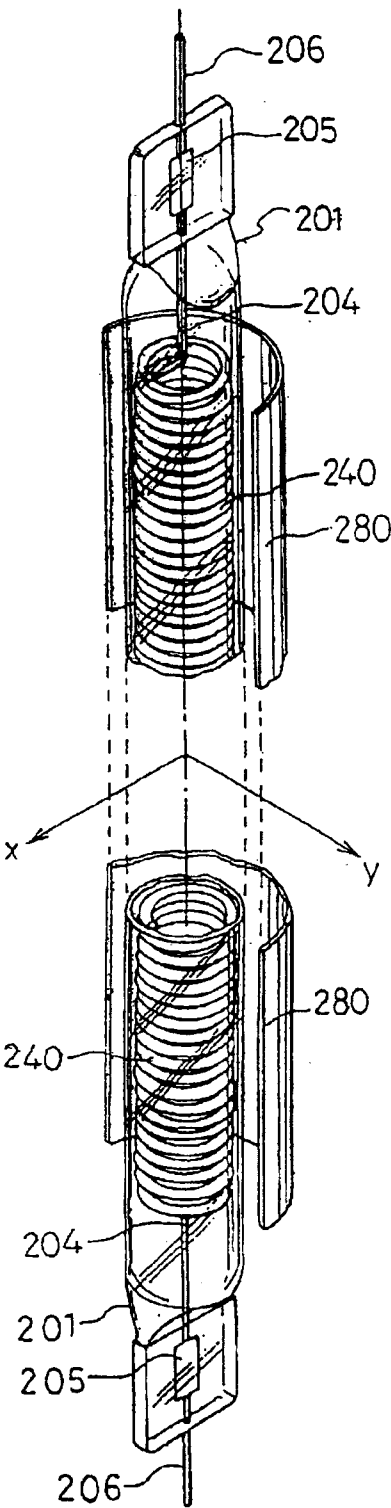


FIG. 26(a)

PRIOR ART

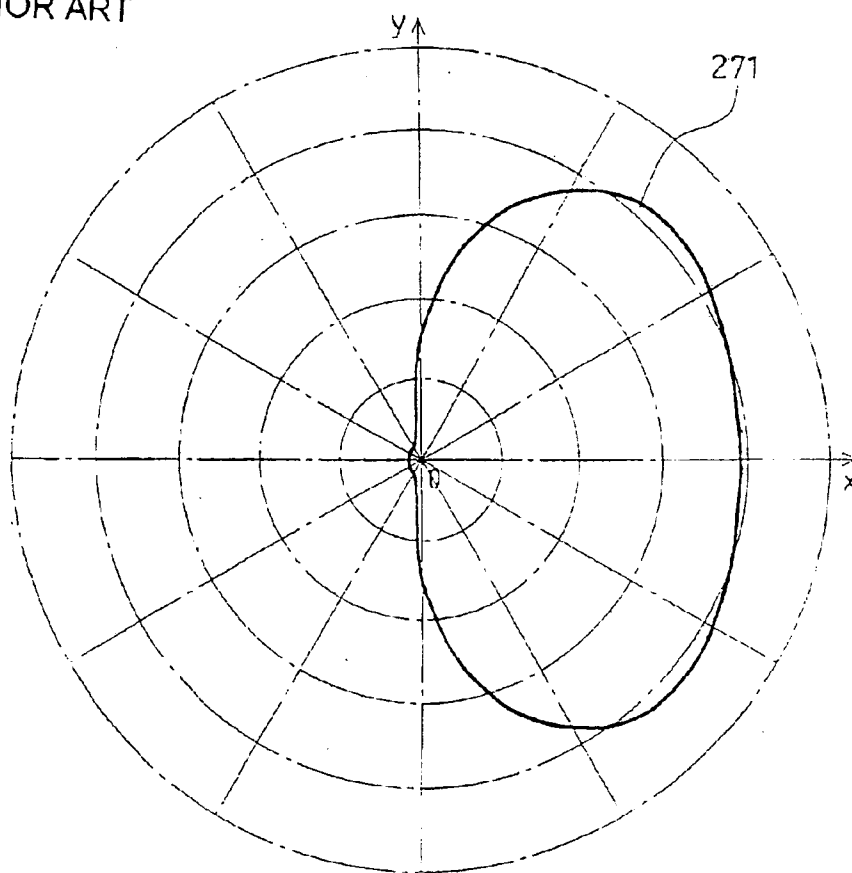
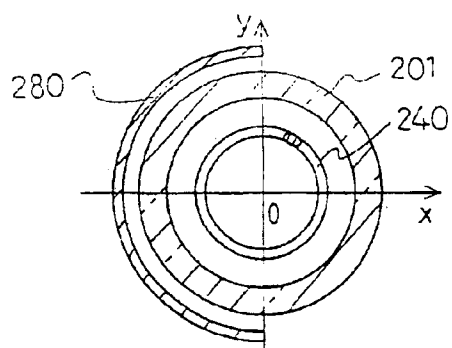


FIG. 26(b)

PRIOR ART



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INFRARED RAY LAMP, HEATING APPARATUS AND METHOD OF PRODUCING THE INFRARED RAY LAMP

TECHNICAL FIELD

The present invention relates to an infrared ray lamp to be used for a heater for heating objects and a space heater for heating rooms, etc. (hereinafter referred to as a heating apparatus), more particularly to an infrared ray lamp having good functions as a heat source by using a carbon-based substance as a heating element, to a heating apparatus using the infrared ray lamp, and to a method of producing the infrared ray lamp.

BACKGROUND ART

A conventional infrared ray lamp causes a problem wherein its power consumption increases abnormally after use for a long time, and its heating portions fuse and break in some cases. This problem will be described below.

As an infrared ray lamp conventionally used as a heat source, an infrared ray lamp having a tungsten spiral filament held at the central portion of a glass tube by a number of supports of tungsten is used. However, the infrared ray emission rate of the tungsten is so low as, 30 to 39%, and the rush current at the time of turning on is high. Furthermore, it is necessary to use a number of the tungsten supports for holding the tungsten spiral filament at the central portion of the glass tube, and the assembly work for them was not easy. In particular, sealing the plural tungsten spiral filaments in the glass tube in order to obtain high output was very difficult.

In order to solve these problems, an infrared ray lamp, wherein a carbon-based substance formed into a rod shape is used instead of the tungsten spiral filaments as a heating element, has been proposed conventionally. As such a conventional infrared ray lamp, an infrared ray lamp disclosed in Japanese Published Unexamined Patent Application, Publication No. Hei 11-54092 applied by the same applicant as that of the present invention is available. Since the carbon-based substance has a high infrared ray emission rate of 78 to 84%, the infrared ray emission rate of the infrared ray lamp also becomes high by using the carbon-based substance as a heating element. Furthermore, since the carbon-based substance has a negative resistance temperature characteristic wherein its resistance value lowers as the temperature rises, the carbon-based substance has a significant characteristic of capable of reducing its rush current at the time of turning on.

FIGS. 20(a), 20(b), and 21 are front views showing the conventional infrared ray lamp described in Japanese Published Unexamined Patent Application, Publication No. Hei 11-54092, wherein the carbon-based substance is used as a heating element. FIG. 20(a) is a view showing the structure of the lead wire taking-out portion of the conventional infrared ray lamp in which a heating element 200 is sealed inside a glass tube 100. FIG. 20(b) is a partially magnified view showing the connection portion between the heating element 200 and the lead wire 104 of the infrared ray lamp shown in FIG. 20(a). FIG. 21 is a partially magnified view showing the connection portion between the two heating elements 200a and 200b and the lead wire 104 of the conventional infrared ray lamp in which the two heating elements 200a and 200b are sealed inside the glass tube. FIG. 20(a) shows the structure of one end of the infrared ray lamp, and the other end of the infrared ray lamp has similar

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structure. Furthermore, the structure of the infrared ray lamp shown in FIG. 21 is similar to that shown in FIG. 20(a), except for the connection portion between the two heating elements 200a and 200b and the lead wire 104 shown in the figure.

As shown, in FIG. 20(a), in the conventional infrared ray lamp, a metal wire 102 wound in a coil shape is wound around the end of the heating element 200 formed of a carbon-based substance and formed into a rod shape. The end portion of the coil-shaped metal wire 102 is covered with a metal foil sleeve 103, and this metal foil sleeve 103 is secured to the end of the heating element 200 by crimping. The internal lead wire 104 formed of a metal wire and having a coil portion 105 wound in a coil-spring shape in the middle of the wire is electrically bonded to one end of the metal foil sleeve 103. One end of a molybdenum foil sheet 107 is spot-welded to the other end of the internal lead wire 104. Furthermore, an external lead wire 108 formed of a molybdenum wire is welded to the other end of the molybdenum foil sheet 107. The heating element 200, the metal foil sleeve 103, the internal lead wire 104, the molybdenum foil sheet 107 and the external lead wire 108 connected in series as described above are inserted into the glass tube 100 and disposed therein. An inert gas, such as argon, nitrogen or the like, is sealed inside the glass tube 100, the glass tube 100 is fused and bonded at the portion of the molybdenum foil sheet 107, thereby completing an infrared ray lamp.

FIG. 21 is a perspective view showing the inside of another conventional infrared ray lamp and showing the structure of the connection portion between the two heating elements 200a and 200b and the metal lead wire 104 of the conventional infrared ray lamp. As shown in FIG. 21, this conventional infrared ray lamp has a structure wherein the two heating elements 200a and 200b are sealed in one glass tube (not shown). In the infrared ray lamp shown in FIG. 21, coil-shaped metal wires 102a and 102b are wound around the end portions of the heating element 200a and 200b respectively, and metal foil sleeves 106 are fitted over the wires. The fitted metal foil sleeves 106 are secured to the end portions of the heating elements 200a and 200b by crimping. The metal lead wire 104 having a coil portion 105 wound in a coil-spring shape in the middle of the wire is electrically connected to the metal foil sleeves 106.

The infrared ray lamps having the above-mentioned structures have good infrared ray emission rates, since their heating elements are formed of a carbon-based substance; but, there are the following problems.

In the conventional infrared ray lamp having the structure shown in FIGS. 20(a) and 20(b), for the lamp of large wattage of the infrared ray lamp, that is, for the lamp of a large power consumption, the coil-shaped metal wire 102 is heated to a high temperature. As a result, when the infrared ray lamp having this structure is used for a long time, the contact resistance of the connection portion among the heating element 200, the coil-shaped metal wire 102 and the metal foil sleeve 103 increases because of the temperature rise. The conventional infrared ray lamp therefore has the problem of abnormal heating at the connection portion. Furthermore, if the temperature at the connection portion between the coil-shaped metal wire 102 and the metal foil sleeve 103 rises continuously for a long time, the temperature at the bonding portion may rise high and, in the worst case, the bonding portion may fuse and break. Moreover, the stress caused by heat cycles due to the difference in thermal expansion coefficient between the heating element 200 and the coil-shaped metal wire 102 is added, and the contact resistance becomes higher than the value at the beginning of use, whereby the temperature rise at the connection portion is accelerated.

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In addition, in the structure of the infrared ray lamp having the two heating elements **200a** and **200b** shown in FIG. 21, the following problems are caused.

In the process wherein both ends of the two heating elements **200a** and **200b** are crimped by using the metal foil sleeve **106**, no problem occurs if the two heating elements **200a** and **200b** are crimped by a uniform tension or compression force; however, crimping may occur in a state of an unbalanced tension or compression force. In the conventional infrared ray lamp undergone crimping in such away, if the heating elements **200a** and **200b** are heated, the two heating elements **200a** and **200b** expand thermally in different states. For this reason, the imbalance of the tension or compression force applied to the heating elements **200a** and **200b** increases. In the case when the balance in the crimped state is improper in particular, one of the carbon-based heating elements, to which the larger tension or compression force is applied, may break.

Next, the problem of directivity in the conventional infrared ray lamp will be described below.

The infrared ray lamp is used as a heater for heating objects or for a space heater for heating rooms by using radiant infrared rays. As this kind of the conventional infrared ray lamp, an infrared ray lamp having the structure shown in FIG. 22 is known. FIG. 22 is a plan view showing an example of the conventional infrared ray lamp. FIG. 23 is a perspective view showing the infrared ray lamp shown in FIG. 22. In FIGS. 22 and 23, the central portion of the infrared ray lamp can be understood easily from the descriptions on both side portions shown in the figures, therefore, the central portion of the infrared ray lamp is not shown in either of the figures.

The conventional infrared ray lamp shown in FIGS. 22 and 23 comprises a substantially cylindrical glass tube **201**, metal foil sheets **205** embedded in both end portions of the glass tube **201**, a heating element **240** hermetically sealed inside the glass tube **201** and internal lead wires **204**. The heating element **240** is a resistance wire formed of nichrome or tungsten and wound in a coil shape. The internal lead wires **204** are used to connect both ends of the heating element **240** to the metal foil sheets **205**. As a result, the heating element **240** is electrically connected to the metal foil sheets **205** and pulled properly by the internal lead wires **204** on both sides, thereby secured stably. At this time, the center axis of the coil-shaped heating element **240** is disposed so as to be substantially coaxial with the center axis of the cylindrical glass tube **201**.

As shown in FIGS. 22 and 23, the external lead wires **206** are connected to the metal foil sheets **205** on both sides respectively. When a voltage is applied across the external lead wires **206** taken out from both sides, a current flows through the heating element **240**, and heat generates from the heating element **240** owing to the resistance of the heating element **240** corresponding to the current. At this time, infrared rays are emitted from the heating element **240**.

FIG. 24(a) is a graph of the distribution curve **270** of the intensity of the infrared rays emitted from the heating element **240** of the infrared ray lamp shown in FIG. 23. FIG. 24(b) is a cross-sectional view showing the portion having the heating element **240** of the infrared ray lamp shown in FIG. 23. The x and y axes shown in FIGS. 24(a) and 24(b) are orthogonal coordinate axes on a plane perpendicular to the axial direction of the heating element **240** shown in FIG. 23. In FIGS. 24(a) and 24(b), the origin **0** corresponds to the center axis of the heating element **240**. In the graph of FIG. 24(a), the values in the radial directions designate the

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emission intensity of the infrared rays, and the values in the circumferential directions designate angles with respect to the center axis on the plane perpendicular to the axial direction of the heating element **240**. These angles are designated by angles from the positive direction of the x axis.

When a constant voltage was applied to the heating element **240**, the amount of the infrared rays reaching a minute area at a constant distance from the center axis (represented by the origin **0** of FIGS. 24(a) and 24(b)) of the heating element **240** was measured, whereby the intensity distribution curve **270** was obtained.

As indicated by the intensity distribution curve **270** in FIG. 24(a), the infrared ray lamp **240** emits infrared rays in all directions at substantially similar intensity. This results from the fact that the cross-sectional shape of the heating element **240** is substantially symmetrical with respect to its axis and has a circular shape as shown in FIG. 24(b).

By the equally distributed infrared rays emitted in all directions at substantially similar intensity as described above, heat is transmitted from the heating element **240** to the outside and used to heat the outside and the surroundings.

In the conventional infrared ray lamp structured as described above, in the case when it is desired to give directivity to the emission intensity of the infrared rays, a structure is known wherein an infrared ray reflection plate is installed outside the infrared ray lamp for example.

FIG. 25 is a perspective view showing an example wherein an infrared ray reflection plate **280** is provided for the conventional infrared ray lamp and showing the positional relationship between the infrared ray lamp and the infrared ray reflection plate **280**. The infrared ray reflection plate **280** has a semi-cylindrical shape and is disposed coaxially with the heating element **240** so as to surround the half of the heating element **240**.

FIG. 26(a) is a graph of the distribution curve **271** of the intensity of the infrared rays emitted from the infrared ray lamp having the infrared ray reflection plate **280**. FIG. 26(b) is a cross-sectional view showing the portion having the heating element **240** of the infrared ray lamp having the infrared ray reflection plate **280** shown in FIG. 25. The x and y axes shown in FIGS. 26(a) and 26(b) are orthogonal coordinate axes on a plane perpendicular to the axial direction of the heating element **240** shown in FIG. 25. The direction opposed to the reflection face of the infrared ray reflection plate **280** is defined as the negative direction of the x axis. In FIGS. 26(a) and 26(b), the origin **0** corresponds to the center axis of the heating element **240**. In the graph of FIG. 26(a), the values in the radial directions represented the emission intensity of the infrared rays, and the values in the circumferential directions represented angles with respect to the center axis on the plane perpendicular to the axial direction of the heating element **240**. These angles are designated by angles from the positive direction of the x axis. In FIG. 26(a), the concentric gradations indicating the emission intensity have the same values of the gradations shown in FIG. 24(a). In addition, the method of measuring the emission intensity is the same as that in the case shown in FIG. 24(a).

As shown in FIG. 26(a), by providing the infrared ray reflection plate **280**, infrared rays are emitted intensely only on one side of the infrared ray lamp, with the positive direction of the x axis used as the center.

As described above, in the conventional infrared ray lamp, it is indicated that the emission of the infrared rays has

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isotropic intensity distribution in all directions. For this reason, in order to give directivity to infrared ray emission, it is necessary to provide the infrared ray reflection plate outside the infrared ray lamp.

However, the infrared ray reflectivity of the infrared ray reflection plate is apt to be lowered because of aging and the adhesion of stains. As a result, the intensity distribution of the infrared ray emission becomes different with the direction of the emission. Furthermore, as the infrared ray reflectivity lowers, the amount of the infrared rays absorbed by the reflection plate itself increases. If this kind of heating apparatus is used for a long time, emission efficiency lowers, and unexpected parts will be overheated.

Furthermore, the emission intensity distribution obtained by providing the semi-cylindrical infrared ray reflection plate for the infrared ray lamp having the above-mentioned isotropic emission intensity distributions in all directions is substantially the same in a wide range on one side in general as shown in FIG. 26(a). For this reason, in the conventional infrared ray lamp, an attempt to increase the emission intensity in a more limited range and to decrease the intensity in other ranges in order to enhance directivity is difficult. As a result, in the case when the conventional heating apparatus is used for localized heating, the problem of low heating efficiency occurs.

DISCLOSURE OF INVENTION

The present invention is intended to solve the above-mentioned problems and also intended to provide a highly reliable infrared ray lamp wherein its power consumption does not increase during use for a long time and its heating portions are prevented from fusing and breaking after use for a long time. The present invention is further intended to make the effect of the reduction of the reflectivity of an infrared ray reflection plate on the directional distribution of the emission intensity of infrared rays lower than that of the conventional infrared ray lamp, and to make the directivity of the emission intensity of infrared rays higher than that of the conventional infrared ray lamp. The present invention provides an infrared ray lamp and a heating apparatus wherein the emission intensity of infrared rays has directivity without using any reflection plate, and also provides a method of producing the infrared ray lamp.

An infrared ray lamp in accordance with the present invention comprises:

at least one heating element having a substantially plate shape, having recessed portions in the vicinities of both ends thereof and formed of a carbon-based substance,

heat-emitting blocks having good conductivity to which both end portions of the heating element are inserted and bonded,

a sintered substance of an adhesive formed and sintered on the insertion and bonding faces of the heating element bonded to the heat-emitting blocks at the regions in the vicinities of both end portions of the heating element including the recessed portions thereof;

a glass tube in which the heating element, the sintered substance of the adhesive and the heat-emitting blocks are hermetically sealed together with an inert gas, and

lead wires electrically connected to the heat-emitting blocks, the end portions of which are led out of the glass tube.

With this structure, in the infrared ray lamp, the recessed portions are provided in the vicinities of both ends of the carbon-based substance used as the heating element, and the

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areas of the contact with the heat-emitting blocks via the carbon-based adhesive are increased, whereby the resistance of the contact can be reduced, heating due to the resistance of the contact can be restricted, and the temperatures of the lead wire installation portions at both end portions can be prevented from becoming locally high. As a result, according to the present invention, it is possible to prevent the lead wire installation portions from fusing and breaking owing to the temperature rise at the portions. In addition, since the recessed portions in the vicinities of both ends of the heating element are filled with the carbon-based adhesive, the fitting or bonding between the heating element and the heat-emitting blocks becomes closer, and the strength of the bonding is enhanced. As a result, in the infrared ray lamp of the present invention, stress due to heat can be absorbed, and abnormal heating can be prevented.

An infrared ray lamp from another viewpoint in accordance with the present invention comprises:

at least one heating element having a substantially plate shape, having recessed portions in the vicinities of both ends thereof and formed of a carbon-based substance,

heat-emitting blocks having good conductivity and each split into two pieces, between which both end portions of the heating element are sandwiched,

a sintered substance of an adhesive formed and sintered on the insertion and bonding faces of the heating element bonded to the heat-emitting blocks at the regions in the vicinities of both end portions of the heating element including the recessed portions thereof,

a glass tube in which the heating element, the sintered substance of the adhesive and the heat-emitting blocks are hermetically sealed together with an inert gas, and

lead wires electrically connected to the heat-emitting blocks, the end portions of which are taken outside the glass tube.

With this structure, in the infrared ray lamp, the heating element is bonded to the heat-emitting blocks by pressure contact; then, since accurate disposition at predetermined positions for fitting is not required, assembly work can be carried out easily, and the cost of production can be reduced significantly.

Method of producing an infrared ray lamp in accordance with the present invention comprises:

a step of forming recessed portions in the vicinities of both ends of at least one heating element having a substantially plate shape and formed of a carbon-based substance,

a step of applying a liquid adhesive formed of a carbon-based organic substance to the regions in the vicinities of both ends of the heating element including the recessed portions thereof,

a step of inserting and bonding both end portions of the heating element to the end portions of heat-emitting blocks having good conductivity by using the adhesive,

a step of drying and firing the heat-emitting blocks and the heating element bonded to each other, and

a step of sealing the heating element and the heat-emitting blocks inside the glass tube together with an inert gas, and of taking the end portions of the lead wires electrically connected to the heat-emitting blocks outside the glass tube.

With these steps, the infrared ray lamp has high reliability by not raising its power consumption abnormally during use for a long time and by preventing its heating portions from fusing and breaking after use for a long time.

An infrared ray lamp from another viewpoint in accordance with the present invention comprises:

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a heating element having a substantially plate shape, the width of which is larger than its thickness by five times or more,

a glass tube in which the heating element is hermetically sealed, and

two electrodes embedded at both end portions of the glass tube, electrically connected to both ends of the heating element respectively and also electrically connected to an external electric circuit.

With this structure, the emission intensity of the infrared ray lamp becomes a maximum value in the thickness direction of the heating element and becomes negligibly small in comparison with the maximum value in the width direction.

A heating apparatus in accordance with the present invention comprises:

a heating element having a substantially plate shape, the width of which is larger than its thickness by five times or more,

a glass tube in which the heating element is hermetically sealed, and

two electrodes embedded at both end portions of the glass tube, electrically connected to both ends of the heating element respectively and also electrically connected to an external electric circuit.

With this structure, the emission intensity of the infrared ray lamp in the heating apparatus becomes a maximum value in the thickness direction of the heating element and becomes negligibly small in comparison with the maximum value in the width direction, thereby having directivity.

A method of producing an infrared ray lamp from another viewpoint of the present invention comprises:

a step of forming a glass tube by forming glass into a substantially cylindrical shape,

a step of hermetically sealing a substantially plate heating element, the width of which is larger than its thickness by five times or more, in the glass tube so that the center line of the heating element in the longitudinal direction thereof is substantially coaxial with the center axis of the glass tube, and

a step of forming a reflection film for reflecting infrared rays into a substantially semi-cylindrical shape on the external face of the cylindrical shape of the glass tube so as to substantially include the range of the disposition of the heating element in the axial direction thereof.

With this structure, the semi-cylindrical reflection film can be formed easily by using the cylindrical shape of the glass tube.

A method of producing an infrared ray lamp from still another viewpoint of the present invention comprises:

a step of forming a glass tube by forming glass into a substantially cylindrical shape,

a step of forming a reflection film for reflecting infrared rays into a predetermined substantially semi-cylindrical shape on the external face or the internal face of the cylindrical shape of the glass tube, and

a step of disposing a substantially plate heating element, the width of which is larger than its thickness by five times or more, so as to be included in the axial range wherein the reflection film is disposed, and of hermetically sealing the heating element inside the glass tube.

With this structure, the semi-cylindrical reflection film can be formed easily even on the internal face of the glass tube by using the cylindrical shape of the glass tube.

While the novel features of the invention are set forth particularly in the appended claims, the invention, both as to

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organization and content, will be better understood and appreciated, along with other objects and features thereof, from the following detailed description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a front view showing the structure of the lead wire taking-out portion of an infrared ray lamp in accordance with a first embodiment of the present invention;

FIG. 2 is a partially magnified view showing the connection portion of the heating element and the heat-emitting block of the infrared ray lamp shown in FIG. 1;

FIG. 3 is a partially magnified view showing the connection portion of the heating element and the heat-emitting block of an infrared ray lamp having another structure in accordance with the first embodiment of the present invention;

FIG. 4 is a partially magnified view showing the connection portion of the heating element and the heat-emitting block of an infrared ray lamp having still another structure in accordance with the first embodiment of the present invention;

FIG. 5 is a front view showing the structure of the lead wire taking-out portion of an infrared ray lamp in accordance with a second embodiment of the present invention;

FIG. 6 is a partially magnified view showing the connection portion of the heating element and the heat-emitting block of the infrared ray lamp shown in FIG. 5;

FIG. 7 is a partially magnified view showing the connection portion of the heating element and the heat-emitting block of an infrared ray lamp having another structure in accordance with the second embodiment;

FIG. 8 is a partially magnified view showing the connection portion of the heating element and the heat-emitting block of an infrared ray lamp having still another structure in accordance with the second embodiment;

FIG. 9(a) is a plan view showing an infrared ray lamp in accordance with a third embodiment of the present invention, and FIG. 9(b) is a front view thereof;

FIG. 10 is a perspective view showing the infrared ray lamp in accordance with the third embodiment of the present invention;

FIG. 11(a) is a graph showing the distribution curve of the intensity of the infrared rays emitted from the heating element of the third embodiment, and FIG. 11(b) shows the cross section of the central portion of the infrared ray lamp of the third embodiment;

FIG. 12(a) is a plan view showing an infrared ray lamp in accordance with a fourth embodiment of the present invention, and FIG. 12(b) is a front view thereof;

FIG. 13 is a perspective view showing the infrared ray lamp in accordance with the fourth embodiment of the present invention;

FIG. 14(a) is a graph showing the distribution curve of the intensity of the infrared rays emitted from the infrared ray lamp of the fourth embodiment, and FIG. 14(b) shows the cross section of the central portion of the infrared ray lamp of the fourth embodiment;

FIG. 15(a) is a plan view showing an infrared ray lamp in accordance with a fifth embodiment of the present invention, and FIG. 15(b) is a front view thereof;

FIG. 16 is a perspective view showing the infrared ray lamp in accordance with the fifth embodiment of the present invention;

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FIG. 17(a) is a graph showing the distribution curve of the intensity of the infrared rays emitted from the infrared ray lamp of the fifth embodiment, and FIG. 17(b) shows the cross section of the central portion of the infrared ray lamp of the fifth embodiment;

FIG. 18 is a perspective view showing the positional relationship between the infrared ray lamp and the infrared ray reflection plate of a heating apparatus in accordance with a sixth embodiment of the present invention;

FIG. 19 is a perspective view showing the positional relationship between the infrared ray lamp and the infrared ray reflection plate of a heating apparatus in accordance with a seventh embodiment of the present invention;

FIGS. 20(a) and 20(b) is a partial view showing the structure of the lead wire taking-out portion of a conventional infrared ray lamp;

FIG. 21 is a partial view showing the structure of the lead wire taking-out portion of a conventional infrared ray lamp wherein two heating elements are sealed in a glass tube;

FIG. 22 is a plan view showing a conventional infrared ray lamp;

FIG. 23 is a perspective view showing the conventional infrared ray lamp;

FIG. 24(a) is a graph showing the distribution curve of the intensity of the infrared rays emitted from the heating element of the conventional infrared ray lamp, and FIG. 24(b) shows the cross section of the central portion of the infrared ray lamp shown in FIG. 23;

FIG. 25 is a perspective view showing the positional relationship between the infrared ray reflection plate and the infrared ray lamp in the conventional infrared ray lamp; and

FIG. 26(a) is a graph showing the distribution curve of the intensity of the infrared rays emitted from the conventional infrared ray lamp provided with an infrared ray reflection plate shown in FIG. 25, and FIG. 26(b) shows the cross section of the central portion of the infrared ray lamp shown in FIG. 25.

It will be recognized that some or all of the Figures are schematic representations for purposes of illustration and do not necessarily depict the actual relative sizes or locations of the elements shown.

BEST MODE FOR CARRYING OUT THE INVENTION

Preferred embodiments of an infrared ray lamp and an infrared heating apparatus in accordance with the present invention will be described below referring to the accompanying drawings.

<<First Embodiment>>

FIG. 1 is a front view showing the structure of an infrared ray lamp in accordance with a first embodiment of the present invention, and shows the structure of the lead wire taking-out portions of the infrared ray lamp. FIG. 1 shows both end portions of the infrared ray lamp of the first embodiment. Since its central portion has a continuous structure connecting both end portions, the central portion is not shown.

As shown in FIG. 1, in the infrared ray lamp of the first embodiment, a heating element 2, heat-emitting blocks 3 and internal lead wires 4 are sealed in a glass tube 1. The internal lead wire 4 is connected to an external lead wire 8 via a molybdenum foil sheet 7. The plate heating element 2 sealed in the glass tube 1 is formed of a carbon-based substance consisting of a mixture of crystallized carbon such as graphite, a resistance value adjustment substance and

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amorphous carbon. This heating element 2 has a plate shape measuring 6 mm in width, 0.5 mm in thickness and 300 mm in length for example. The heat-emitting block 3 is formed of a conductive material and electrically connected to one end of the heating element 2 by a method described later. A coil portion 5 is formed at one end of the internal lead wire 4, and a spring portion 6 having elasticity is formed following the coil portion 5.

As shown in FIG. 1, the coil portion 5 of the internal lead wire 4 is wound tightly on the outer peripheral face of the heat-emitting block 3 so as to be electrically connected thereto. The spring portion 6 of the internal lead wire 4 is disposed away from the outer peripheral face of the heat-emitting block 3 by a predetermined distance and is structured to expand and contract so that the dimensional change of the heating element 2 due to its expansion can be canceled and absorbed.

At the sealing portion 1c of the infrared ray lamp of the first embodiment, the internal lead wire 4 inside the glass tube 1 is connected to one end of the molybdenum foil sheet 7, and the other end of the molybdenum foil sheet 7 is connected to the external lead wire 8.

FIG. 2 is a partially magnified perspective view showing the fitting condition of the heating element 2 and the heat-emitting block 3 in accordance with the first embodiment shown in FIG. 1. As shown in FIG. 2, a slit 3a is formed at the center of one end portion of the heat-emitting block 3. On the other hand, in the vicinity of the end portion of the heating element 2, a groove 2a extending in a direction perpendicular to the insertion direction of the heating element 2 (in the direction indicated by the arrow in FIG. 2) is formed. Furthermore, in the vicinity of the groove 2a of the heating element 2, an adhesive 9 is applied. The heating element 2 formed in this way is structured so that it is inserted into the slit 3a of the heat-emitting block 3 and secured to each other.

The adhesive 9 applied to the heating element 2 is formed of a carbon-based substance that is converted into a mixture of crystallized carbon such as graphite and amorphous carbon when heated to a high temperature. In the first embodiment, the heat-emitting block 3 is formed of graphite having good conductivity. Furthermore, in the first embodiment, the internal lead wire 4 is formed of a tungsten wire having a thermal expansion coefficient approximately equal to that of carbon. However, other metal wires, such as molybdenum wire and titanium wire, maybe used as the internal lead wire 4, if no problem occurs in heat resistance in working environments. The external lead wire 8 is formed of a molybdenum wire.

In the infrared ray lamp of the first embodiment, the heat-emitting block 3 is close-fitted via the adhesive 9 in the vicinity of the end portion of the plate heating element 2 as described above. In addition, the coil portion 5 of the internal lead wire 4 is wound tightly on the heat-emitting block 3 and secured thereto. In this way, the heating element 2 is electrically connected to the internal lead wire 4 via the adhesive 9 and the heat-emitting block 3. In the internal lead wire 4, the end portion of the spring portion 6, the winding diameter of which is larger than that of the coil portion 5, is electrically connected to the molybdenum foil sheet 7 which is embedded in the sealing portion 1c of the glass tube 1. The other end of the molybdenum foil sheet 7 is also connected to the external lead wire 8 inside the sealing portion 1c.

In the infrared ray lamp of the first embodiment, the heating element 2, the heat-emitting blocks 3 and the internal lead wires 4 connected in series are inserted into the space inside the heat-resistant glass tube 1, an inert gas, such

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as argon or nitrogen, is filled inside the glass tube 1, and the end portions (the sealing portions) of the glass tube 1 are melted and fused so as to be sealed. A part of the internal lead wire 4, the molybdenum foil sheet 7 and a part of the external lead wire 8 are sealed in the sealing portion 1c of the glass tube 1. The infrared ray lamp of the first embodiment is formed as described above.

In the infrared ray lamp of the first embodiment structured as described above, when the infrared ray lamp is turned on by applying a voltage across the external lead wires 8 disposed at both ends, the heating element 2 formed of the carbon-based substance is heated to a high temperature because of its resistance. Even when the heating element 2 is expanded in its longitudinal direction by this heating, since the spring portion 6 of the internal lead wire 4 is provided between the heating element 2 and the molybdenum foil sheet 7, the effect of the dimensional change due to the expansion of the heating element 2 is cancelled by the contraction of the spring portion 6. As a result, it is possible to prevent any unnecessary bending force from applying to the heating element 2. Since no unnecessary bending force applies to the heating element 2 that becomes brittle at high temperatures, the heating element 2 does not break even at high temperatures.

In the infrared ray lamp of the first embodiment, the heat-emitting block 3 formed of a material having good electric conductivity is connected to the vicinity of the end portion of the heating element 2 by using the carbon-based adhesive having good electric conductivity. For this reason, in the infrared ray lamp of the first embodiment, the contact resistance therebetween can be made small, and the temperature at the connection portion can be lowered.

Next, the fitting condition of the heating element 2 and the heat-emitting block 3 in the infrared ray lamp of the first embodiment will be described in more detail.

As shown in FIG. 2, at manufacturing of an infrared ray lamp, the adhesive 9 mainly consisting of a liquid carbon-based organic substance is sufficiently applied to the end portion of the heat element 2 including the groove 2a formed in the vicinity of the end portion of the heating element 2. And then, the heating element 2 applied with the adhesive 9 is inserted into the slit 3a of the heat-emitting block 3 to make close contact therewith. After the heating element 2 is made close contact with and fitted into the heat-emitting block 3, drying and heating (firing) are carried out, whereby a sintered substance mainly consisting of the carbon-based substance of the adhesive 9 and having a high conductivity is formed. As a result, the heating element 2 and the heat-emitting block 3 are connected via the sintered substance of the adhesive 9 having high conductivity.

In the first embodiment, by forming the groove 2a in the heating element 2, the area of the contact between the heating element 2 and the heat-emitting block 3 increases, and the resistance of the contact can be reduced.

Furthermore, since the adhesive 9 consisting of the carbon-based organic substance is very likely to be stuck to the heat-emitting block 3 formed of graphite, the adhesive 9 enters the groove 2a, and the bonding between the heating element 2 and the heat-emitting block 3 is carried out at their projected and recessed faces, whereby the strength of the bonding is enhanced significantly. In the first embodiment, the elucidation has been made on such example of structure that the number of the grooves 2a formed in the vicinity of the end portion of the heating element 2 is one, but similar effect can also be obtained even if plural grooves are formed on one face or on both faces; and a higher effect is obtained as the larger the number of the grooves is.

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In the first embodiment, even when the clearance between the heating element 2 and the heat-emitting block 3 is of a range of 0 to 100 μm , no difference occurs in the resistance of the contact and the strength of the bonding.

Next, by using the method of the connection between the heating element and the heat-emitting block of the infrared ray lamp of the above-mentioned first embodiment, the connection between the heating element and the heat-emitting block of the infrared ray lamp having another structure will be described.

In an infrared ray lamp having two rod-like heating elements 21a and 21b, FIG. 3 is a partially magnified perspective view showing a method of connecting the heating elements 21a and 21b to a heat-emitting block 31. FIG. 4 is a partially magnified perspective view showing another method of connecting the heating elements 22a and 22b to a heat-emitting block 32, in an infrared ray lamp having two of the rod-like heating elements 22a and 22b.

In the infrared ray lamps shown in FIGS. 3 and 4, structures other than those shown in the figures are similar to those of the first embodiment shown in the above-mentioned FIG. 1.

As shown in FIG. 3, the end portions of the heating elements 21a and 21b of this infrared ray lamp are inserted into two holes 31a and 31b formed in the heat-emitting block 31 respectively and connected thereto. The plural grooves 21c formed in the heating elements 21a and 21b extend in a direction perpendicular to the insertion direction (the direction indicated by the arrow in FIG. 3) of the heating elements 21a and 21b.

The heating elements 21a and 21b and the heat-emitting block 31 of the infrared ray lamp shown in FIG. 3 are formed of similar materials as those of the above-mentioned first embodiment, and the adhesive 9 of the second embodiment is formed of a carbon-based substance to become a mixture of crystallized carbon such as graphite and amorphous carbon when heated to a high temperature, just as in the case of the first embodiment.

In the vicinities of the end portions of the above-mentioned cylindrical heating elements 21a and 21b, the plural grooves 21c (three grooves in the example shown in FIG. 3) are formed. For this reason, projected and recessed faces are formed in the vicinities of the end portions of the heating elements 21a and 21b, and the adhesive 9 is sufficiently applied to the end portions including the projected and recessed faces. And, the heating elements 21a and 21b applied with the adhesive 9 are inserted into the holes 31a and 31b of the heat-emitting block 31 respectively and made close contact therewith. After the heating elements 21a and 21b are made close contact with and fitted into the heat-emitting block 31, drying and heating (firing) steps are carried out, whereby a sintered substance consisting of the carbon-based substance of the adhesive 9 is formed. As a result, the heating elements 21a and 21b are connected to the heat-emitting block 31 via the sintered substance of the adhesive 9 having high conductivity.

In the example shown in FIG. 3, since the projected and recessed faces are formed in the vicinities of the end portions of the cylindrical heating elements 21a and 21b, the area of the contact between the heating elements 21a and 21b and the heat-emitting block 31 is increased. Furthermore, the grooves 21c are formed in the vicinities of the heating elements 21a and 21b in a direction perpendicular to the insertion direction, and the sintered substance of the adhesive 9 is formed in the grooves 21c. For this reason, the resistance of the contact between the heating elements 21a and 21b and the heat-emitting block 31 of the infrared ray

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lamp shown in FIG. 3 can be reduced, and the strength of the bonding can be enhanced significantly.

In the infrared ray lamp shown in FIG. 4, the plural (three in the example shown in FIG. 4) grooves 22c are formed on the external faces in the vicinities of the end portions of the two heating elements 22a and 22b. The plural grooves 22c formed in the heating elements 22a and 22b are provided in a direction perpendicular to the insertion direction (the direction indicated by the arrow in FIG. 4) of each of the heating elements 22a and 22b, thereby forming projected and recessed faces. In addition, the adhesive 9 is sufficiently applied to the end portions of the heating element 22a and 22b including the projected and recessed faces in the vicinities thereof.

On the other hand, two holes 32a and 32a are formed in the heat-emitting block 32, and grooves 32b are formed in each of the internal faces of these holes 32a and 32a. These grooves 32b extend in a direction perpendicular to the insertion direction (the direction indicated by the arrow in FIG. 4) of each of the heating elements 22a and 22b.

The adhesive 9 is applied to the heating elements 22a and 22b structured as described above, and the heating elements 22a and 22b are inserted into the holes 32a and 32a of the heat-emitting block 32 respectively and made close contact therewith. After the heating elements 22a and 22b are made close contact with and fitted into the heat-emitting block 32, drying and heating (firing) steps are carried out, whereby a sintered substance consisting of the carbon-based substance of the adhesive 9 is formed. As a result, the heating elements 22a and 22b are connected to the heat-emitting block 32 via the sintered substance of the adhesive 9 of high conductivity.

In the infrared ray lamp shown in FIG. 4, the projected and recessed faces are formed in the vicinities of the end portions of the cylindrical heating elements 22a and 22b, and the grooves 32b are formed in the internal faces of the holes 32a and 32b. As a result, the area of the contact between the heating elements 22a and 22b and the heat-emitting block 32 is increased. Furthermore, the grooves 32b are formed in the vicinities of the end portions of the heating elements 22a and 22b and in the internal faces of the holes 32a and 32a in a direction perpendicular to the insertion direction. The sintered substance of the adhesive 9 is formed in these grooves 32b. For this reason, in the infrared ray lamp shown in FIG. 4, the resistance of the contact between the heating elements 22a and 22b and the heat-emitting block 32 can be reduced, and the strength of the bonding therebetween is enhanced significantly.

In the infrared ray lamp shown in FIG. 4, both end portions of the plural heating elements 22a and 22b are bonded to the holes in the heat-emitting block 32 by using the carbon-based adhesive 9. In the stage when the plural heating elements 22a and 22b are inserted into the heat-emitting block 32, the carbon-based adhesive 9 is still soft; therefore, even when balance of the tension or compression force between the heating elements is distorted, the distortion is relieved until a heat treatment for curing the adhesive 9 is conducted. Then, after balance of the tension or compression force between the plural heating elements is made nearly uniform, the adhesive 9 is cured and carbonized. As a result, even when the heating elements 22a and 22b are heated to a high temperature, the distortion of the tension or compression force balance between the heating elements does not increase to such extent that the heating elements 22a and 22b are broken. By producing the infrared ray lamp as described above, it is possible to easily create a long-life infrared ray lamp having plural heating elements 22a and 22b sealed in one glass tube.

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In the infrared ray lamps shown in FIGS. 3 and 4, similar effects can be obtained regardless of whether the holes 31a and 32a formed in the heat-emitting blocks 31 and 32 are through holes or stop holes (holes with bottom).

<<Second Embodiment>>

Next, an infrared ray lamp in accordance with a second embodiment of the present invention will be described referring to the accompanying drawings. FIG. 5 is a plan view showing the infrared ray lamp of the second embodiment in accordance with the present invention. FIG. 5 shows both end portions of the infrared ray lamp of the second embodiment. Since its central portion has a continuous structure connecting both end portions, the central portion is not shown in FIG. 5. FIG. 6 is a partially magnified perspective view showing the connection condition between a heating element and heat-emitting blocks in accordance with the second embodiment shown in FIG. 5. FIGS. 7 and 8 show other structures of the infrared ray lamp of the second embodiment, and are partially magnified perspective views showing the methods of the connection between the heating element and the heat-emitting blocks.

The infrared ray lamp of the second embodiment in accordance with the present invention has a plate heating element 23 and two-split heat-emitting blocks 33a and 33b. Since the other structures of the second embodiment are similar to those of the above-mentioned first embodiment, their explanations are omitted.

In the infrared ray lamp of the second embodiment, the heating element 23, the heat-emitting blocks 33a and 33b and the internal lead wires 4 are sealed in the glass tube 1 as shown in FIGS. 5 and 6, just as in the case of the above-mentioned first embodiment. The internal lead wire 4 is connected to the external lead wire 8 via the molybdenum foil sheet 7. The plate heating element 23 sealed in the glass tube 1 is formed of a carbon-based substance consisting of a mixture of crystallized carbon such as graphite, a resistance value adjustment substance and amorphous carbon. This heating element 23 has a plate shape measuring 6 mm in width, 0.5 mm in thickness and 300 mm in length for example. The heat-emitting blocks 33a and 33b are formed of a conductive material and electrically connected to one end of the heating element 23 by a method described later. A coil portion 5 is formed at one end of the internal lead wire 4, and a spring portion 6 having elasticity is formed following the coil portion 5.

As shown in FIG. 6, in the infrared ray lamp of the fourth embodiment, grooves 23a and 23b are formed in the top and bottom faces of the plate portion of the plate heating element 23 respectively. The grooves 23a and 23b extend in a direction perpendicular to the longitudinal direction of the heating element 23. The adhesive 9 is sufficiently applied to the vicinity of the end portion of the heating element 23 including these grooves 23a and 23b. In the end portion of this heating element 23, a pair of heat-emitting blocks 33a and 33b are bonded via the adhesive 9 having high conductivity so as to attain electrical connection. The adhesive 9 is formed of a carbon-based substance that is converted into a mixture of crystallized carbon such as graphite and amorphous carbon when heated to a high temperature. The heat-emitting blocks 33a and 33b are two blocks having similar shape, i.e., a nearly semicircular shape in cross section, and formed of graphite having good conductivity.

In the second embodiment, the internal lead wire 4 is formed of a tungsten wire having a thermal expansion coefficient close to that of carbon. However, other metal wires, such as molybdenum and titanium wires, may be used as the internal lead wire 4, if no problem occurs in heat

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resistance in working environments. The external lead wire 8 is formed of a molybdenum wire.

As described above, in the infrared ray lamp of the second embodiment, the heat-emitting blocks 33a and 33b sandwich the vicinity of the end portion of the plate heating element 23 via the adhesive 9 so as to attain bonding. Furthermore, the coil portion 5 of the internal lead wire 4 is wound tightly around the heat-emitting blocks 33a and 33b and secured thereto. In this way, the heating element 23 is electrically connected to the internal lead wires 4 via the adhesive 9 and the heat-emitting blocks 33a and 33b. In the internal lead wire 4, the end portion of the spring portion 6, the winding diameter of which is larger than that of the coil portion 5, is electrically connected to the molybdenum foil sheet 7 embedded in the sealing portion of the glass tube 1. The other end of this molybdenum foil sheet 7 is also connected to the external lead wire 8 inside the sealing portion.

In the infrared ray lamp of the second embodiment, the heating element 23, the heat-emitting blocks 33a and 33b and the internal lead wire 4 connected in series are inserted into the space inside the heat-resistant glass tube. After filling an inert gas, such as argon or nitrogen in the space inside the glass tube 1, the end portions (the sealing portions) of the glass tube 1 are melted and fused so as to be sealed. A part of the internal lead wire 4, the molybdenum foil sheet 7 and a part of the external lead wire 8 are sealed in the sealing portion of the glass tube 1. The infrared ray lamp of the second embodiment is formed as described above.

In the infrared ray lamp of the second embodiment structured as described above, when the infrared ray lamp is turned on by applying a voltage across the external lead wires 8 (FIG. 5) disposed at both ends, the heating element 23 formed of the carbon-based substance is heated to a high temperature because of its resistance. Even when the heating element 23 is expanded in its longitudinal direction by this heating, since the spring portion 6 of the internal lead wire 4 is provided between the heating element 23 and the molybdenum foil sheet 7, the dimensional change due to the expansion of the heating element 23 is absorbed by the contraction of the spring portion 6. As a result, it is possible to prevent any unnecessary bending force from applying to the heating element 23. For this reason, no unnecessary bending force is applied to the heating element 23 that is brittle at high temperatures, and the heating element 23 does not break even at high temperatures.

In the infrared ray lamp of the second embodiment, the heat-emitting blocks 33a and 33b formed of a material having good electric conductivity are connected to the vicinity of the end portion of the heating element 23 via the carbon-based adhesive having good electric conductivity. For this reason, in the infrared ray lamp of the second embodiment, the contact resistance can be decreased, and the temperature at the connection portion can be lowered.

Next, the bonding condition of the heating element 23 and the heat-emitting blocks 33a and 33b in the infrared ray lamp of the second embodiment will be described in more detail.

As shown in FIG. 6, in the infrared ray lamp of the second embodiment, the grooves 23a and 23b are formed in the top and bottom faces of the vicinity of the end portion of the heating element 23. The adhesive 9 formed of a liquid carbon-based organic substance is sufficiently applied to the end portion including the grooves 23a and 23b, and the heating element 23 is sandwiched between a pair of the heat-emitting blocks 33a and 33b and bonded thereto. After

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this bonding, the heating element 23 and the heat-emitting blocks 33a and 33b are dried and heated (fired), thereby securely connected by the sintered substance formed of the carbon-based substance of the adhesive 9 and having high conductivity.

In the second embodiment, by forming the grooves 23a and 23b in the heating element 23, the area of the contact between the heating element 23 and the heat-emitting blocks 33a and 33b increases, whereby the resistance of the contact can be reduced.

Furthermore, since the adhesive 9 formed of the carbon-based organic substance is very likely to be stuck to the heat-emitting blocks 33a and 33b formed of graphite, the adhesive 9 enters the grooves 23a and 23b, and the bonding between the heating element 23 and the heat-emitting blocks 33a and 33b is carried out at their projected and recessed faces, whereby the strength of the bonding is enhanced significantly. In the second embodiment, the structure wherein the number of the grooves formed in the vicinity of the end portion of the heating element 23 is one is explained as an example; however, an effect can also be obtained even if plural grooves are formed on one face or on both faces, and a higher effect is obtained as the number of the grooves increases.

In the second embodiment, the heating element 23 is bonded to the heat-emitting blocks 33a and 33b by pressure contact. As a result, unlike the case of an assembly process such as a fitting process, it is not necessary to accurately place the heating element and the heat-emitting blocks at predetermined positions; the assembly work can thus be carried out easily, and the cost of production can be reduced significantly.

FIG. 7 is a partially magnified perspective views showing another structure of the infrared ray lamp of the second embodiment, and shows an example of the method of the connection between the plate heating element 23 and two-split heat-emitting blocks 34a and 34b.

As shown in FIG. 7, grooves 23a and 23b are formed in the top and bottom faces in the vicinity of the end portion of the heating element 23. The grooves 23a and 23b extend in a direction perpendicular to the longitudinal direction of the heating element 23. The adhesive 9 formed of a liquid carbon-based organic substance is sufficiently applied to the end portion including these grooves 23a and 23b.

On the other hand, a hollowed step portion 34d is formed on each of the heat-emitting blocks 34a and 34b at a position for sandwiching the heating element 23. In addition, a projected portion 34c is formed on this step portion 34d. This projected portion 34c is formed at a position wherein it fits in each of the grooves 23a and 23b formed in the above-mentioned heating element 23.

The heating element 23 structured as described above is placed between the two heat-emitting blocks 34a and 34b and bonded thereto. At this time, the projected portions 34c of the heat-emitting blocks 34a and 34b fit in the grooves 23a and 23b in the heating element 23. After this fitting, the heating element 23 and the heat-emitting block 34a and 34b are dried and heated (fired), thereby securely connected by the sintered substance formed of the carbon-based substance of the adhesive 9 and having high conductivity.

Since the second embodiment shown in FIG. 7 is structured so that the projected portions 34c of the heat-emitting blocks 34a and 34b fit in the grooves 23a and 23b in the heating element 23, the area of the contact between the heating element 23 and the heat-emitting blocks 34a and 34b increases, whereby the resistance of the contact can be reduced.

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In addition, since the projected portions 34c fit in the grooves 23a and 23b, the bonding condition between the heating element 23 and the heat-emitting blocks 34a and 34b via the adhesive 9 becomes strong, whereby the strength of the bonding is enhanced.

The structure wherein the grooves are formed in the heating element 23 and the projected portions are formed on the heat-emitting blocks 34a and 34b is explained as an example in the second embodiment; however, the present invention is not limited to this kind of structure; the grooves and the projected portions may be formed opposite to each other, and the number of each is not limited to one.

FIG. 8 is a partially magnified perspective views showing still another structure of the infrared ray lamp of the second embodiment, and shows the method of the connection between a plate heating element 24 and two-split heat-emitting blocks 35a and 35b.

As shown in FIG. 8, a through hole 24a is formed in the vicinity of the end portion of the heating element 24. The adhesive 9 formed of a liquid carbon-based organic substance is sufficiently applied to the end portion including this through hole 24a.

On the other hand, a hollowed step portion 35d is formed on each of the heat-emitting blocks 35a and 35b at a position for sandwiching the heating element 24. In addition, a projected portion 35c is formed on this step portion 35d. This projected portion 35c is formed at a position wherein it fits in the through hole 24a formed in the above-mentioned heating element 24.

The heating element 24 structured as described above is sandwiched between the two heat-emitting blocks 35a and 35b and bonded thereto. At this time, the projected portions 35c of the heat-emitting blocks 35a and 35b fit in the through hole 24a in the heating element 24. After this bonding, the heating element 24 and the heat-emitting block 35a and 35b are dried and heated (fired), thereby securely connected by the sintered substance formed of the carbon-based substance of the adhesive 9 and having high conductivity.

Since the embodiment shown in FIG. 8 is structured so that the projected portions 34c of the heat-emitting blocks 35a and 35b fit in the through hole 24a in the heating element 24, the area of the contact between the heating element 24 and the heat-emitting blocks 35a and 35b increases, whereby the resistance of the contact can be reduced.

In addition, since the projected portions 35c fit in the through hole 24a, the condition of the bonding between the heating element 24 and the heat-emitting blocks 35a and 35b via the adhesive 9 becomes strong, whereby the strength of the bonding is enhanced.

The structure wherein the through hole and the projected portion are circular and the number of each is one is explained as an example in the embodiment shown in FIG. 8; however, the present invention is not limited to this kind of structure; if an oval hole and an oval projected portion are used or if plural holes and plural projections are used and if they can be fitted into each other for example, similar effect as that of the above-mentioned embodiment can be obtained.

Furthermore, it may be possible to use the structure wherein only the projected portion 35c shown in FIG. 8 is formed into a rod shape as a separate piece, and a through hole is formed in the step portion 35d of each of the heat-emitting blocks 35a and 35b so that the rod-like projected portion is inserted into the through holes in the heat-emitting blocks 35a and 35b and the thorough hole 24a in the heating element 24. With this structure, the heat-

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emitting blocks 35a and 35b can be processed easily, and the cost of production can be reduced.

The heat-emitting block formed of graphite having conductivity and an electrode terminal function is explained as an example in the first and second embodiments; however, the material of the heat-emitting block is not limited to graphite; various materials having heat resistance up to 1200° C. good electrical conductivity and good thermal conductivity are applicable. Since graphite itself is low in hardness and strength for example, various materials enhanced in hardness and strength, such as a material obtained by mixing a carbide, a nitride, a boride, etc. with graphite and by firing the mixture, a material obtained by adding glass-like carbon to graphite and by firing the mixture, and the like, are applicable.

The present invention has the following effect as made clear by the above-mentioned detailed explanations of the first and second embodiments.

In accordance with the present invention, the heating portions can be prevented from fusing and breaking during use for a long time, whereby it is possible to obtain an infrared ray lamp having high reliability and long life.

The infrared ray lamp of the present invention uses a heating element formed of a carbon-based substance and formed into a rod-like shape instead of the conventional tungsten spiral filament, and the infrared ray emission rate of the rod-like carbon-based substance is high, 78 to 84%; for this reason, the infrared ray emission rate of the infrared ray lamp is high. Furthermore, since the rod-like carbon-based substance has a negative temperature characteristic wherein the resistance lowers as the temperature rises, it is possible to reduce the rush current at the time when the infrared ray lamp of the present invention is turned on.

Furthermore, since the infrared ray lamp of the present invention is structured such that the heat-emitting blocks having good conductivity are bonded to the end portions of the rod-like carbon-based heating element, the resistance of the contact between the heating element and the heat-emitting blocks at the time of heating can be reduced, and temperature increase can be lowered, whereby it is possible to significantly enhance the reliability of the lead wire installation portions.

Furthermore, the infrared ray lamp of the present invention has the structure wherein the projected and recessed portions are formed between the rod-like carbon-based heating element and the heat-emitting blocks and then bonded and fired via the carbon-based adhesive. Because of this structure, the strength of the bonding portions of the infrared ray lamp of the present invention becomes high. Furthermore, since the rod-like carbon-based heating element and the adhesive for joining the heat-emitting blocks are formed of similar material, their thermal expansion coefficients are almost similar, whereby it is possible to provide a highly reliable infrared ray lamp not causing any accidents, such as breakage, during on-off switching operation for a long time. Furthermore, since the structure wherein the rod-like carbon-based heating element and the heat-emitting blocks are bonded by the fitting due to the engagement of the projected and recessed portions and by using the carbon-based adhesive is used in the present invention, it is possible to enhance workability and to raise quality at the time of the bonding.

In accordance with the method of producing the infrared ray lamp of the present invention, it is possible to obtain a highly reliable infrared ray lamp characterized in that its power consumption does not change abnormally even after use for a long time, and that the heating portions are

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prevented from fusing and breaking during use for a long time; furthermore, it is possible to enhance workability and to raise quality at the time of the assembly and bonding.

<<Third Embodiment>>

Next, a third embodiment of the present invention will be described referring to the accompanying drawings. However, the materials, sizes, production methods and the like of the embodiment described below are only examples preferable for an embodiment of the present invention. The applicable range of the present invention is therefore not limited by these examples.

FIG. 9(a) is a plan view showing an infrared ray lamp in accordance with the third embodiment of the present invention, and FIG. 9(b) is a front view thereof. In addition, FIG. 10 is a perspective view showing the infrared ray lamp of FIGS. 9(a) and 9(b). However, since the central portion of the infrared ray lamp can be understood from both side portions shown in the figures, the central portion of the infrared ray lamp is not shown in either of the figures.

The infrared ray lamp of the third embodiment comprises a substantially cylindrical glass tube 301, metal foil sheets 305 embedded in both end portions 301c of this glass tube 301, a heating element 302 hermetically sealed inside the glass tube 301, heat-emitting blocks 303 secured to both end portions of the heating element 302, internal lead wires 304 for connecting the heat-emitting blocks 303 to the metal foil sheets 305, and external lead wires 306 for connecting the metal foil sheets 305 to an external electric circuit.

The glass tube 301 is formed of quartz glass. The cylindrical portion of the glass tube 301 is about 10 mm in outside diameter, about 1 mm in thickness and about 360 mm in length. The sealing portions 301c at both ends of the cylindrical portion are each formed into a plate shape, and an argon gas having atmospheric pressure is filled inside the cylindrical portion.

The heating element 302 is formed of a carbon-based substance consisting of a mixture of crystallized carbon such as graphite, a resistance value adjustment substance such as a nitrogen compound and amorphous carbon. The resistance value adjustment substance is mixed to adjust the resistance of the heating element 302. This resistance value adjustment substance is used to make the resistance value of the heating element higher than that of a heating element formed of only carbon.

The heating element 302 in accordance with the third embodiment has a plate shape having a thickness t of 0.5 mm, a width T of 1.0 mm ($\approx 2t$), 2.5 mm ($\approx 5t$) or 6.0 mm ($\approx 12t$) and a length of about 300 mm. However, the plate heating element 302 having a width T of 6.0 mm ($\approx 12t$) is shown in FIGS. 9(a), 9(b) and 10.

The heat-emitting blocks 303 secured to both end portions of the heating element 302 are formed of a carbon-based substance similar to that of the heating element 302. The shape of the heat-emitting block 303 has a substantially cylindrical shape having about 6 mm in diameter and about 20 mm in length. A slit 303a, in which the longitudinal end portion of the heating element 2 is inserted, is formed in the end face 303b of the heat-emitting block 303 opposed to the heating element 302 so as to pass through its center. The heating element 2 is fitted into this slit 303a and secured to the heat-emitting block 303. The internal lead wire 304 is wound tightly around the central portion of the heat-emitting block 303, thereby forming a close-contact portion 304a.

The cross-sectional area of the heat-emitting block 303 is sufficiently larger than the cross-sectional area of the heating element 302 (about nine times or more in the third embodiment). The resistance value of the heat-emitting

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block 303 is therefore sufficiently smaller than the resistance value of the heating element 302. As a result, when a current flows through the heating element 302 and the heating element 302 generates heat, the heat generation at the heat-emitting block 303 itself is sufficiently smaller than that at the heating element 302 and negligible as described later. In addition, although heat is transmitted from the heating element 302 to the heat-emitting block 303, part of the heat is emitted from the surface of the heat-emitting block 303. As a result, the amount of the heat transmitted from the heat-emitting block 303 to the internal lead wire 304 is very scarce, and the internal lead wire 304 is therefore not overheated.

The internal lead wire 304 is formed of molybdenum or tungsten, and is a conductive wire of about 0.7 mm in diameter. The internal lead wire 304 has a spiral coil portion 304b following the close-contact portion 304a wound around the heat-emitting block 303. The spiral coil portion 304b is larger than the close-contact portion 304a by about 0.5 to 1.0 mm in diameter, and is provided so as to be coaxial with the center axis of the heat-emitting block 303. The spiral coil portion 304b is disposed away from the side face of the heat-emitting block 303 by a predetermined distance so that it can expand and contract like a coil spring in the axial direction of the heat-emitting block 303. In addition, one end of the internal lead wire 304 is secured to the metal foil sheet 305 by crimping. At the time of assembly, the internal lead wires 304 on both sides are pulled so that each of them becomes longer about 3 mm outwardly in the longitudinal direction than its normal length, whereby the heating element 302 is secured.

As described above, in the third embodiment, the heating element 302 is electrically connected to the metal foil sheets 305, and pulled appropriately to both sides thereof by the internal lead wires 304, thereby secured stably. At this time, the heating element 302 is secured so that the center line of the heating element 302 in the longitudinal direction thereof is aligned with the center axis of the glass tube 301.

In addition, the spiral coil portion 304b of the internal lead wire 304 has a function described below. As described later, when a current flows through the heating element 302 and the heating element 302 generates heat, the temperatures of the heating element 302 and the glass tube 301 are raised by the heat, and they undergo thermal expansion. At this time, a thermal stress occurs between the heating element 302 and the glass tube 301 because of the difference between their thermal expansion coefficients. This thermal stress is absorbed by the elasticity of the spiral coil portion 304b. Because of this structure, in the third embodiment, the connection between the heat-emitting block 303 and the metal foil sheet 305 via the internal lead wire 304 is not impaired by the thermal stress.

The metal foil sheet 305 is a molybdenum foil sheet measuring about 3 mm by 7 mm by 0.02 mm (thickness). The inner lead wire 304 is secured to one end of the metal foil sheet 305, and the external lead wire 306 is secured to the other end thereof. The external lead wire 306 is formed of molybdenum and welded to the metal foil sheet 305.

When a voltage is applied to the heating element 302 via the external lead wires 306, a current flows through the heating element 302. Since the heating element 302 has a resistance, heat generates from the heating element 302. At this time, the heating element 302 emits infrared rays.

FIG. 11(a) is a graph showing the distribution curve of the intensity of the infrared rays emitted from the heating element 302 of the third embodiment. FIG. 11(b) shows the cross section of the central portion of the infrared ray lamp

of the third embodiment having the heating element 302. The x and y axes shown in FIGS. 11(a) and 11(b) are orthogonal coordinate axes on a plane perpendicular to the axial direction of the heating element 302 shown in FIG. 10. In FIGS. 11(a) and 11(b), the origin 0 corresponds to the center axis of the heating element 302. In the graph of FIG. 11(a), the values in the radial directions designate the emission intensity off the infrared rays, and the values in the circumferential directions designate angles with respect to the center axis on the plane perpendicular to the axial direction of the heating element 302. These angles are designated by angles from the positive direction of the x axis.

The thick solid line 307a, the thin solid line 307b and the broken line 307c in FIG. 11(a) designate the intensity distribution curves in the case when the width T of the heating element 302 is 6.0 mm, 2.5 mm and 1.0 mm, respectively. Since the thickness (t) of the heating element 302 is 0.5 mm, the intensity distribution curve 307a is obtained in the case when the width T (6.0 mm) of the heating element 302 is 12 t, the intensity distribution curve 307b is obtained in the case when the width T (2.5 mm) of the heating element 302 is 5 t, and the intensity distribution curve 307c is obtained in the case when the width T (1.0 mm) of the heating element 302 is 2 t.

In the third embodiment, the intensity distribution curves 307a, 307b and 307c were measured as described below.

First, a constant voltage is applied to a 600 W infrared ray lamp, and infrared rays are emitted from the infrared ray lamp. In a condition wherein infrared rays are emitted from the infrared ray lamp stably, the amount of the infrared rays is measured at a position located a constant distance (about 300 mm) away from the center line (the origin 0 of FIGS. 11(a) and 11(b)) of the heating element 302 in a direction perpendicular thereto. At this time, the amount of infrared rays reaching a predetermined minute area at a predetermined position is measured. This measurement is repeated while the angle with respect to the heating element 302 is changed, with the distance from the origin 0 being maintained constant. As the result of this measurement, the intensity distribution curves 307a, 307b and 307c shown in FIG. 11(a) were obtained.

As indicated by the intensity distribution curves 307a, 307b and 307c shown in FIG. 11(a), the directivity of the intensity of the infrared rays emitted from the heating element 302 becomes higher as the ratio of the width T to the thickness t of the heating element 2 becomes higher. When $T \geq 5 t$ in particular, that is, when the ratio of the width T to the thickness t is five or more, the emission intensity in the y axis direction is significantly lower than that in the x axis direction.

When the infrared rays are emitted unequally as described above, for example, when only a predetermined region is desired to be heated, the region should be placed on the x axis. On the contrary, when only the predetermined region is not desired to be heated, the region should be placed on the y axis. As a result, in the third embodiment, the emission intensity can have directivity, even if such a reflection plate as that used for the conventional infrared ray lamp shown in the above-mentioned FIGS. 25, 26(a) and 26(a) is not provided.

The heating element 302 of the third embodiment is formed of a carbon-based substance consisting of a mixture of crystallized carbon such as graphite, a resistance value adjustment substance such as a nitrogen compound and amorphous carbon. As described above, the carbon-based substance used as the material of the heating element 302

has an infrared ray emission rate higher than those of the conventional nichrome and tungsten. For this reason, when the carbon-based substance is used as the heating element 302 of the infrared ray lamp, the efficiency of the emission from the heating element 302 is higher than those from the conventional heating elements.

Furthermore, since the resistance value of the heating element 302 of the third embodiment is higher than those of the conventional heating elements, even if the surface area of the heating element having the shape of a rod, a plate or the like is smaller than those of the conventional heating elements, the heating element can emit infrared rays having sufficient intensity. As a result, since the surface area of the heating element 302 is smaller than those of the conventional heating elements, heat emission from the heating element 302 to the gas around the element is scarce, whereby efficiency reduction due to heat emission from the heating element 302 is restricted.

Because of the above-mentioned reasons, when a constant voltage is applied to the infrared ray lamp, the emission intensity of the third embodiment shown in FIG. 11(a) is about 20 to 30% higher than the emission intensity, shown in FIG. 24(a), of the conventional infrared ray lamp having the heating element 240 formed of nichrome or tungsten.

In FIG. 11(a) and FIG. 24(a), the concentric gradations for the emission intensity indicate similar intensity values respectively.

However, the fact that the heating element 302 is formed of the carbon-based substance is not essential in the present invention. Even if the heating element 302 is formed of the conventional nichrome or tungsten, when the width T of the heating element 302 is larger than its thickness t by five times or more, it is possible to obtain emission intensity having such relatively high directivity as those indicated by the intensity direction curves 307a and 307b shown in FIG. 11(a).

Although the heating element 302 of the third embodiment formed integrally into the shape of a rod or plate is explained as an example, the heating element of the present invention is not limited to this kind of shape; a bundle obtained by binding plural rod-like members for example may be used as a whole to form a heating member.

Furthermore, although the infrared ray lamp of the third embodiment having the emission blocks 303 is explained as an example, the present invention is not limited to this kind of structure. In the case when the amount of the heat transmitted from the heating element to the internal lead wires is scarce to the extent that the internal lead wires are not overheated for example in accordance with the specifications of an infrared ray lamp, the structure wherein the emission blocks are omitted is also applicable.

<<Fourth Embodiment>>

Next, a fourth embodiment of the present invention will be described referring to the accompanying drawings. However, the materials, sizes, production methods and the like of the embodiment described below are only examples preferable for an embodiment of the present invention. The applicable range of the present invention is therefore not limited by these examples.

FIG. 12(a) is a plan view showing an infrared ray lamp in accordance with the fourth embodiment of the present invention, and FIG. 12(b) is a front view thereof. In addition, FIG. 13 is a perspective view showing the infrared ray lamp of FIGS. 12(a) and 12(b). However, since the central portion of the infrared ray lamp can be understood from both side portions shown in the figures, the central portion of the infrared ray lamp is not shown in either of the figures.

Furthermore, in the fourth embodiment, similar components as those of the third embodiment shown in FIGS. 9(a), 9(b) and 10 are designated by the same numerals, and their explanations are omitted.

The infrared ray lamp of the fourth embodiment has a reflection film 301a for infrared rays in a constant range on the external face of the glass tube 301 as shown in FIGS. 12(a), 12(b), and 13, in addition to the structure of the third embodiment. The reflection film 301a is a gold thin film evaporated on the external face of the glass tube 301 so as to have a thickness of about 5 μm. This reflection film 301a reflects about 70% of the infrared rays emitted from the heating element 302. As shown in FIGS. 12(a), 12(b) and 13, the reflection film 301a is disposed between the heat-emitting blocks 303 provided on both sides, in other words, disposed at a position opposed to the light-emitting portion of the heating element 302 in the longitudinal direction thereof. This reflection film 301a has a semi-cylindrical shape, and the internal face of the reflection film 301a is disposed so as to be opposed to the wider side face 302a of the heating element 302.

FIG. 14(a) is a graph showing the distribution curve 307d of the intensity of the infrared rays emitted from the heating element 302 of the fourth embodiment. FIG. 14(b) shows the cross section of the central portion of the infrared ray lamp of the fourth embodiment having the heating element 302. The x and y axes shown in FIGS. 14(a) and 14(b) are orthogonal coordinate axes on a plane perpendicular to the axial direction of the heating element 302 shown in FIG. 13. In FIGS. 14(a) and 14(b), the origin 0 corresponds to the center axis of the heating element 302. In FIG. 14(a), the values in the radial directions designate the emission intensity of the infrared rays, and the values in the circumferential directions designate angles with respect to the center axis on the plane perpendicular to the axial direction of the heating element 302. These angles are designated by angles from the positive direction of the x axis. The concentric gradations for the emission intensity in FIG. 14(a) indicate the same values of the gradations in FIG. 11(a).

In addition, a constant power of 600 W is applied to the infrared ray lamp. Since the measurement method is the same as that of the third embodiment, its explanation is omitted.

As indicated by the intensity distribution curve 307d in FIG. 14(a), the infrared rays from the heating element 302 are emitted most intensely in the positive direction of the x axis, that is, in a direction opposite to the reflection plate 301a with respect to the heating element 302 (the right direction in FIG. 14(b)). The maximum emission intensity is about 1.5 times as high as that of the infrared ray lamp of the third embodiment.

On the other hand, the infrared rays from the heating element 302 are hardly emitted in the negative direction of the x axis, that is, in the direction wherein the infrared rays are shielded by the reflection film 301a (in the left direction in FIG. 14(b)).

When the intensity distribution curve 307d in FIG. 14(a) is compared with the conventional intensity distribution curve 271 indicated in FIG. 26(a), the emission intensity in the conventional intensity distribution curve 271 is substantially uniform in a wide angle range near an area in the positive direction of the x axis. On the other hand, in the case of the fourth embodiment, the emission intensity gradually lowers as the distance from the x axis in the positive direction thereof increases. As a result, the emission intensity in the fourth embodiment is larger than that of the conventional example, and the range wherein the intensity

becomes a maximum value in the fourth embodiment is narrower than that in the conventional example.

The infrared ray lamp of the fourth embodiment is thus suited to a case wherein an object disposed in the positive direction of the x axis is locally heated for example.

In the infrared ray lamp of the fourth embodiment, the reflection film 301a is produced in accordance with the following forming process.

- (1) The glass tube 301 is formed into a cylindrical shape. (Step 1)
 - (2) The heating element 302 and the like are disposed inside the glass tube 301, and the glass tube 301 is hermetically sealed. (Step 2)
 - (3) Gold is evaporated on the external face of the glass tube 301 thereby to form the reflection film 301a. (Step 3)
- By forming the reflection film 301a as described above, the reflection film 301a can be formed by using the external shape of the glass tube 301. As a result, the reflection film 301a having an accurate semi-cylindrical shape can be formed easily.

In the above-mentioned process for forming the reflection film 301a, step 3 may be carried out before step 2.

Furthermore, the reflection film 301a may be formed by transfer or the like, instead of evaporation. In this case, transfer is carried out as described below.

- (1) A mixture of resin, gold and glass is formed into a film and bonded to the surface of the glass tube 301.
 - (2) The film bonded to the surface of the glass tube 301 is baked thereby to vaporize the resin included in the film.
- Transfer is carried out as described above, and a gold film is formed on the surface of the glass tube 301.

Since the internal face of the reflection film 301a in the fourth embodiment, used as a reflection face, is made close contact with the external face of the glass tube 301, the internal face does not make contact with the air. In the conventional infrared ray lamp shown in the above-mentioned FIG. 25, the reflection plate 280 is disposed with a predetermined space provided from the glass tube 201; for this reason, the reflection face of the reflection plate 280 is stained with adherents and the like from the outside; however, this kind of problem has been solved in the fourth embodiment.

In the fourth embodiment, the reflection film 301a is formed into the shape of the external face of the glass tube 301, that is, a semi-cylindrical shape, and is maintained in the shape. The reflection film can be maintained at substantially similar shape for a longer time than the reflection plate 280 used for the conventional infrared ray lamp.

As described above, in the fourth embodiment, the reflection film 301a is maintained for a long time, and the reflectivity of its reflection face does not lower. The infrared ray lamp of the fourth embodiment therefore maintains its good characteristics for a longer time in comparison with the structure wherein the reflection plate 280 is installed in the conventional infrared ray lamp.

In the fourth embodiment, the structure wherein the reflection film 301a is formed on the external face of the glass tube 301 is described as an example; however, the present invention is not limited to this structure; the structure wherein a reflection film formed on the internal face of the glass tube may be used. However, in the case of such a structure, step 3 must be carried out before step 2 in the above-mentioned process for forming the reflection film.

In the case when the reflection film is formed on the internal face of the glass tube 301, the reflection film is not exposed to the air, and its reflection face is not stained with adherents and the like. For this reason, just as in the case

when the reflection film is formed on the external face of the glass tube 301, the good characteristics of the reflection film are maintained for a longer time without causing any changes with time in comparison with the case when the reflection plate 280 is used for the conventional infrared ray lamp. However, since the reflection film formed on the internal face of the glass tube makes contact with the high-temperature gas inside the glass tube, the thickness of the reflection film may be reduced by evaporation, dispersion and the like, and its reflectivity may lower. For this reason, in the case when the reflection film is formed on the internal face of the glass tube, the distance between the reflection film and the heating element is required to be set at a sufficiently large value.

Although gold used as the material of the reflection film 301a is described as an example in the fourth embodiment, metals other than gold, such as titanium nitride, silver and aluminum, can be used; metals having high reflectivity for infrared rays and being stable at high temperatures are applicable.

The reflection film 301a having a semi-cylindrical shape is described as an example in the fourth embodiment; however, the present invention is not limited to this shape; various shapes are applicable in consideration of the reflection direction of infrared rays. Instead of the semi-cylindrical shape, the shape of a part of a circle, a parabola or an ellipse in cross section for example may be used as the shape of the reflection film. Furthermore, it is possible to use a shape formed of a combination of plural straight lines, such as a part of a polygon (the shape of the letter $\square$ for example (or the shape of a bathtub)) or a shape formed of a combination of straight and curved lines (the shape of the letter U for example) or a flat shape in cross section. The shape of the reflection film 301a should only be a shape suited for obtaining the desired directional distribution of the emission intensity of infrared rays. To form the reflection film 301a having this kind of shape, the portion of the glass tube wherein the reflection film 301a is formed by evaporation or the like should only be formed into a shape corresponding to the desired shape of the reflection film; this can be attained easily by taken the method of forming the reflection film 301a described before.

<<Fifth Embodiment>>

Next, a fifth embodiment of the present invention will be described referring to the accompanying drawings. However, the materials, sizes, production methods and the like of the embodiment described below are only examples preferable for an embodiment of the present invention. The applicable range of the present invention is therefore not limited by these examples.

FIG. 15(a) is a plan view showing an infrared ray lamp in accordance with the fifth embodiment of the present invention, and FIG. 15(b) is a front view thereof. In addition, FIG. 16 is a perspective view showing the infrared ray lamp of FIGS. 15(a) and 15(b). However, since the central portion of the infrared ray lamp can be understood from both side portions shown in the figures, the central portion of the infrared ray lamp is not shown in either of the figures.

Furthermore, in the fifth embodiment, the same components as those of the third embodiment shown in FIGS. 9(a), 9(b) and 10 are designated by the same numerals, and their explanations are omitted.

The infrared ray lamp of the fifth embodiment has a reflection film 301b for infrared rays in addition to the structure of the third embodiment, just as in the case of the above-mentioned fourth embodiment. However, in the infrared ray lamp of the fifth embodiment, the reflection film

301b is formed on the external face of the glass tube 301 at a position different from that in the above-mentioned fourth embodiment. Although the reflection film 301a of the fourth embodiment is disposed so as to be opposed to the wider side portion 2a of the heating element 302 (FIGS. 12(a), 12(b) and 13), the reflection film 301b of the fifth embodiment is disposed so as to be opposed to the narrower side portion 2b of the heating element 302.

The material, thickness, reflectivity, shape and forming method of the reflection film 301b of the fifth embodiment are similar to those of the reflection film 301a of the fourth embodiment.

FIG. 17(a) is a graph showing the distribution curve 307e of the intensity of the infrared rays emitted from the heating element 302 of the fifth embodiment. FIG. 17(b) shows the cross section of the central portion of the infrared ray lamp of the fifth embodiment having the heating element 302. The x and y axes shown in FIGS. 17(a) and 17(b) are orthogonal coordinate axes on a plane perpendicular to the axial direction of the heating element 302 shown in FIG. 16. The x axis corresponds to the thickness direction of the heating element 302, and the y axis corresponds to the width direction thereof. In FIGS. 17(a) and 17(b), the origin 0 corresponds to the center axis of the heating element 302. In FIG. 17(a), the values in the radial directions designate the emission intensity of the infrared rays, and the values in the circumferential directions designate angles with respect to the center axis on the plane perpendicular to the axial direction of the heating element 302. These angles are designated by angles from the positive direction of the x axis. The concentric gradations for the emission intensity in FIG. 17(a) indicate the same values of the gradations in FIG. 11(a).

In addition, a constant power of 600 W is applied to the infrared ray lamp. Since the measurement method is the same as that of the third embodiment, its explanation is omitted.

In the infrared ray lamp of the fifth embodiment, the positive direction of the y axis (the direction of the arrow of the y axis in FIGS. 16, 17(a) and 17(b)) is the direction of the internal face of the reflection film 301b.

As shown in the intensity distribution curve 307e of the infrared ray emission in FIG. 17(a), the emission intensity of the infrared rays from the heating element 302 in the vicinity of the y axis in the positive direction thereof is lower than that in the vicinity of the x-axis direction. On the y axis side in the negative direction thereof, emission is restricted by the reflection film 301b as a matter of course.

When the intensity distribution curve 271 of the conventional infrared ray lamp shown in FIG. 26(a) is compared with that of the fifth embodiment, the angle range in the direction wherein the emission intensity is high in the fifth embodiment is wider than that in the conventional example.

As a result, the infrared ray lamp of the fifth embodiment is suited, for example, in the case when the center of an object to be heated is placed on the y axis of the infrared ray lamp in the positive direction thereof and in the case when the entire flat face of the object to be heated, which is perpendicular to the y axis, is heated uniformly.

<<Sixth Embodiment>>

Next, a heating apparatus using the infrared ray lamp in accordance with the present invention will be described as a sixth embodiment.

The infrared ray lamp described in the above-mentioned third embodiment is used as the infrared ray lamp for the heating apparatus of the sixth embodiment, and the reflection plate 280 shown in FIG. 25 is provided for this infrared ray lamp.

All of the above-mentioned infrared ray lamps in accordance with the above-mentioned first to fifth embodiments are structured to have substantially similar external shape as that of the conventional infrared ray lamp. For this reason, in a heating apparatus having the conventional infrared ray lamp, it is easy for ordinary engineers skilled in the related art to replace the infrared ray lamp with one of the infrared ray lamps in accordance with the first to fifth embodiments.

Heating apparatuses each having the conventional infrared ray lamp that is replaceable with the infrared ray lamp of the present invention as described above are the following apparatuses, for example.

(1) Heating apparatuses, such as a heater, a kotatsu (a Japanese traditional heating device), an air conditioner, an infrared treatment apparatus and a bathroom heater

(2) Drying apparatuses, such as a clothing drier, a bedding drier, a food treatment apparatus, a garbage treatment apparatus, a heating-type deodorizing apparatus and a bathroom drier

(3) Heating-type sterilizing apparatuses

(4) Cooking apparatuses, such as an oven, an oven range, an oven toaster, a toaster, a roaster, a warming apparatus, a yakitori cooker (skewered chicken cooker), a cooking stove, a defroster and a brewer

(5) Hairdressing apparatuses, such as a drier and a permanent wave heater

(6) Apparatuses for fixing letters, images, etc. on sheets

(a) Apparatuses for carrying out display by using toner, such as an LBP (laser beam printer), a PPC (plain paper copier) and a facsimile

(b) Apparatuses for thermal transfer of an original film to an object by heating

(7) Soldering heaters

(8) Driers for semiconductor wafers, etc.

(9) Apparatuses for heating pure water when cleaning wafers, etc. in semiconductor production processes, and

(10) Industrial coating driers

In other words, an apparatus for heating objects by using an infrared ray lamp as a heat source can be an apparatus whose infrared ray lamp can be replaced with as described above.

FIG. 18 is a perspective view showing the positional relationship between the infrared ray lamp and the infrared ray reflection plate 308a of the heating apparatus of the sixth embodiment. In FIG. 18, the central portion of the infrared ray lamp is not shown. Furthermore, since the infrared ray lamp used herein is the infrared ray lamp described in the above-mentioned third embodiment, its explanation is omitted.

The reflection plate 308a of the sixth embodiment is formed of aluminum, has a semi-cylindrical shape measuring about 0.4 to 0.5 mm in thickness, and has a mirror-finished reflection face on its internal face. The infrared ray reflectivity of the reflection plate 308a is about 80 to 90%. The reflection plate 308a is disposed in parallel with the center line of the heating element 302, with a predetermined space provided from the external face of the glass tube 301. The reflection plate 308a is installed by using the center line of the heating element 302 as its center. As shown in FIG. 18, the reflection face, that is, the internal face of the reflection plate 308a, is disposed so as to be opposed to the wider side portion 302a of the heating element 302.

The reflection plate 308a formed of aluminum is explained as an example in the sixth embodiment; however, instead of aluminum, materials having high infrared ray reflectivity and being stable at high temperatures, such as gold, titanium nitride, silver and stainless steel, are applicable.

The reflection plate 308a having a semi-cylindrical shape is explained in the sixth embodiment; however, its cross section can also take other shapes, for example, a shape having a part of a circle, a parabola or an ellipse; or a shape formed of a combination of plural straight lines, such as a part of a polygon (the shape of the Japanese letter "コ" for example), a shape formed of a combination of them (the shape of the English letter "U" for example) or a flat shape; the shape should only be a shape suited for obtaining the desired directional distribution of the emission intensity of infrared rays.

By installing the reflection plate 308a as described above, the directional distribution of the emission intensity of the infrared rays has substantially similar shape as that of the intensity distribution curve 307d in the fourth embodiment shown in FIG. 14(a). With the above-mentioned structure, it is possible to obtain infrared rays having similar directional distribution of the emission intensity as that of the infrared ray lamp of the fourth embodiment. As a result, the heating apparatus of the sixth embodiment is suited for a use wherein an object disposed at a position opposed to the reflection face of the reflection plate 308a is heated locally for example.

The emission intensity of the infrared ray lamp of the third embodiment has directivity in the x-axis direction as shown in FIGS. 11(a) and 11(b). For this reason, in the heating apparatus of the sixth embodiment, the emission intensity of the infrared rays by the reflection plate 308a becomes higher than that of the conventional example. In addition, in the case when the reflectivity of the reflection plate 308a is reduced considerably because of changes with time, the adherence of stains, etc., the effect on the directional distribution of the emission intensity in the sixth embodiment is less than that in the case when the conventional infrared ray lamp shown in FIG. 22 is used for example.

<<Seventh Embodiment>>

Next, a heating apparatus using the infrared ray lamp in accordance with the present invention will be described as a seventh embodiment.

The infrared ray lamp of the heating apparatus of the seventh embodiment is structured such that the reflection plate 308a described in the above-mentioned sixth embodiment is disposed 90 degrees rotated around the center line of the infrared ray lamp.

FIG. 19 is a perspective view showing the positional relationship between the infrared ray lamp and the infrared ray reflection plate 308b of the heating apparatus of the seventh embodiment. However, in FIG. 19, the central portion of the infrared ray lamp is not shown. Furthermore, since the infrared ray lamp used herein is the infrared ray lamp described in the third embodiment, its explanation is omitted.

As shown in FIG. 19, the reflection face, that is, the internal face of the reflection plate 308b, is disposed so as to be opposed to the narrower side portion 302b of the heating element 302.

By disposing the reflection plate 308b as described above, the directional distribution of the emission intensity of infrared rays is substantially equal to that of the fifth embodiment shown in FIG. 17(a). In other words, similar directional distribution of the emission intensity as that of the fifth embodiment can be obtained by using the infrared ray lamp of the third embodiment. The heating apparatus of the seventh embodiment is thus suited for a use wherein the entire flat face of an object placed in parallel with the heating element 302 and opposed to the reflection plate 308b is heated substantially uniformly for example.

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Furthermore, the infrared ray lamp of the third embodiment shown in FIG. 10 has directivity in emission intensity as shown in FIGS. 11(a) and 11(b). For this reason, in the heating apparatus of the seventh embodiment, in the case when the reflectivity of the reflection plate 308b is reduced considerably because of changes with time, the adherence of stains, etc., the effect on the directional distribution of the emission intensity is less than that in the case when the conventional infrared ray lamp shown in FIG. 22 is used for example.

In the infrared ray lamp of the present invention, the intensity of the infrared rays emitted from the heating element has directivity described below. In other words, the emission intensity of the infrared rays becomes a maximum value in the thickness direction of the heating element, and the intensity in the width direction of the heating element has a small value that is substantially negligible in comparison with the maximum value. The conventional reflection plate is not required to be used for such a use wherein an infrared ray lamp having such directivity is suited, whereby the lamp can be structured simply. The infrared ray lamp having this structure does not cause reduction in the reflectivity of the reflection plate, thereby preventing reduction in efficiency.

In addition, in the case when the infrared ray lamp of the present invention has a reflection film, the intensity distribution curve of the emission of the infrared rays emitted from the heating element can be adjusted to have a predetermined shape. As a result, the intensity of the infrared rays emitted in unnecessary directions can be restricted, whereby the infrared ray lamp of the present invention exhibits good emission efficiency. Furthermore, unlike the reflection plate, the reflection face of the reflection film is not stained by external adherents and the like. Moreover, changes with time in the shape of the reflection film and the like are less significant than those of the reflection plate. As a result, the high reflectivity of the reflection film is maintained for a longer period than that of the reflection plate. The infrared ray lamp of the present invention therefore maintains its good characteristics for a long time.

In the infrared ray lamp of the present invention, by providing the reflection film at a position desirable for the heating element, the intensity of the infrared rays reflected by and emitted from the reflection film can be increased in a specific direction, and the range of the high emission intensity can be narrowed. As a result, the infrared ray lamp of the present invention having this kind of reflection film becomes a device suited for a use wherein the area in the direction opposed to the reflection film is heated locally, for example, suited for fixing and the like in a copier.

Furthermore, in the infrared ray lamp of the present invention, by providing the reflection film at another position desirable for the heating element, the intensity of the infrared rays reflected by and emitted from the reflection film can be made substantially the same, whereby the range of the emission intensity can be widened. As a result, the infrared ray lamp of the present invention having this kind of reflection film becomes a device suited for a use wherein the entire flat face of an object placed in parallel with the heating element and opposed to the reflection film is heated uniformly, for example, suited for a toaster.

In the method of producing the infrared ray lamp in accordance with the present invention, the reflection film is formed by using the shape of the glass tube. This facilitates the formation of the semi-cylindrical reflection film.

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In the heating apparatus in accordance with the present invention, the infrared ray lamp of the present invention has similar shape as that of the conventional infrared ray lamp; for this reason, the infrared ray lamp of the conventional heating apparatus can be replaced with the infrared ray lamp of the present invention. As a result, by providing the conventional heating apparatus with the infrared ray lamp having directivity in the emission intensity of infrared rays, a heating apparatus having good characteristics can be obtained, and the heating apparatus can be used for heating objects or rooms.

In the heating apparatus of the present invention, by installing the semi-cylindrical reflection plate instead of the reflection film, the direction curve of the intensity of the emission of the infrared rays can be adjusted to have a predetermined shape. With this structure of the infrared ray lamp of the heating apparatus of the present invention, the intensity of the infrared rays emitted in unnecessary directions can be restricted. In addition, even if the reflectivity of the reflection plate lowers, the directivity of the infrared ray lamp is not so affected as in the case of the conventional apparatus, since the infrared ray lamp has directivity. For this reason, the heating efficiency of the heating apparatus in accordance with the present invention is superior to that of the conventional apparatus.

In the heating apparatus in accordance with the present invention, by providing the reflection film at a position desirable for the heating element, the intensity of the infrared rays reflected by and emitted from the reflection film can be increased in a specific direction, and the range of the high emission intensity can be narrowed. As a result, the heating apparatus of the present invention having this kind of reflection film becomes a device suited for a use wherein the area in the direction opposed to the reflection film is heated locally.

Furthermore, in the heating apparatus of the present invention, by providing the reflection film at another position desirable for the heating element, the intensity of the infrared rays reflected by and emitted from the reflection film can be made substantially the same, whereby the range of the emission intensity can be widened. As a result, the heating apparatus of the present invention having this kind of reflection film becomes a device suited for a use wherein the entire flat face of an object placed in parallel with the heating element and opposed to the reflection film is heated uniformly.

Although the present invention has been described in terms of the presently preferred embodiments, it is to be understood that such disclosure is not to be interpreted as limiting, but various alterations and modifications will no doubt become apparent to those skilled in the art to which the present invention pertains, after having read the above disclosure; accordingly, it is intended that the appended claims be interpreted as covering all alterations and modifications as fall within the true spirit and scope of the invention.

INDUSTRIAL APPLICABILITY

The present invention, relating to a heating apparatus for heating objects, rooms, etc., can provide a heating apparatus that emits infrared rays highly efficiently and has a long life by using an infrared ray lamp widely used as a heat source, and can also provide a versatile apparatus wherein the directivity of infrared ray emission can be selected depending on an object to be heated.

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What is claimed is:

1. An infrared ray lamp comprising:

- a heating element which is formed of a carbon-based substance including at least crystallized carbon, a resistance value adjustment substance and amorphous carbon which has a substantially plate shape, the width of which is larger than its thickness by five times or more,
- a glass tube in which said heating element is hermetically sealed, and
- an electrode embedded at both end portions of said glass tube, electrically connected to both ends of said heating element respectively and also electrically connected to an external electric circuit,
- a connection device which is secured to each end portion of said heating element, thereby electrically connected to said heating element, and
- a lead wire having a spring portion which is secured to said connecting device and said electrode and pulls said heating element at a predetermined tension, and electrically connecting said connecting device and said electrode.

2. An infrared ray lamp in accordance with claim 1, wherein

- the spring portion of said lead wire is formed in a spiral shape, and
- said spring portion has a larger diameter than the width of said heating element.

3. An infrared ray lamp in accordance with claim 1, wherein a reflection film for reflecting infrared rays is provided on the internal or external face of said glass tube so that the emission intensity of said infrared rays emitted from said heating element has a predetermined distribution.

4. An infrared ray lamp in accordance with claim 3, wherein said reflection film having a semicylindrical shape being substantially coaxial with the center line of said heating element in the longitudinal direction thereof is provided along substantially similar length as that of the infrared ray emitting portion of said heating element.

5. An infrared ray lamp in accordance with claim 4, wherein the central portion of the cross section of said reflection film is disposed so as to be opposed to the wider side portion of said heating element.

6. An infrared ray lamp in accordance with claim 4, wherein the central portion of the cross section of said reflection film is disposed so as to be opposed to the narrower side portion of said heating element.

7. An infrared ray lamp in accordance with claim 3, wherein the cross section of said reflection film has a shape formed of a part of a parabola having its focus substantially on the center line of said heating element in the longitudinal direction thereof, along substantially similar length as that of the infrared ray emitting portion of said heating element.

8. An infrared ray lamp in accordance with claim 3, wherein the cross section of said reflection film has a shape formed of a part of an ellipse having one of its focuses substantially on the center line of said heating element in the longitudinal direction thereof, along substantially similar length as that of the infrared ray emitting portion of said heating element.

9. A heating apparatus provided with an infrared ray lamp comprising:

- a heating element which is formed of a carbon-based substance including at least crystallized carbon, a resistance value adjustment substance and amorphous carbon, and which has a substantially plate shape, the width of which is larger than its thickness by five times or more,

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a glass tube in which said heating element is hermetically sealed, and

an electrode embedded at both end portions of said glass tube, electrically connected to both ends of said heating element respectively and also electrically connected to an external electric circuit,

a connection device which is secured to each end portion of said heating element, thereby electrically connected to said heating element, and

a lead wire having a spring portion which is secured to said connecting device and said electrode and pulls said heating element at a predetermined tension, and electrically connecting said connecting device and said electrode.

10. A heating apparatus in accordance with claim 9, wherein

- the spring portion of said lead wire is formed in a spiral shape, and
- said spring portion has a larger diameter than the width of said heating element.

11. A heating apparatus in accordance with claim 9 or 10, further comprising a reflection plate for reflecting infrared rays so that the intensity of said infrared rays emitted from said heating element has a predetermined directional distribution.

12. A heating apparatus in accordance with claim 11, wherein said reflection plate has a semi-cylindrical shape being substantially coaxial with the center axis of said infrared ray lamp.

13. A heating apparatus in accordance with claim 11, wherein the cross section of said reflection plate has a shape formed of a part of a parabola having its focus substantially on the center axis of said infrared ray lamp.

14. A heating apparatus in accordance with claim 11, wherein the cross section of said reflection plate has a shape formed of a part of an ellipse having one of its focuses substantially on the center axis of said infrared ray lamp.

15. A heating apparatus in accordance with claim 11, wherein the central portion of the cross section of said reflection plate is disposed so as to be opposed to the wider side portion of said heating element.

16. A heating apparatus in accordance with claim 11 wherein the central portion of the cross section of said reflection plate is disposed so as to be opposed to the narrower side portion of said heating element.

17. A method of producing an infrared ray lamp, comprising:

- a step of forming a heating element which is formed of a carbon-based substance including at least crystallized carbon, a resistance value adjustment substance and amorphous carbon into a substantially plate shape, the width of which is larger than its thickness by five times or more,

a step of disposing a lead wire having a spring portion which pulls said heating element at a predetermined tension,

a step of hermetically sealing said heating element inside said glass tube so that the center line of said heating element in the longitudinal direction thereof is substantially coaxial with the center axis of said glass tube, and

a step of forming a reflection film for reflecting infrared rays into a substantially semi-cylindrical shape on the external face of the cylindrical shape of said glass tube so as to substantially include the range of the disposition of said heating element in the axial direction thereof.

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18. A method of producing an infrared ray lamp, comprising:

a step of forming a heating element which is formed of a carbon-based substance including at least crystallized carbon, a resistance value adjustment substance and amorphous carbon into a substantially plate shape, the width of which is larger than its thickness by five times or more,

a step of forming a reflection film for reflecting infrared rays into a predetermined substantially semi-cylindrical shape on the external face or the internal face of the cylindrical shape of said glass tube,

a step of disposing a lead wire having a spring portion which pulls said heating element at a predetermined tension, and

a step of disposing said heating element so as to be included in the axial range wherein said reflection film is disposed, and of hermetically sealing said heating element inside said glass tube.

19. An infrared ray lamp comprising:

a heating element having a substantially plate shape, the width of which is larger than its thickness by five times or more, and being formed of a carbon-based substance including at least crystallized carbon, a resistance value adjustment substance and amorphous carbon,

a heat emitting block having a good conductivity which is bonded to each end portion said heating element,

an internal lead wire having a close-contact portion wound around said heat-emitting block and a spring portion.

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a glass tube in which said heating element, said heat emitting block, said close-contact portion, and said spring portion is hermetically sealed, and

an electrode embedded at both end portions of said glass tube, electrically connected to said inner lead wire respectively and also electrically connected to an external electric circuit.

20. A heating apparatus provided with an infrared ray lamp comprising,

a heating element having a substantially plate shape, the width of which is larger than its thickness by five times or more, and being formed of a carbon-based substance including at least crystallized carbon, a resistance value adjustment substance and amorphous carbon,

a heat emitting block having a good conductivity which is bonded to each end portion of said heating element,

an internal lead wire having a close-contact portion wound around said heat-emitting block and a spring portion,

a glass tube in which said heating element, said heat emitting block, said close-contact portion, and said spring portion is hermetically sealed, and

an electrode embedded at both end portions of said glass tube, electrically connected to said inner lead wire respectively and also electrically connected to an external electric circuit.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,845,217 B2
DATED : January 18, 2005
INVENTOR(S) : Konishi

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 4,

Line 64, please delete "Bide" and insert therefor -- side --.

Column 8,

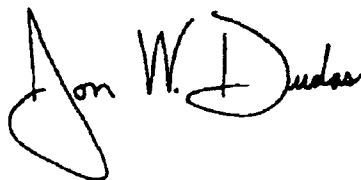
Line 52, please delete "FIG. 12(a)" and insert therefor -- FIG. 12(b) --.

Column 32,

Line 52, please delete "elate" and insert therefor -- plate --.

Signed and Sealed this

Thirty-first Day of May, 2005

A handwritten signature in black ink, appearing to read "Jon W. Dudas". The signature is stylized with a large, looped initial "J" and a cursive "Dudas".

JON W. DUDAS
Director of the United States Patent and Trademark Office

ANEXO 2



US007217936B2

(12) **United States Patent**
Ressler

(10) **Patent No.:** **US 7,217,936 B2**
(45) **Date of Patent:** **May 15, 2007**

(54) **SYSTEM AND METHOD FOR PRODUCT
STERILIZATION USING UV LIGHT SOURCE**

(76) Inventor: **Barry Ressler**, 137 Lake Pl. South,
Danbury, CT (US) 06810
(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

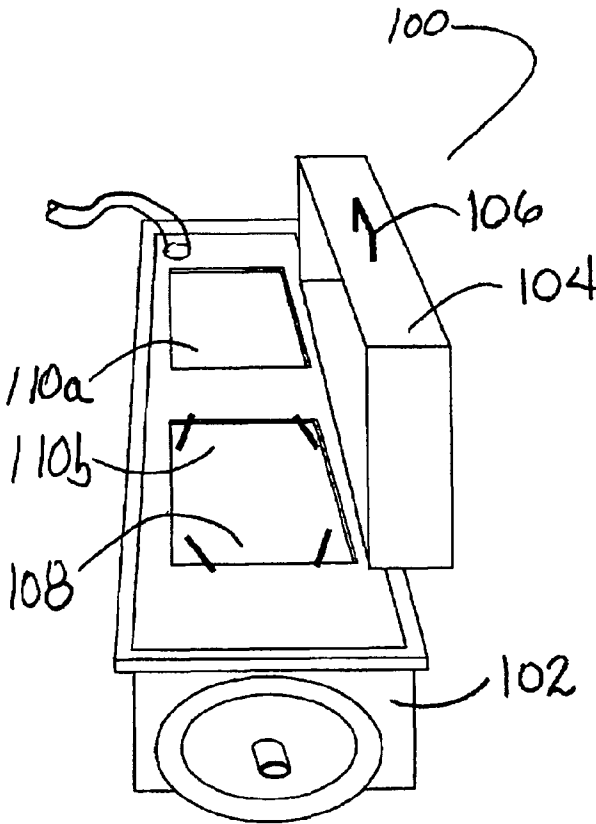
(21) Appl. No.: **11/056,698**
(22) Filed: **Feb. 11, 2005**

(65) **Prior Publication Data**
US 2005/0173652 A1 Aug. 11, 2005

Related U.S. Application Data
(60) Provisional application No. 60/543,710, filed on Feb.
11, 2004.
(51) **Int. Cl.**
A61L 2/10 (2006.01)
A61L 2/26 (2006.01)
(52) **U.S. Cl.** **250/455.11; 250/504 R**
(58) **Field of Classification Search** **250/455.11,**
250/504 R
See application file for complete search history.

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* cited by examiner
Primary Examiner Nikita Wells
Assistant Examiner Johnnie I. Smith, II
(74) *Attorney, Agent, or Firm* Robert L. Epstein; Epstein
Drangel Bazerman & James, LLP

(57) **ABSTRACT**
System and method for sterilization, using UV light
source(s), of products, e.g., polymer-based products,
whether positioned within or external to their packaging,
using monochromatic, continuous wave, high-intensity,
incoherent light in single and/or multiple light source con-
figurations. The treatment system(s) and method(s) may be
used for sterilization of alternative products, including, for
example, food products such as meat and poultry, enteral
and/or parenteral solutions and systems, and the like.
7 Claims, 2 Drawing Sheets



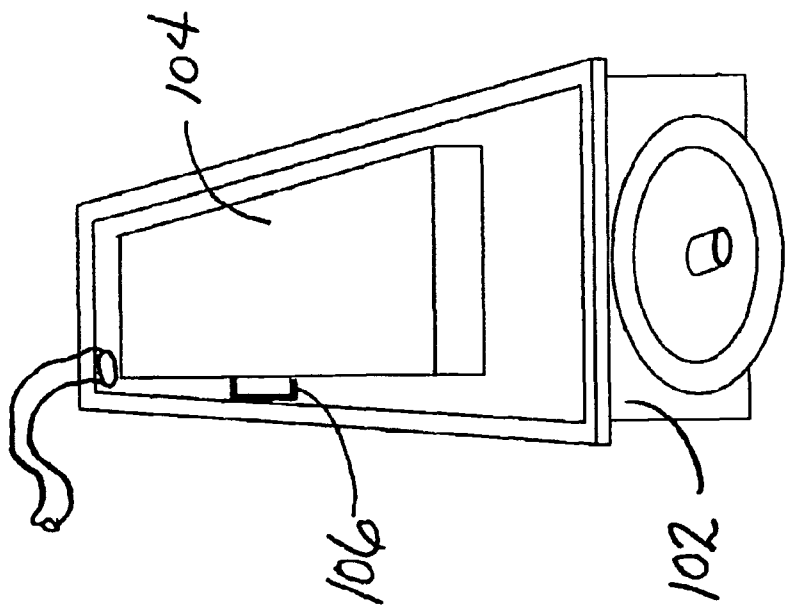


FIG 1A

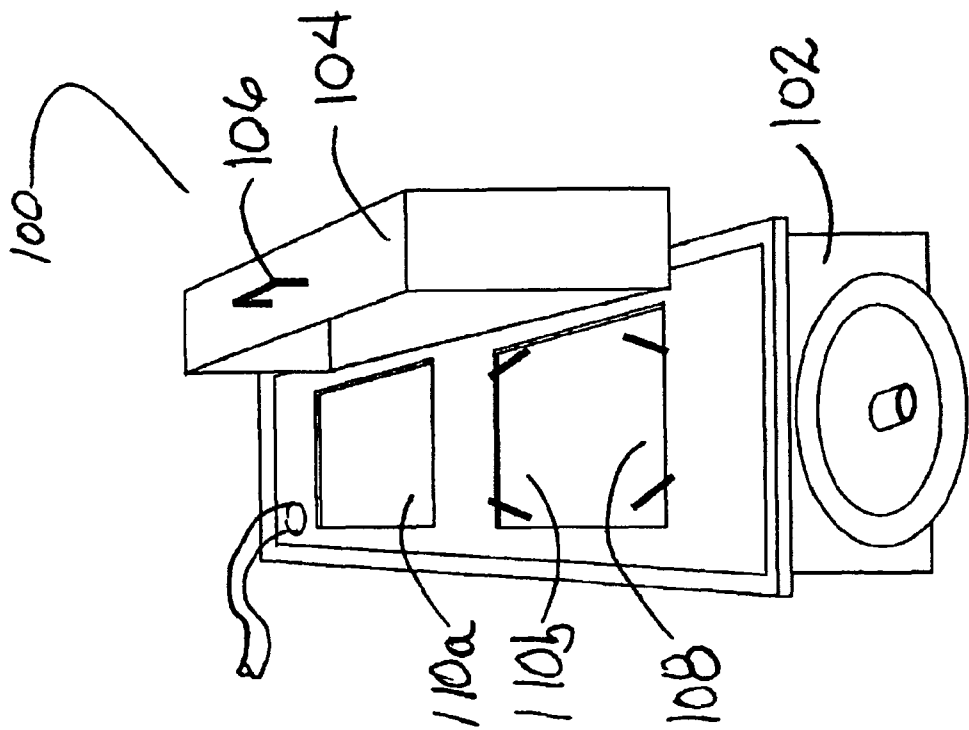
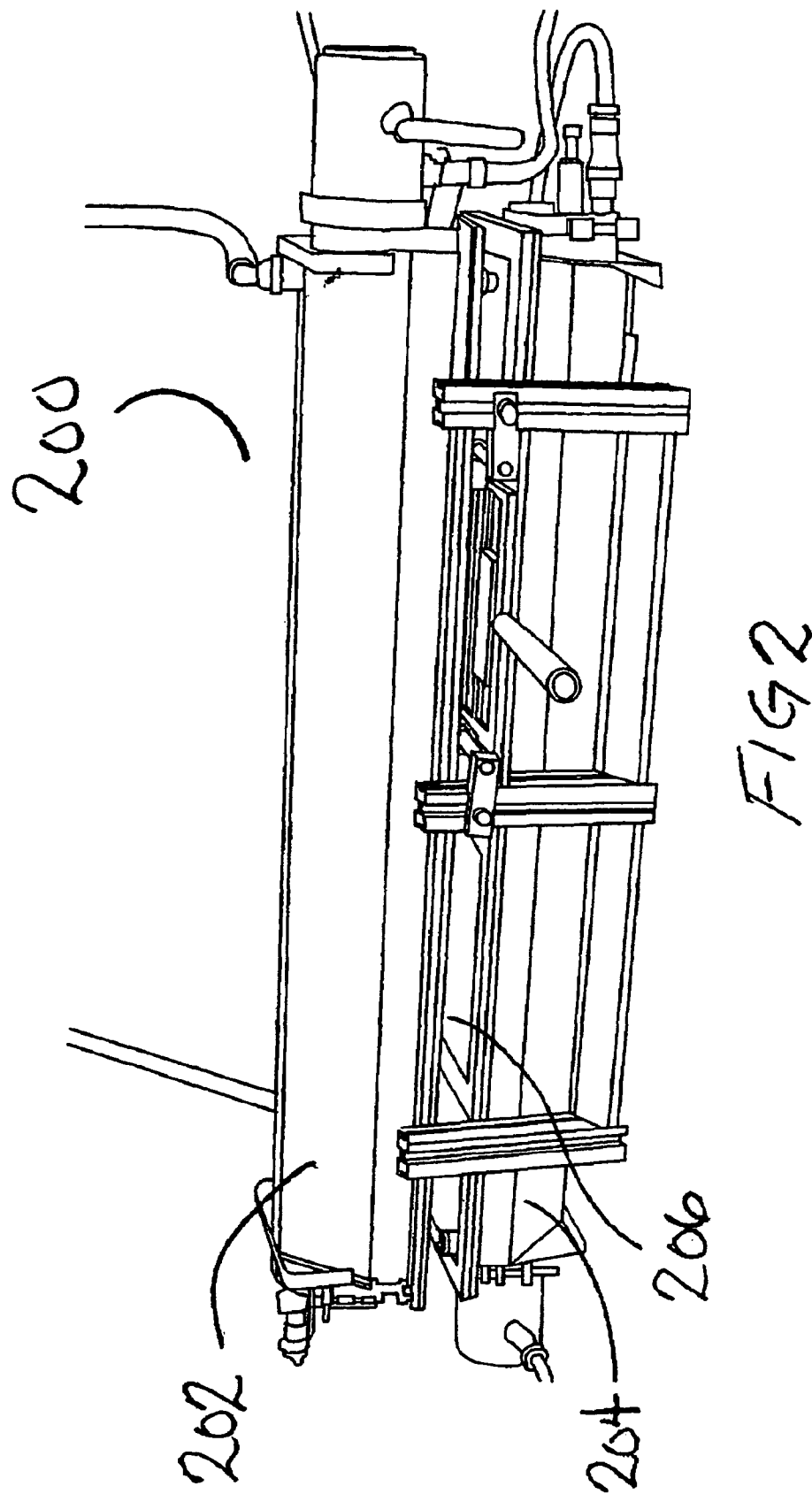


FIG 1



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**SYSTEM AND METHOD FOR PRODUCT
STERILIZATION USING UV LIGHT SOURCE**

This application claims the benefit of U.S. Provisional Application No. 60/543,710 filed Feb. 11, 2004.

BACKGROUND

1. Technical Field
The present disclosure is directed to system(s) and method(s) for sterilization of products and/or systems using UV light source(s). More particularly, the present disclosure is directed to system(s) and method(s) for sterilization of polymer-based products, whether positioned within or external to their packaging, using monochromatic, continuous wave, high-intensity, incoherent light in single and/or multiple light source configurations. The disclosed treatment system(s) and method(s) advantageously preserve physical and performance properties of the product/system while achieving a desired level of sterilization. The disclosed treatment system(s) and method(s) may be used for sterilization of alternative products, including, for example, food products such as meat and poultry, enteral and/or parenteral solutions and systems, and the like.

2. Background Art
Sterilization is generally defined as the complete destruction of all organisms, including a large number of highly resistant bacterial endospores. A host of sterilization techniques have been developed to address specific sterilization needs. Typical sterilization techniques include the use of moist heat from a steam autoclave, ethylene oxide gas sterilizing techniques, dry heat techniques, and newer chemical sterilizers.

Steam sterilization is widely used and is generally viewed as relatively cost-effective sterilization technique. The use of steam sterilization techniques employing an autoclave is recognized as an efficient, simple, and relatively cost-effective approach for destroying all relevant organisms. However, certain components (e.g., medical device/instrumentation components and accessories) cannot endure the extremes of heat and pressure. For example, steam and pressure are known to damage rubber, Lexan® plastic components, and other synthetic materials, and the use of a steam autoclave for any anesthesia equipment is generally not recommended, unless the treatment method is specifically recommended by the manufacturer.

Ethylene oxide is acceptable for many materials used in manufacturing medical devices and the like, including the reusable components of anesthesia machines, ventilators, and monitors. However, it is generally inappropriate to place these entire systems in an ethylene oxide chamber. In addition, polystyrene component parts cannot be exposed to ethylene oxide gas. Ethylene oxide sterilization employs a powerful poisonous fumigant gas, and therefore mandates an appropriate means of aeration to remove all traces of residual gas. Workers exposed to ethylene oxide are required to comply with all procedures specified by OSHA and the EPA. Alternative chemical treatment techniques include the use of hydrogen peroxide and peroxyacetic acid with buffers and low heat.

More recently, a sterilization technique was disclosed in U.S. Pat. No. 5,786,598 to Clark et al., entitled "Sterilization of Packages and Their Contents Using High-Intensity, Short-Duration Pulses of Incoherent, Polychromatic Light in a Broad Spectrum." As noted in the title, the Clark '598 patent involves the use of high-intensity, short-duration pulses of incoherent, polychromatic light in a broad spectrum to

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sterilize product containers and deactivate microorganisms therein. The Clark '598 proposes "the deactivation of microorganisms within parenteral and/or enteral solutions and packages or within contact lens solutions and packages and/or ophthalmic solutions and packages." [See col. 1, lines 11-20.] The use of short-duration pulses of incoherent, polychromatic light in a broad spectrum, as disclosed in the Clark '598 patent, is believed to be ineffective and/or unacceptable for at least some aspects of the proposed applications.

Despite efforts to date, a need remains for system(s) and/or method(s) for use in sterilizing polymer-based product(s), whether positioned within or external to their packaging, wherein such treatment regimen achieves a desired sterilization level without negatively affecting the physical properties and/or the efficacy of the underlying polymer-based product(s). A need also exists for system(s) and/or method(s) for use in sterilizing alternative products (e.g., food products such as meat and poultry, enteral and/or parenteral solutions and systems, and the like), whether positioned within or external to their packaging, wherein such treatment regimen achieves a desired sterilization level without negatively affecting the physical properties and/or the efficacy of the underlying product(s).

These and other objectives are satisfied according to the present disclosure wherein sterilization is achieved using monochromatic, continuous wave, high-intensity, incoherent light in single and/or multiple light source configurations. The disclosed treatment system(s) and method(s) advantageously achieve a desired sterilization level without negatively affecting the physical properties and/or the efficacy of the underlying product(s). These and other features/functionalities will be apparent to persons skilled in the art from the detailed description which follows.

SUMMARY OF THE DISCLOSURE

An advantageous approach for the sterilization of products, including heat sensitive materials, whether within or external to their packaging and/or packaging containers, is disclosed herein. The disclosed sterilization system(s) and method(s) are effective in inactivating viral and bacterial microorganisms without physical or performance damage to the treated product or its packaging. A single or multiple array of light sources delivers monochromatic germicidal, ambient temperature light at radiance levels of at least 200 mw/cm² to 600 mw/cm² to deactivate multiple organisms. According to exemplary embodiments of the present disclosure, products are sterilized to Sterilization Assurance Levels (SALs) of at least 10⁻⁵ cfu/ml at discrete wavelengths of 193; 222; 248; 282; 308 and 354 nm (+/- 5 nm).

The disclosed sterilization treatment regimen may be undertaken in a batch, semi-batch or continuous mode. In an exemplary embodiment of the present disclosure, target product(s), and/or container-packaged product(s) are treated continuously by positioning the product(s)/container(s) on a moving element (e.g., a belt) that is moved above, below or between one or more light sources. The rate at which the product(s)/container(s) are moved past the light source(s) may be adjusted so as to achieve the desired energy treatment level. In batch/semi-batch embodiments, the treatment time may be varied to achieve the desired energy treatment level. As noted below, additional processing parameters affect the sterilization procedure, and may be adjusted/selected (either alone or in combination with the rate/residence time) to achieve the desired sterilization result(s).

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Thus, the intensity of the monochromatic light source(s) that are employed according to the sterilization system(s) and/or method(s) of the present disclosure may be adjusted to achieve the desired sterilization results. For example, in processing systems wherein multiple light sources are employed, the individual light sources may be operated at different intensities to achieve the desired sterilization results. Light source intensity is generally selected based on the treatment algorithm for a single microorganism or suite (panel) of organisms/microorganisms. In typical treatment regimens, the panel of organisms includes, but is not limited to, *Bacillus pumilus* (spore former), *Candida albican* (yeast), lipid and non-lipid virus, *Clostridium sporogenes* (anaerobic spore former), *Staphylococcus aureus* (vegetative Gram positive), *Pseudomonas aeruginosa* (vegetative Gram negative), *Aspergillus niger* (filamentous fungi), *Mycobacterium terrae*, Porcine Parvo Virus (PPV and B19), Lysteria, and Salmonella. The sterilization treatment regimen disclosed herein is effective in treating products/packaging of varying geometries. Thus, for example, the product and/or product package may be planar, convex, concave or an alternative geometry, e.g., a geometric combination of the foregoing geometries. The light sources may be modified to achieve desired results. Thus, for example, partially coated optical surfaces may be employed, such coated surfaces being advantageously tuned to a desired monochromatic wavelength. The use of partially coated optical surfaces may be effective in generating light that satisfies spectral intensity requirements in excess of 500 mw/cm².

Additional features and functionalities associated with the disclosed sterilization system(s) and method(s) will be apparent from the detailed description which follows, particularly when viewed together with the figures appended hereto.

BRIEF DESCRIPTION OF THE FIGURES

To assist those of ordinary skill in the art to which the present disclosure appertains in making and using the disclosed sterilization system(s) and method(s), reference is made to the appended figures, wherein:

FIG. 1 is a photograph (top view) of an exemplary sterilization system/assembly for delivering monochromatic, continuous wave, high-intensity, incoherent light to products, e.g., polymer-based products, using a single light source according to the present disclosure;

FIG. 1A is a photograph (side view) of the exemplary sterilization system/assembly of FIG. 1, with the cover structure positioned in a closed position; and

FIG. 2 is a photograph (side view) of an alternative exemplary sterilization system/assembly for delivering monochromatic, continuous wave, high-intensity, incoherent light to products, e.g., polymer-based products, using dual light sources (top and bottom) according to the present disclosure.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENT(S)

According to the present disclosure, systems and methods for sterilization of products, including heat sensitive materials, whether within or external to their packaging and/or packaging containers, are provided. These systems/methods are effective in inactivating viral and bacterial microorganisms without physical or performance damage to the treated product or its packaging. A single or multiple array of light sources delivers monochromatic germicidal, ambient tem-

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perature light at irradiance levels of at least 200 mw/cm² to 600 mw/cm² to deactivate multiple organisms. According to exemplary embodiments of the present disclosure, products (e.g., packaged contact lenses) are sterilized to Sterilization Assurance Levels (SALs) of at least 10⁻⁵ cfu/ml (colony forming units/milliliter) at discrete wavelengths of 193; 222; 248; 282; 308 and 354 nm (+/-5 nm). Currently preferred wavelengths for use in sterilizing treatments of polymeric contact lens products (whether packaged or non-packaged) are 282 and 308 nm.

The disclosed sterilization treatment regimen may be undertaken in a batch, semi-batch or continuous mode. The application of monochromatic UV light using the disclosed light source(s) to inactivate viral and bacterial microorganisms in sterilizing contact lenses is a particularly attractive alternative to currently practiced sterilization methods, such as steam sterilization, because the disclosed UV radiation treatment is readily incorporated into an in-line (i.e., continuous or substantially continuous) process, in which the sterilization may be accomplished in a matter of seconds or less. In addition, the disclosed monochromatic UV light is effective for sterilization of heat sensitive materials without negatively affecting physical properties and/or performance attributes thereof. Additional performance features/functionality associated with such polymer-based products (e.g., contact lenses) that were not feasible with conventional steam sterilization (e.g., because steam sterilization damaged or destroyed such features/functionality) are potentially feasible using the disclosed monochromatic UV sterilization technique.

In an exemplary embodiment of the present disclosure, target product(s) and/or container-packaged product(s) are treated continuously by positioning the product(s)/container(s) on a moving element (e.g., a belt) that is moved above, below or between one or more light sources. For example, with reference to FIG. 2, top and bottom light sources define an intermediate region in which products (e.g., packaged contact lenses) may be transported for sterilization treatment. A variety of structures and mechanisms may be used to transport products through the intermediate region while permitting UV radiation to reach the products for sterilization purposes, e.g., conveyor belts and/or tracks of various designs and constructions. The selection and implementation of appropriate conveyor/transport systems is well within the skill of persons skilled in the art. It is further expressly noted that transport systems may be incorporated in single light source implementations of the disclosed sterilization systems, e.g., of the type depicted in FIG. 1 hereto.

The rate at which the product(s)/container(s) are moved past the light source(s) in continuous or semi-continuous embodiments of the present disclosure may be adjusted so as to achieve the desired energy treatment level. Similarly, in batch/semi-batch embodiments, the treatment time may be varied to achieve the desired energy treatment level. As noted below, additional processing parameters affect the sterilization procedure, and may be adjusted/selected (either alone or in combination with the rate/residence time and/or other processing parameters) to achieve the desired energy delivery and resultant sterilization effect(s).

Thus, the intensity of the monochromatic light source(s) that are employed according to the sterilization system(s) and/or method(s) of the present disclosure may be adjusted to achieve the desired sterilization results. For example, in processing systems wherein multiple light sources are employed, the individual light sources may be operated at different intensities and/or for different periods of time to

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achieve the desired sterilization results. A control system may be advantageously associated with the light source(s) to control operating parameters thereof. A typical control system includes a processor that is programmed to operate the light sources at desired intensity levels and for desired period(s) of time. In the case of continuous treatment regimens, the control system may also advantageously control the rate at which products pass through the treatment region, e.g., based on the speed of the conveyor/transport system. A manual over-ride is typically provided, so as to permit an operator to adjust/modify treatment parameters on an as-needed basis.

Treatment parameters, e.g., light source intensity, are generally selected based on the treatment algorithm for a single microorganism or suite (panel) of organisms/microorganisms. In typical treatment regimens, the panel of organisms includes, but is not limited to, *Bacillus pumilus* (spore former), *Candida albican* (yeast), lipid and non-lipid virus, *Clostridium sporogenes* (anaerobic spore former), *Staphylococcus aureus* (vegetative Gram positive), *Pseudomonas aeruginosa* (vegetative Gram negative), *Aspergillus niger* (filamentous fungi), *Mycobacterium terrae*, Porcine Parvo Virus (PPV and B19), Lysteria, and Salmonella. Additional and/or alternative organisms may be utilized, in whole or in part, in developing and implementing an appropriate treatment regimen, as will be readily apparent to persons skilled in the art. Sterilization treatment regimens utilizing monochromatic germicidal, ambient temperature light, as disclosed herein, are effective in treating products/packaging of varying geometries. Thus, for example, the product and/or product package may be planar, convex, concave or an alternative geometry, e.g., a geometric combination of the foregoing geometries. The light sources may be modified to achieve desired sterilization results. Thus, for example, partially coated optical surfaces may be employed, such coated surfaces being advantageously tuned to a desired monochromatic wavelength. The use of partially coated optical surfaces may be effective in generating light that satisfies spectral intensity requirements in excess of 500 mw/cm².

Light source systems according to the present disclosure emit light over a large active area and are advantageously configured to operate at ambient temperatures. The substantially monochromatic output of these sources can be tuned to produce high spectral irradiance (watts/nm) within peaks of the process action spectra to maximize the germicidal effectiveness (or other desired process/application) as a function of the required biological objective. The range of available geometries (including coaxial sources radiating either inwardly or outwardly, and planar sources emitting from one or both sides) and the capability to independently adjust irradiance and total power provide significant flexibility in system design and allow for more efficient light delivery systems.

With particular reference to FIGS. 1 and 1A, exemplary treatment system 100 includes a base structure 102 and a cover structure 104. Cover structure 104 is hingedly mounted with respect to base structure 102 and includes a handle 106 to facilitate repositioning thereof (i.e., opening/closing). FIG. 1 shows cover structure 104 in an "open" position, and FIG. 1A shows cover structure 104 in a "closed" position. Cover structure 104 is typically fabricated from a material that is effective in filtering/shielding the light rays produced by the light source so as to protect operators and others in the vicinity of treatment system 100. Thus, the size and geometry of cover structure 104 is typically selected so as to permit positioning of product(s) in an

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appropriate treatment position relative to the light source, while ensuring that the emitted light rays are filtered/shielded thereby.

Treatment system 100 includes a light source 108 positioned within base structure 102 that is designed to generate and emit monochromatic germicidal, ambient temperature light through treatment windows 110a, 110b. Light source 108 is an excimer light source that generally produces 90% of its output within a 10 nm band that can be discretely adjusted across the VUV, UV-A, UV-B and UV-C by changing the rare and/or halogen gases used. Efficiencies vary with gas mix and geometry from 10% to >30% with demonstrated input powers from <1 watt to >10 kW. The overall design and operation of exemplary light sources for use in the disclosed system are disclosed, described and depicted in commonly assigned patent applications, Ser. No. 09/805,610 (filed Mar. 13, 2001; published as U.S. Pat. Ser. No. 2002-0177118 A1) and Ser. No. 10/661,262 (filed Sep. 12, 2003) (the "Prior Applications"), the entire contents of which are hereby incorporated by reference in their entireties. For example, the Prior Applications disclose and describe exemplary flow patterns/arrangements for the introduction and withdrawal of cooling fluids (e.g., see tubing/hoses in FIGS. 1 and 1A), exemplary treatment window designs and the like, each of which is visually apparent in FIG. 1 and/or FIG. 1A.

According to exemplary embodiments of the disclosed systems, an appropriate fluid is used to maintain the light source(s) at a desired temperature and/or within a desired temperature range. Water is a preferred heat exchange medium for dissipating/absorbing heat generated through operation of the light source(s). However, alternative cooling fluids may be employed, as will be apparent to persons skilled in the art. In selecting an appropriate cooling fluid, it is desirable to select a fluid that, in use, is substantially transparent to the germicidal radiation to be passed through. Of note, it is also desirable to select a fluid that is not susceptible to bubble generation and/or bubble propagation, because the presence/formation of bubbles can undesirably scatter germicidal radiation and negatively effect the sterilization efficiency and/or effectiveness of the disclosed system. Thus, precautions may be advantageously taken to minimize and/or prevent bubble formation/propagation in cooling fluid use, e.g., through the use of appropriate additives or the like.

Thus, in use, products for sterilization, e.g., contact lens products, medical products and/or components, food products and the like (whether packaged or non-packaged) are positioned above a window 110a, 110b, the cover structure 106 is "closed" so as to shield the treatment region, and the light source 108 is energized to deliver monochromatic germicidal, ambient temperature light thereto. The light source is advantageously maintained at a substantially controlled temperature through heat transfer/heat exchange modalities, as described in the Prior Applications. As noted above, the Prior Applications are incorporated herein by reference in their entireties.

With reference to FIG. 2, a further exemplary treatment system 200 is depicted. System 200 includes a first (upper) light source housing 202 and a second (lower) light source housing 204. Light sources (not visible) are positioned within housings 202, 204 and are advantageously maintained at a substantially constant temperature utilizing heat transfer/heat exchange modalities, as described in the Prior Applications. A treatment region 206 is defined between housings 202, 204. Treatment windows (not visible) are defined in the first and second housings 202, 204, such that

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monochromatic germicidal light from the respective light sources may reach products within treatment region 206.

A conveyor/transport system (not visible) is advantageously provided for transporting products through treatment region 206, i.e., between housings 202, 204. According to exemplary embodiments of the present disclosure, the conveyor may advance the products through treatment region 206 in a fixed orientation relative to the light source(s). Alternatively, it may be desirable to include structure(s) and/or mechanism(s) that are effective to cause repositioning of the products relative to the light source(s) as they pass through the treatment region. For example, in the case of thick and/or irregularly shaped products, it may be desirable to effect rotation of the products at one or more points within the treatment region. Effective structure(s) and/or mechanism(s) for effecting reorientation of the products within the treatment region may be associated with the conveyor, with the upper and/or lower housings, or a combination thereof. The repositioning of the products may be effected in a substantially random fashion, e.g., by providing diverter walls or the like, or may be effected in a controlled fashion, e.g., through controlled robotics or the like. In any case, the inclusion of a repositioning mechanism may be desirable to provide efficient and reliable sterilization treatments to products of various sizes and geometries.

The distance between upper housing 202 and lower housing 204 is generally selected to permit passage of desired products therebetween with minimal clearance. According to exemplary embodiments of the present disclosure, the spacing between housings 202, 204 may be adjusted, e.g., by repositioning at least one of housings 202, 204 relative to the other housing. Thus, for example, upper housing 204 may be supported by a frame structure that permits/facilitates vertical repositioning thereof relative to lower housing 202 (e.g., through manual or powered repositioning of upper housing 204). As noted previously, the light source within upper housing 204 may be designed/configured to deliver monochromatic light having different characteristics relative to the light source within lower housing 202. Thus, the dual light source arrangement of FIG. 2 further enhances the flexibility/versatility of the disclosed sterilization regimens according to the present disclosure.

According to the present disclosure, a sterilization assurance level (SAL) of 10^{-6} may be achieved for inoculated product and packaging that include a panel that may include (but are not limited to) *Bacillus pumilus* (spore former), *Candida albican* (yeast), lipid and non-lipid virus, *Clostridium sporogenes* (anaerobic spore former), *Staphylococcus aureus* (vegetative Gram positive), *Pseudomonas aeruginosa* (vegetative Gram negative), *Aspergillus niger* (filamentous fungi), *Mycobacterium terrae*, Porcine Parvo Virus (PPV and B19), Lysteria, Salmonella. In achieving the foregoing SAL, the overall performance properties of the sterilized products (whether packaged or non-packaged), e.g., contact lenses or the like, are not materially affected.

In operating the disclosed sterilization treatment systems, numerous processing variables and/or product properties may influence the effectiveness of the sterilization treatment and/or the associated product survivability criteria (i.e., post-sterilization product performance and/or efficacy). For example, exemplary processing variables and product properties that may require consideration in developing appropriate/optimal processing parameters for contact lenses include:

Power delivery to light sources (Power is directly related to the UV radiation dose delivered to products)

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Treatment time (Treatment time is directly related to the UV radiation dose delivered to products)

Base Curve of contact lenses to be treated (Base curve radius may influence the desired/optimal UV radiation dose)

Diameter of contact lenses to be treated (Diameter may influence the desired/optimal UV radiation dose)

Oxygen Permeability of contact lenses (Oxygen permeability may influence the desired/optimal UV radiation dose)

Equilibrium Water Content of contact lenses (Equilibrium water content may influence the desired/optimal UV radiation dose)

Modulus of contact lenses (Modulus may influence the desired/optimal UV radiation dose)

Elongation at break of contact lenses (Elongation at break may influence the desired/optimal UV radiation dose)

Tensile Strength of contact lenses (Tensile strength may influence the desired/optimal UV radiation dose)

Toughness modulus of contact lenses (Toughness modulus may influence the desired/optimal UV radiation dose)

Although the present disclosure has been described with reference to exemplary embodiments thereof, it is to be understood that the disclosure is not limited thereto. Rather, the systems and methods disclosed herein encompass modifications, enhancements and/or variations that will be readily apparent to persons skilled in the art, based on a review of the present disclosure, including specifically the Prior Applications incorporated herein by reference in their entireties.

The invention claimed is:

1. Apparatus for sterilization of ophthalmic products such as contact lenses comprising non-attenuated, monochromatic, continuous wave, high intensity, incoherent light source means including cooling fluid to maintain same within a desired temperature range, a housing enclosing no more than one light source means therein, without additional means for cooling said enclosed light source means, said housing having a wall with substantially planar, substantially transparent section defining a treatment area within which the product to be sterilized is situated, and means for covering said treatment area when said light source means is energized.

2. The apparatus of claim 1 wherein said light source means comprises a bounded volume of photon-producing gas.

3. The apparatus of claim 1 wherein said light source generates light with wavelengths of 193, 222, 248, 282, 308 and 354 nm, in a sterilization dosage.

4. Apparatus for sterilization of ophthalmic products such as contact lenses comprising first and second non-attenuated, mono-chromatic, continuous wave, high intensity, incoherent light source means, each including cooling fluid to maintain same within a desired temperature range, first and second housings each respectively enclosing no more than one light source means therein, without additional means for cooling said enclosed light source, each of said housings having a wall with a substantially planar, substantially transparent section, said housings being situated in spaced relation, with said planar transparent sections of each facing each other, so as to define a treatment area therebetween and means for retaining the product to be sterilized in said treatment area.

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5. The apparatus of claim 4 wherein said product retaining means comprises means for moving said product through said treatment area.

6. The apparatus of claim 4 wherein each of said light source means comprises a bounded volume of photon-producing gas.

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7. The apparatus of claim 4 wherein each of said light source means generates light with wavelengths of 193, 222, 248, 282, 308 and 354 nm, in a sterilization dosage.

* * * * *

ANEXO 3



(12) **United States Patent**
Aiki et al.

(10) **Patent No.: US 6,703,785 B2**
(45) **Date of Patent: Mar. 9, 2004**

(54) **NEGATIVE ION GENERATOR**

FOREIGN PATENT DOCUMENTS

(75) Inventors: **Yoshiaki Aiki, Tokyo (JP); Wakao Sakamoto, Aomori (JP)**
(73) Assignee: **Andes Electric Co., Ltd., Aomori Prefecture (JP)**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

Primary Examiner—David Vu
(74) *Attorney, Agent, or Firm—Wenderoth, Lind & Ponack, L.L.P.*

(21) Appl. No.: **10/173,882**

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(52) **U.S. Cl.** **315/111.81; 310/318**

(58) **Field of Search** **313/325; 315/363, 315/111.81, 111.91, 209 PZ; 310/318**

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(57) **ABSTRACT**

A negative ion generator, which can suppress positive ion generation, permits ready control of a quantity of generated negative ions and permits a size and thickness reduction. The negative ion generator is of an electron emission type in which, for negative ion generation, electrons are emitted into the air by impressing a negative high voltage on a stylus electric discharge electrode. A piezoelectric transformer is used for amplifying a non-rectified drive voltage from a transformer drive circuit. As a result of rectification of the AC high voltage from the piezoelectric transformer, a negative high voltage is obtained, which is impressed on the stylus electric discharge electrode for electron emission therefrom, thereby generating negative ions in the air.

5 Claims, 2 Drawing Sheets

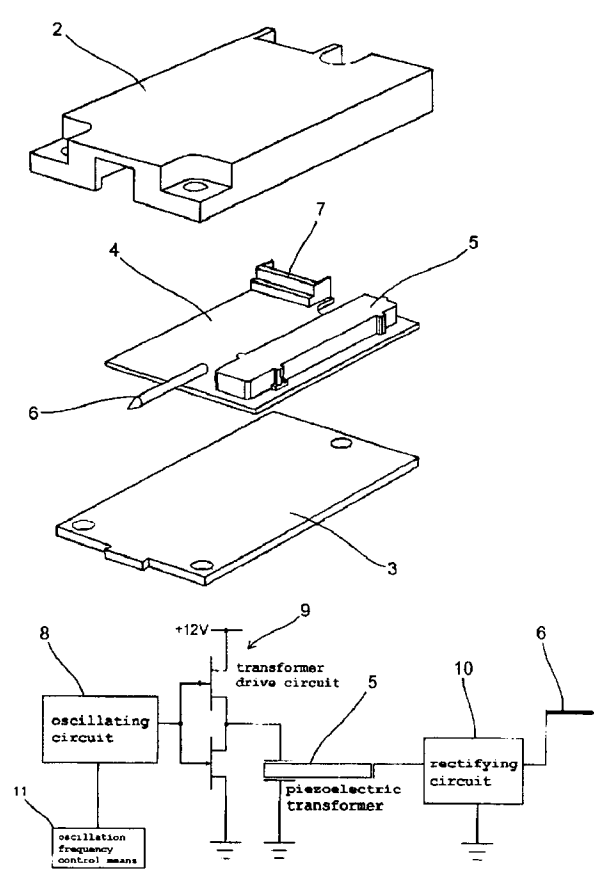


Fig. 1

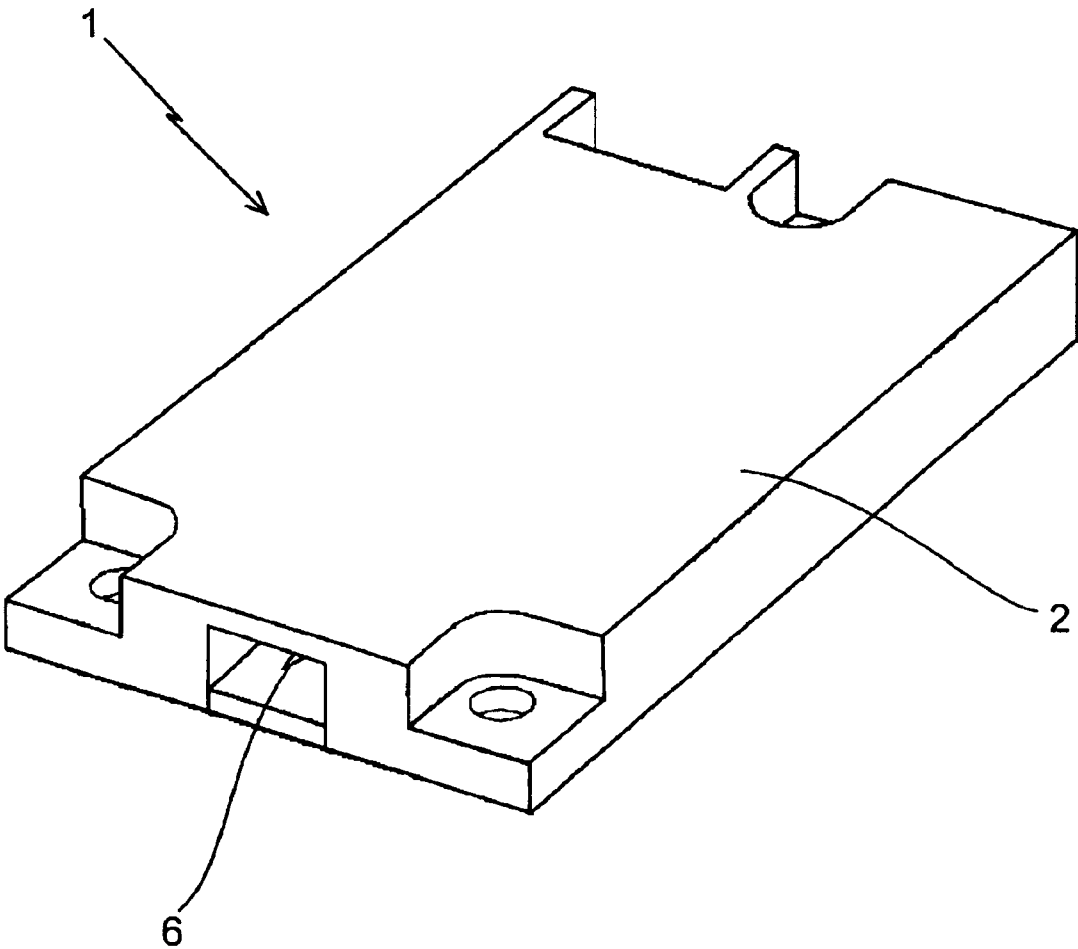


Fig. 2

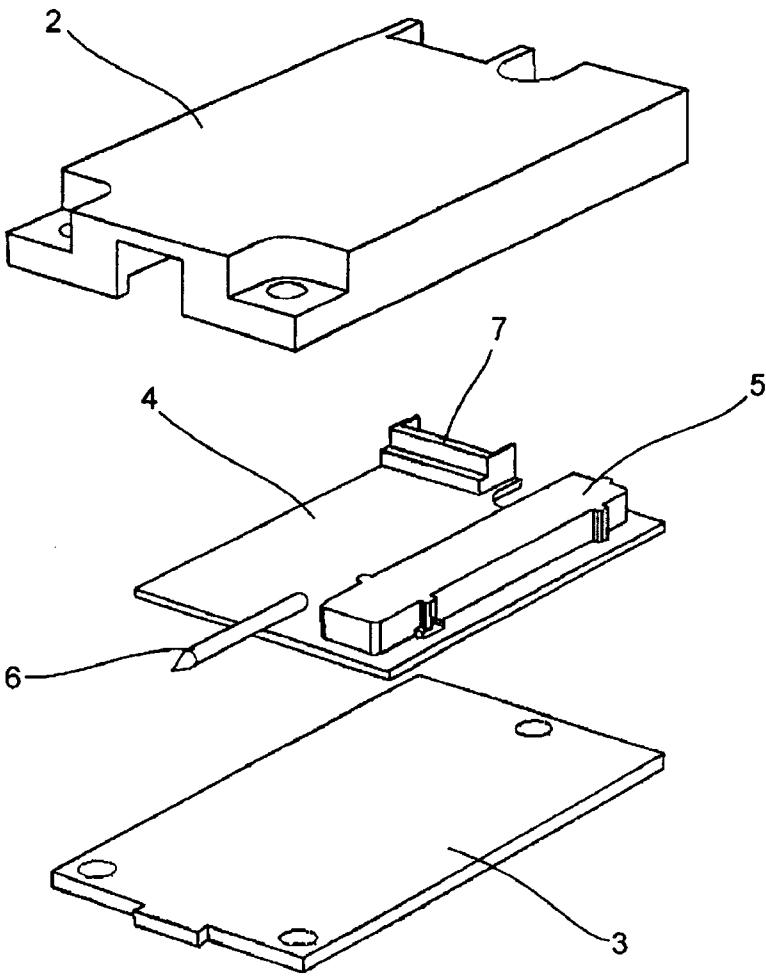
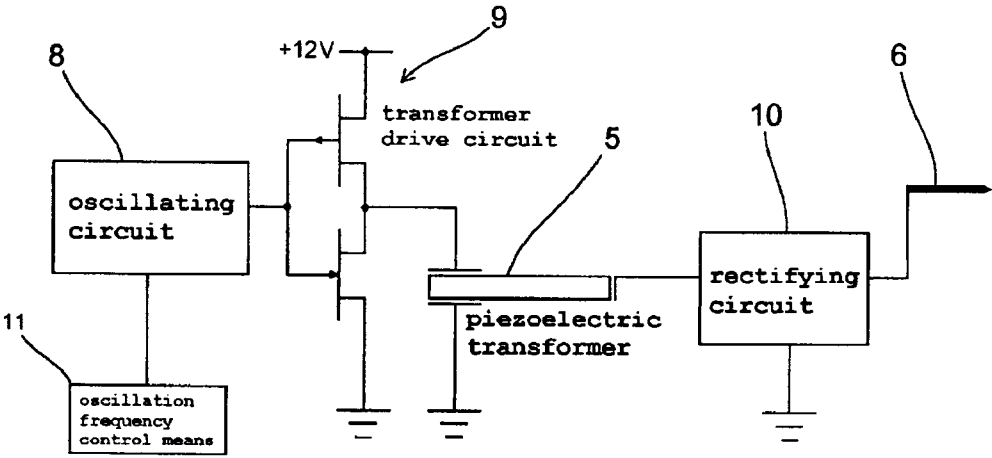


Fig. 3



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NEGATIVE ION GENERATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to negative ion generators for adequately generating negative ions by negatively charging gas molecules, such as oxygen molecules or fine particles in air.

2. Prior Art

Recently, negative ions are attracting attention in that they can provide a good influence on the living body, such as a healthy effect of preventing oxidization of the human body, an effect of holding the freshness of foodstuff and a deodorizing effect. Various types of negative ion generators are thus present, which can generate negative ions by negatively charging gas molecules, such as oxygen molecules and fine particles in air. A high voltage generation circuit in such a negative ion generator uses a ferrite high voltage transformer, which has a coil wound on an iron core, and performs electromagnetic coupling amplification by electromagnetic induction.

However, the high voltage transformer of coil type in the prior art negative ion generator generates an electromagnetic wave when performing the electromagnetic coupling amplification, and this electromagnetic wave is a cause of generating positive ions, which have adverse effects, such as oxidizing effects, on the living body. In other words, the prior art negative ion generator has a contradiction that despite it generates negative ions, it also generates a considerable number of positive ions, which cancel negative ions and have adverse effects, such as oxidizing the living body. In addition, limitations are imposed on the size and thickness reduction of the coil type high voltage transformer because of such reasons as the necessity of ensuring breakdown voltage. Therefore, it has been impossible to meet market demands for size and thickness reduction of the negative ion generator for the mounting thereof in various apparatuses. Furthermore, in order that the quantity of generated negative ions is variable, a voltage varying circuit for varying the drive voltage inputted to the transformer is necessary, and the number of circuit components is inevitably increased.

SUMMARY OF THE INVENTION

The invention, accordingly, has an object of providing a negative ion generator, which can suppress the generation of positive ions, permits ready control of the quantity of generated negative ions and permits size and thickness reduction. To attain this object, an electron emission type negative ion generator is provided which emits electrons into air when a negative high voltage is impressed on stylus electric discharge electrode. This negative ion generator uses a piezoelectric transformer for amplifying a non-rectified drive voltage from a transformer drive circuit. An AC high voltage from the piezoelectric transformer is rectified to obtain a negative high voltage, which is impressed on the stylus electric discharge electrode for electron emission wherefrom, thereby generating negative ions in air.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing a negative ion generator according to the invention;

FIG. 2 is an exploded perspective view showing the negative ion generator according to the invention; and

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FIG. 3 is a schematic circuitry diagram of the negative ion generator according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1 and 2 show the construction of a negative ion generator according to the invention. The illustrated negative ion generator 1 is a module comprising a thin and small casing with dimensions of 44×77×6 mm, a base member 4 accommodated in a casing 3, a piezoelectric transformer 5, a stylus electric discharge electrode 6, a drive circuit (not shown) and an input/output terminal 7 which is connected to a power supply and also to external circuitry. This negative ion generator 1 can be assembled as a negative ion generator module in various apparatus and facilities, such as air cleaners and foodstuff stock warehouses.

FIG. 3 is a circuit diagram showing the negative ion generator 1. The negative ion generator 1 has an oscillating circuit 8 using a compact timer IC as oscillating means. The oscillating circuit 8 generates a signal at a frequency of, for instance, 75 kHz as resonant frequency of the piezoelectric transformer 5 (which is determined by the length direction dimension) or the neighborhood (± 5 kHz) of the resonant frequency. This signal is inputted to a transformer drive circuit 9, which is constituted by a field-effect transistor, and in turn, outputs an AC voltage for driving the piezoelectric transformer 5.

The piezoelectric transformer 5 is a small, thin and highly efficient transformer. As an example, the piezoelectric transformer 5 has a structure comprising a thin and elongate rectangular piezoelectric ceramic body, input electrodes formed on opposite side surfaces of a length direction one half of the ceramic body and output electrodes formed on the end surfaces of the ceramics body opposite the input electrodes. When an AC voltage in the neighborhood of the resonant frequency of the transformer drive circuit 9 is impressed on the input electrodes, the piezoelectric ceramic body undergoes mechanical oscillations due to the inverse piezoelectric effect, and due to the piezoelectric effect, the mechanical oscillations appear as high voltage at the output electrodes. This high voltage is outputted.

A rectifying circuit 10 rectifies the high voltage output from the output electrodes of the piezoelectric transformer 5 to a negative high voltage of -1.0 to -6.0 kV. This negative high voltage is impressed on the stylus electric discharge electrode 6, which emits electrons from its tip. In this way, negative ions are generated. The quantity of generated negative ions can be set as desired in a range of 1,000 to 2,000,000 ions/cc.

An oscillation frequency control means 11 controls the quantity of generated negative ions. Specifically, the oscillation frequency control means 11 is a variable resistor (of $105\text{ k}\Omega \pm 5\text{ k}\Omega$, for instance), which is provided at an oscillation frequency control terminal of the timer IC in the oscillating circuit 8. By varying the resistance of the variable resistor, the frequency of the signal outputted from the timer IC in the oscillating circuit 8 can be varied in a range of $75\text{ kHz} \pm 5\text{ kHz}$. By varying the AC voltage for driving the piezoelectric transformer 5 in a range of $75\text{ kHz} \pm 5\text{ kHz}$, the high voltage output of the piezoelectric transformer 5 can be varied greatly according to the deviation from the resonant frequency. In this way, the quantity of generated negative ions can be greatly varied in the range of 1,000 to 2,000,000 ions/cc.

In the above embodiment, the timer IC used the oscillation frequency control means 11 for varying the negative

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high voltage, which is impressed on the stylus electric discharge electrode 6. However, this is by no means limitative. For instance, it is possible to adopt pulse width control as another control method in the timer IC, that is, a variable resistor may be provided at a pulse width control terminal of the timer IC for varying the pulse width of the output signal, thereby varying the magnitude of the AC voltage inputted to the piezoelectric transformer.

As has been described in the foregoing, the negative ion generator according to the invention, which is an electron emission type negative ion generator for generating negative ions by the emission of electrons from the stylus electric discharge electrode into the air with a negative high voltage applied to the electric discharge electrode, uses the piezoelectric transformer as a means for outputting a non-rectified AC high voltage for generating the negative high voltage. Thus, it is possible to suppress and eliminate adverse effects of positive ion generation in the coil type transformer used for the prior art negative ion generator, and also realize a size and thickness reduction of the apparatus.

In addition, for driving the piezoelectric transformer, the timer IC is used as an oscillating means for generating an AC voltage in the neighborhood of the resonant frequency of the piezoelectric transformer. Thus, the oscillating means can be constructed with a small number of components and be reduced in size, thus contributing to the size and thickness reduction of the negative ion generator.

Furthermore, the timer IC is provided with the oscillation frequency adjusting means for adjusting the frequency. The oscillation frequency adjusting means causes variation of the frequency of the AC voltage impressed on the piezoelectric transformer for the driving thereof, that is, causes frequency deviation from the resonant frequency of the piezoelectric transformer, thus varying the negative high voltage impressed on the stylus electric discharge electrode. Thus, unlike the prior art, no large-scale voltage varying circuit is necessary, and deviation of the frequency of the AC voltage for driving the piezoelectric transformer from the resonant frequency thereof is caused by using the sole variable resistor, thereby permitting great variation of the output

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voltage from the piezoelectric transformer. It is, thus, possible to make the voltage varying circuit compact for reducing the size and thickness of the negative ion generator.

What is claimed is:

1. A negative ion generator for generating negative ions by electron emission into air, said negative ion generator comprising:

- a piezoelectric transformer operable to output a non-rectified AC high voltage;
- a rectifying circuit operable to generate a negative high voltage from the non-rectified AC high voltage from said piezoelectric transformer;
- a discharge electrode connected to said rectifying circuit and adapted to emit electrons;
- an oscillating circuit operable to generate a signal having a frequency in a neighborhood of a resonant frequency of said piezoelectric transformer for controlling a frequency of an AC voltage to drive said piezoelectric transformer; and
- an oscillation frequency controller operable to deviate the frequency of the signal of said oscillating circuit applied to said piezoelectric transformer from the resonant frequency of said piezoelectric transformer such that the negative high voltage applied to said discharge electrode is varied.

2. A negative ion generator as recited in claim 1, wherein said oscillation circuit comprises a timer IC.

3. A negative ion generator as recited in claim 1, wherein said oscillation frequency controller comprises a variable resistor.

4. A negative ion generator as recited in claim 1, wherein said discharge electrode is a stylus electric discharge electrode.

5. A negative ion generator as recited in claim 1, further comprising a transformer drive circuit connected between said oscillating circuit and said piezoelectric transformer, said transformer drive circuit being operable to supply the AC voltage to drive said piezoelectric transformer.

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US006464715B1

(12) **United States Patent**
Gysens et al.

(10) **Patent No.: US 6,464,715 B1**
(45) **Date of Patent: Oct. 15, 2002**

(54) **INTENSIVE MULTIDIRECTIONAL
PHOTOTHERAPY DEVICE**
(75) **Inventors: Lucien Gysens; Marie Yvonne
Wauters, both of Charleroi (BE)**
(73) **Assignee: Medestime S.A., Charleroi (BE)**

(*) **Notice:** Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

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(22) **PCT Filed: Oct. 30, 1998**
(86) **PCT No.: PCT/BE98/00164**
§ 371 (c)(1),
(2), (4) **Date: Aug. 15, 2000**
(87) **PCT Pub. No.: WO99/22813**
PCT Pub. Date: May 14, 1999

(30) **Foreign Application Priority Data**
Oct. 30, 1997 (BE) 9700872
(51) **Int. Cl.⁷ A61N 5/006**
(52) **U.S. Cl. 607/91; 607/88; 607/93;
600/22; 237/3; 237/14; 200/61; D24/163**
(58) **Field of Search 607/88-94, 96,
607/100-103, 108, 112; 600/21, 22; 237/3,
14, 2 A; 435/809; D24/163; 200/61; 119/311,
319**

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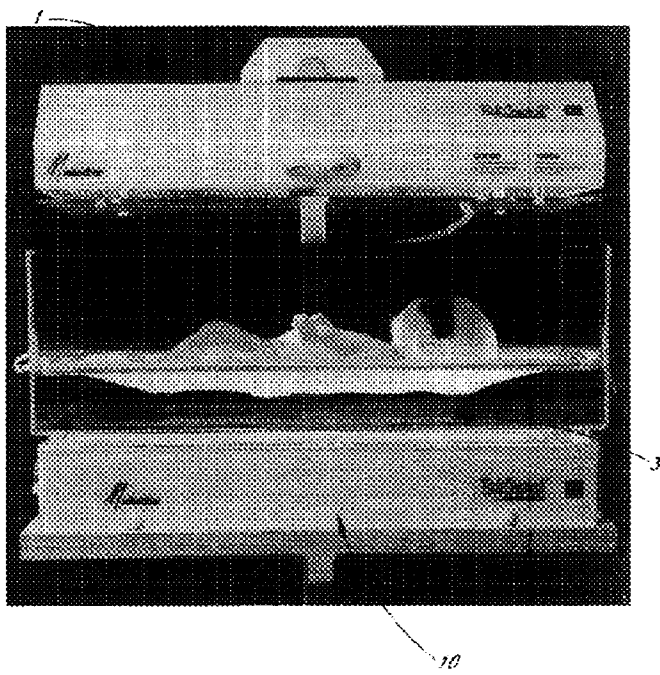
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Primary Examiner—Linda C. M. Dvorak
Assistant Examiner—Ahmed Farah
(74) *Attorney, Agent, or Firm*—Knobbe, Martens, Olson &
Bear, LLP

(57) **ABSTRACT**

Disclosed is a phototherapy device for treating icterus in
new-born patients, comprising a light box with at least one
light source arranged in the box for illuminating the patient
and a support for the patient to be placed upon which is at
least partially transparent or tinted as to allow the light from
the light box to expose the patient from below with respect
to its direction of gravity, making it possible to expose areas
having a high bilirubin concentration which tend to follow
the direction of gravity.

19 Claims, 7 Drawing Sheets

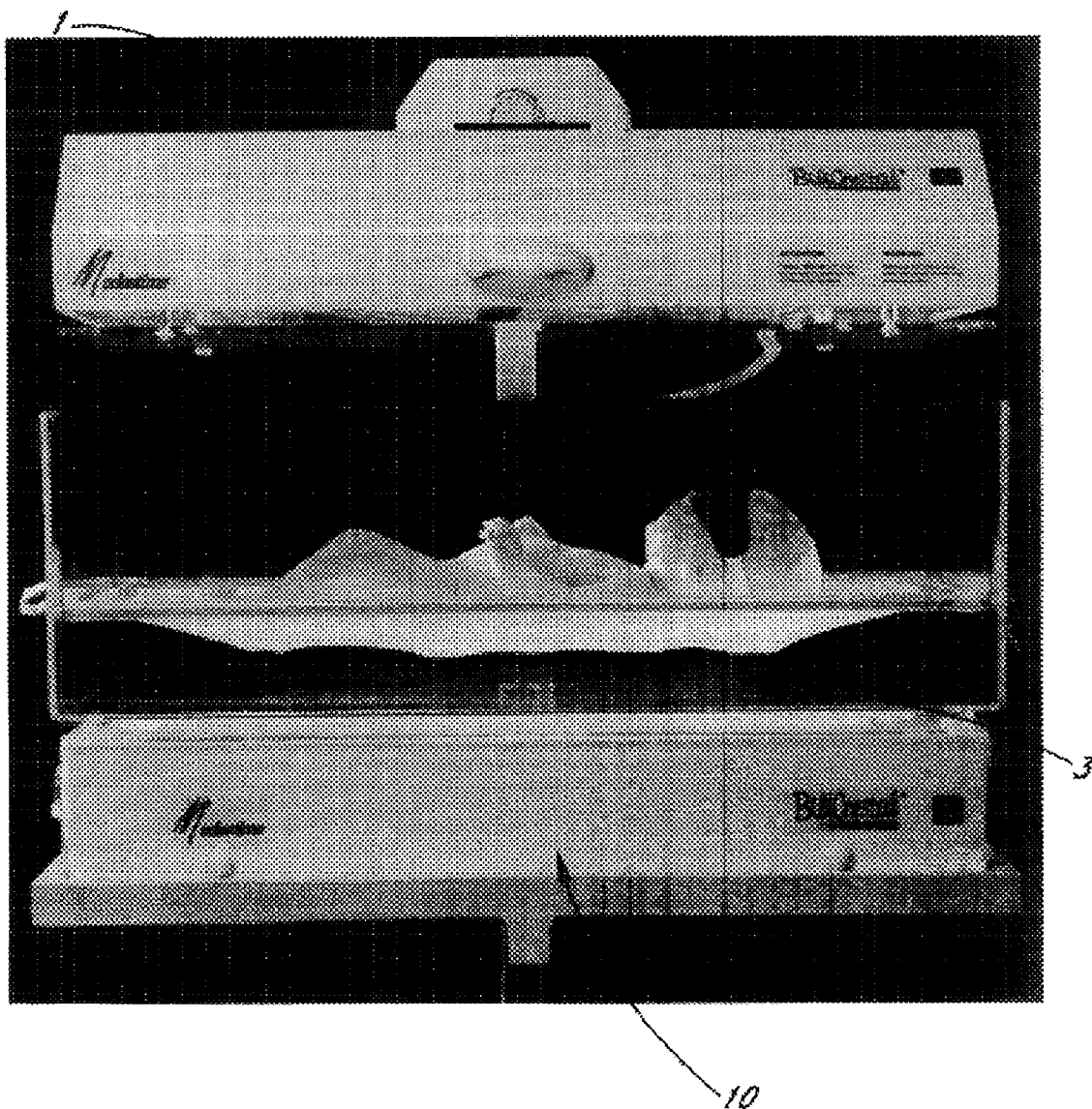


U.S. Patent

Oct. 15, 2002

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*FIG. 1*

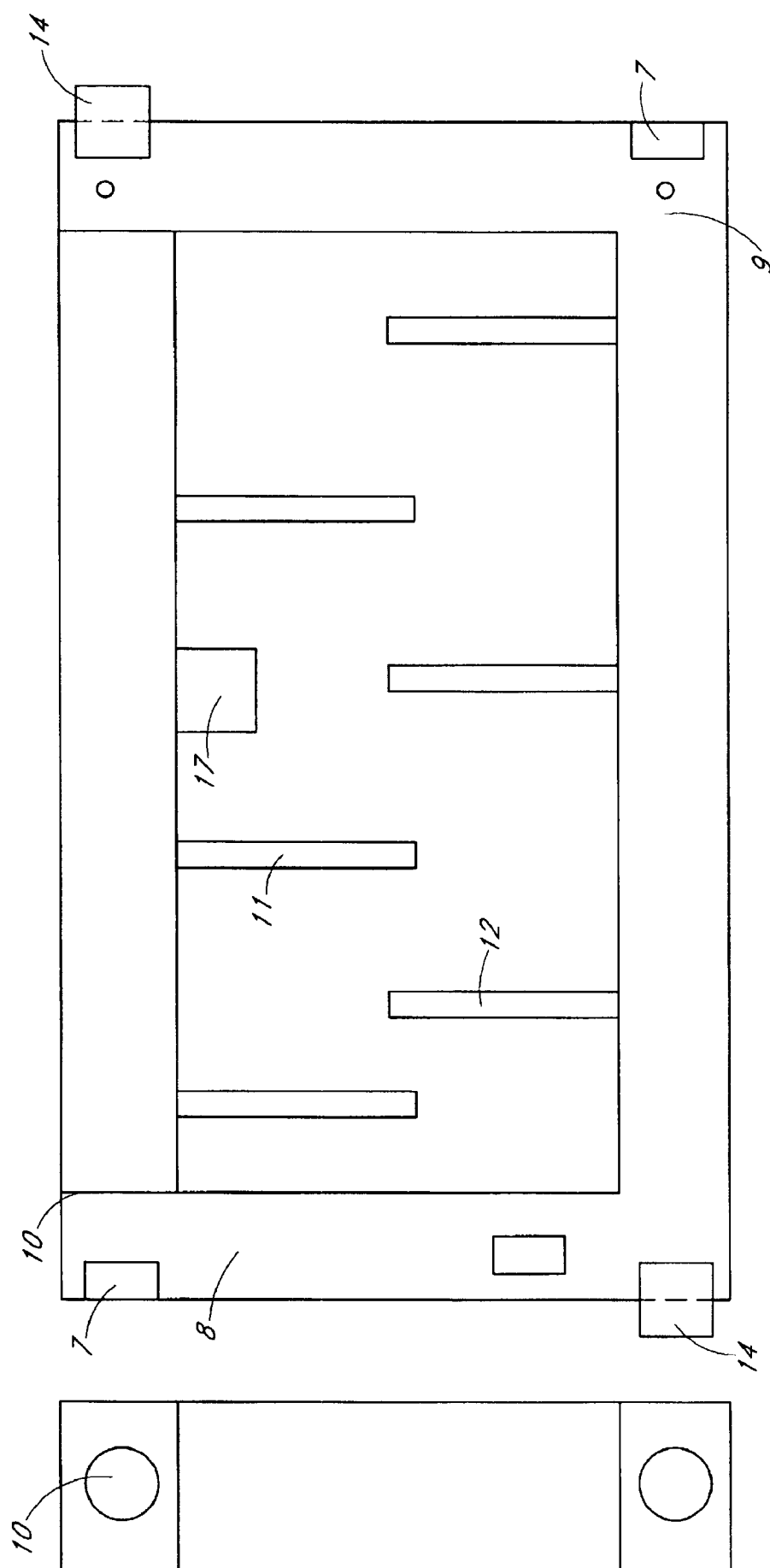
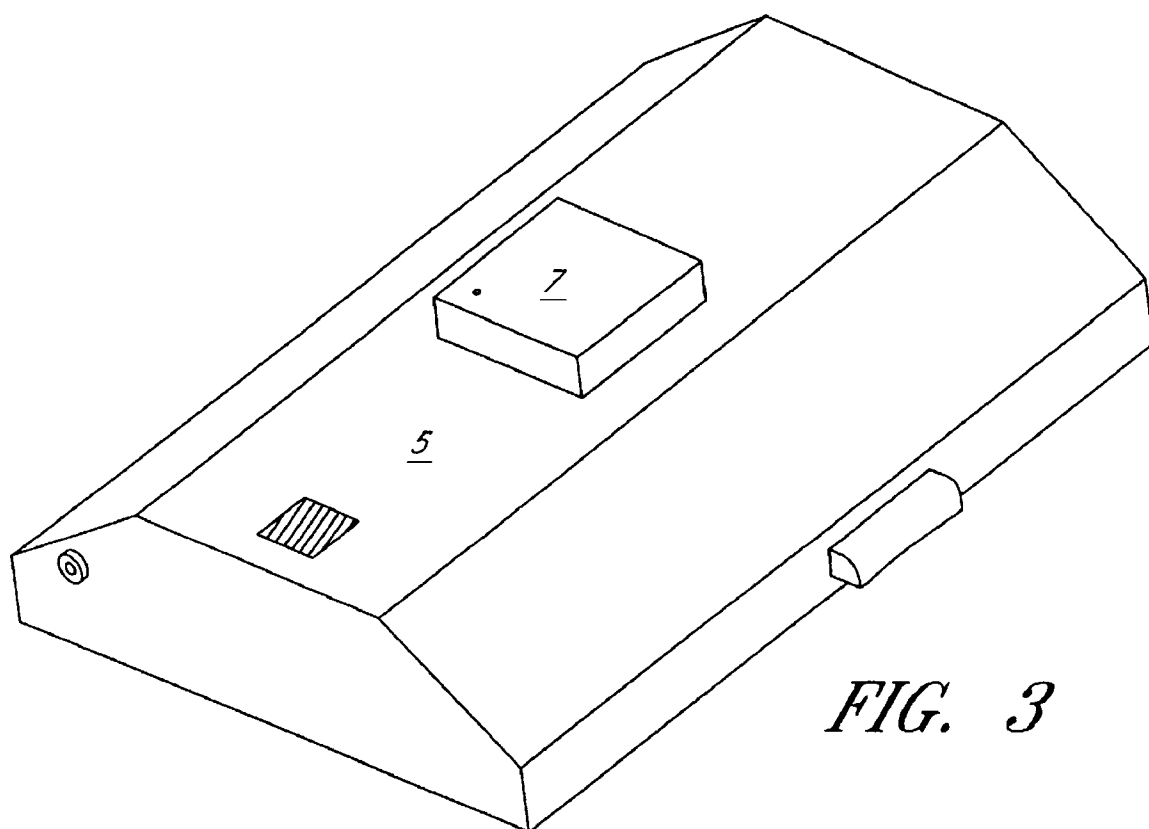
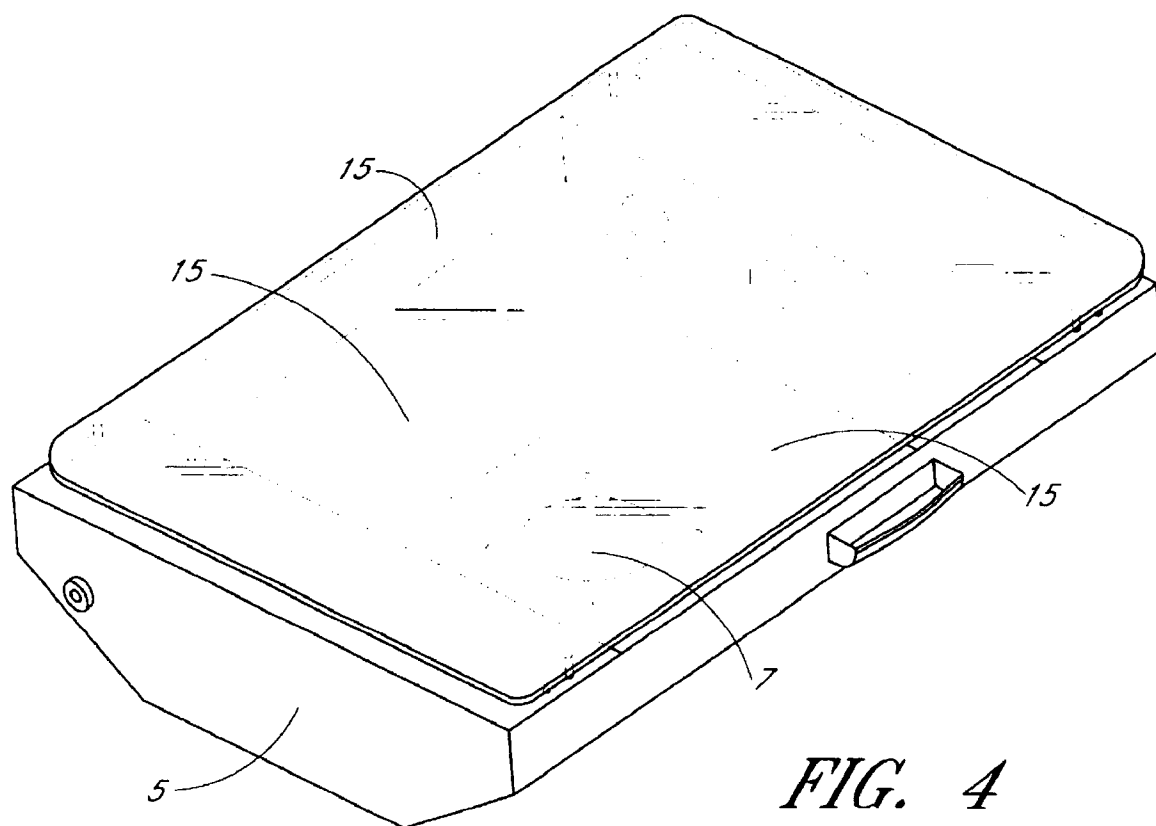
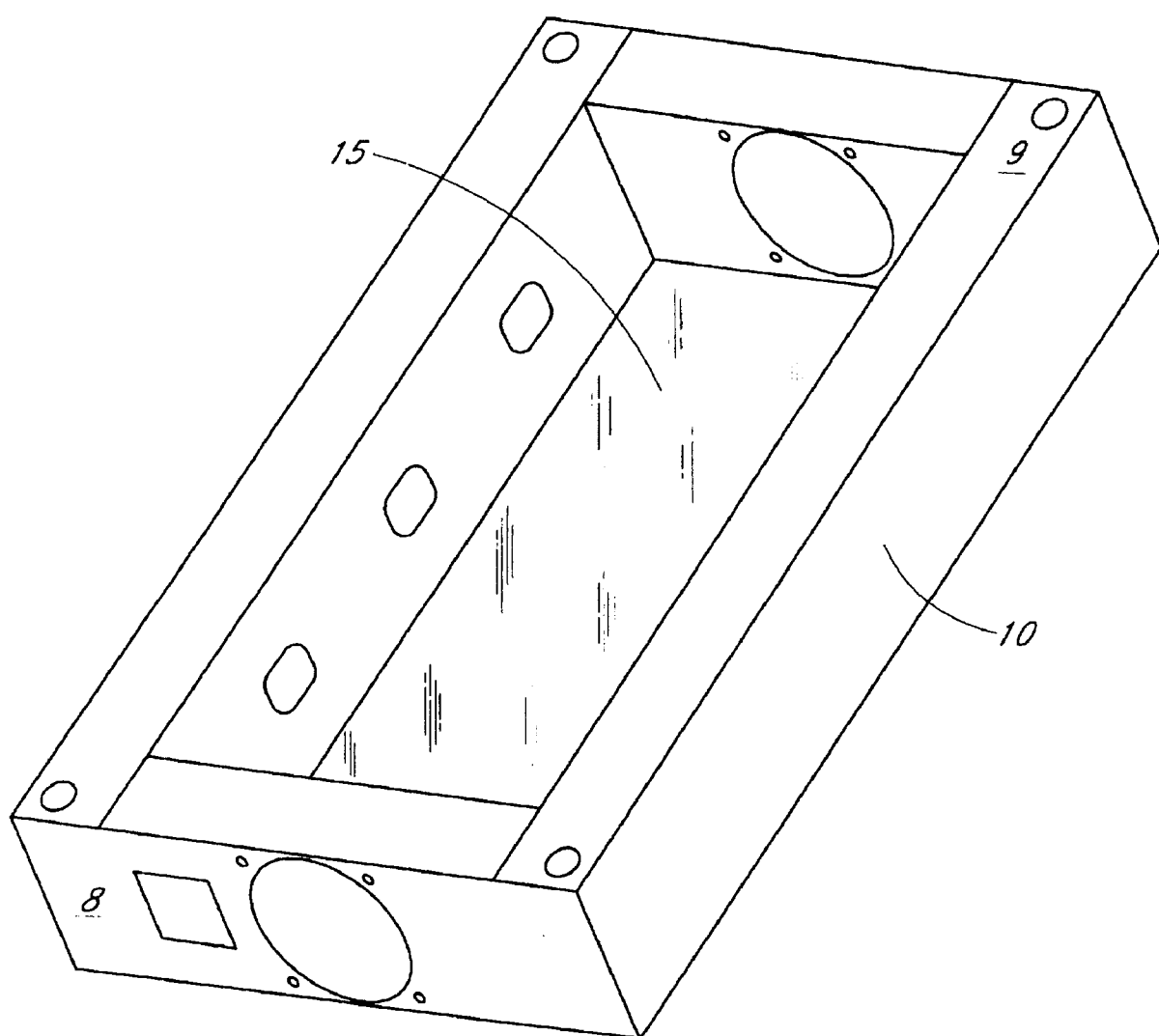


FIG. 2

*FIG. 3**FIG. 4*

*FIG. 5*

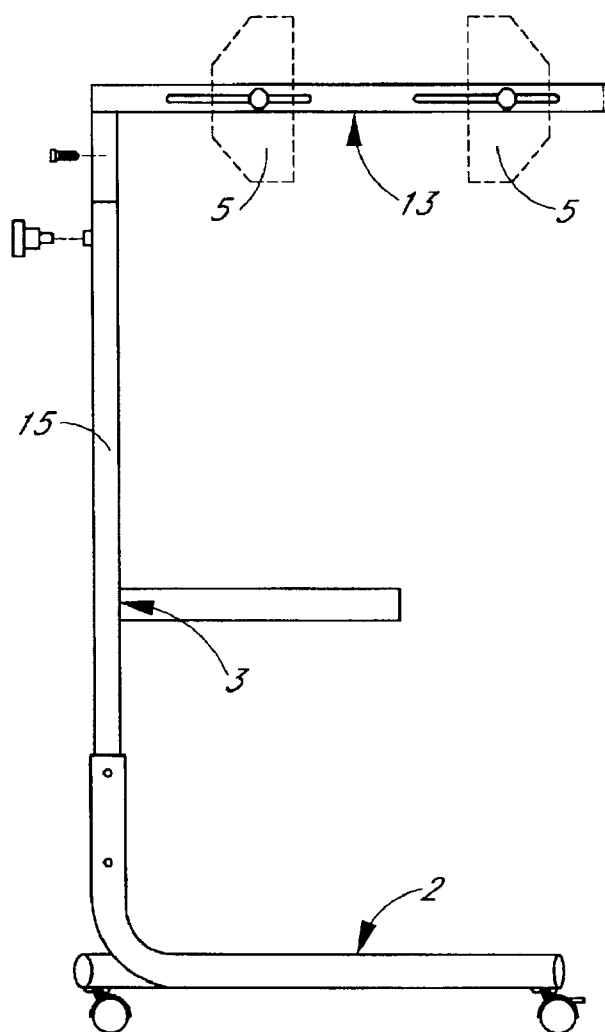


FIG. 6

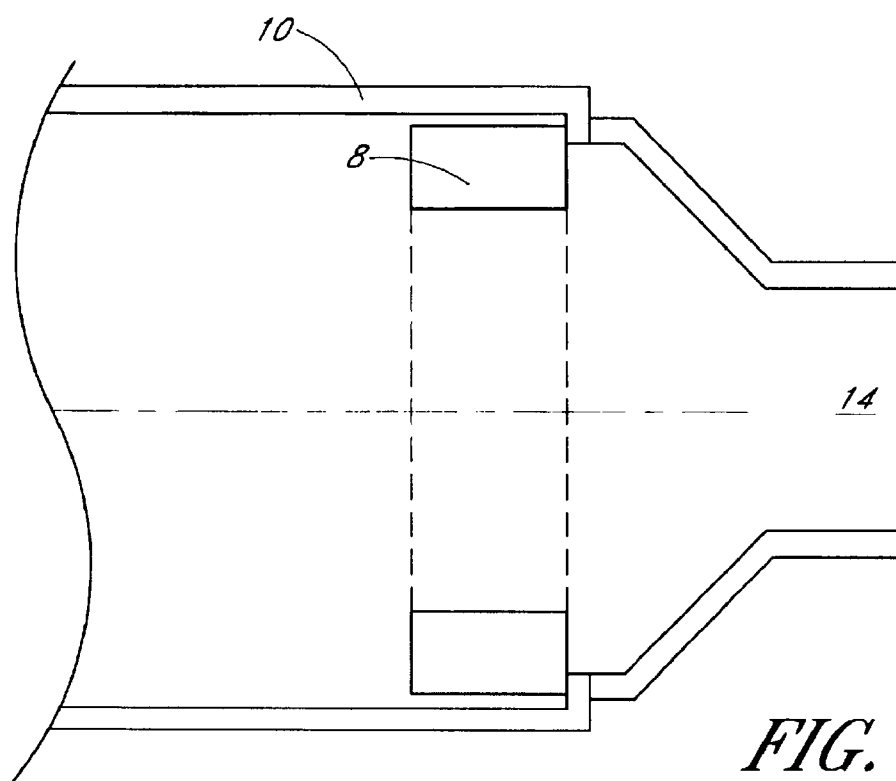


FIG. 7

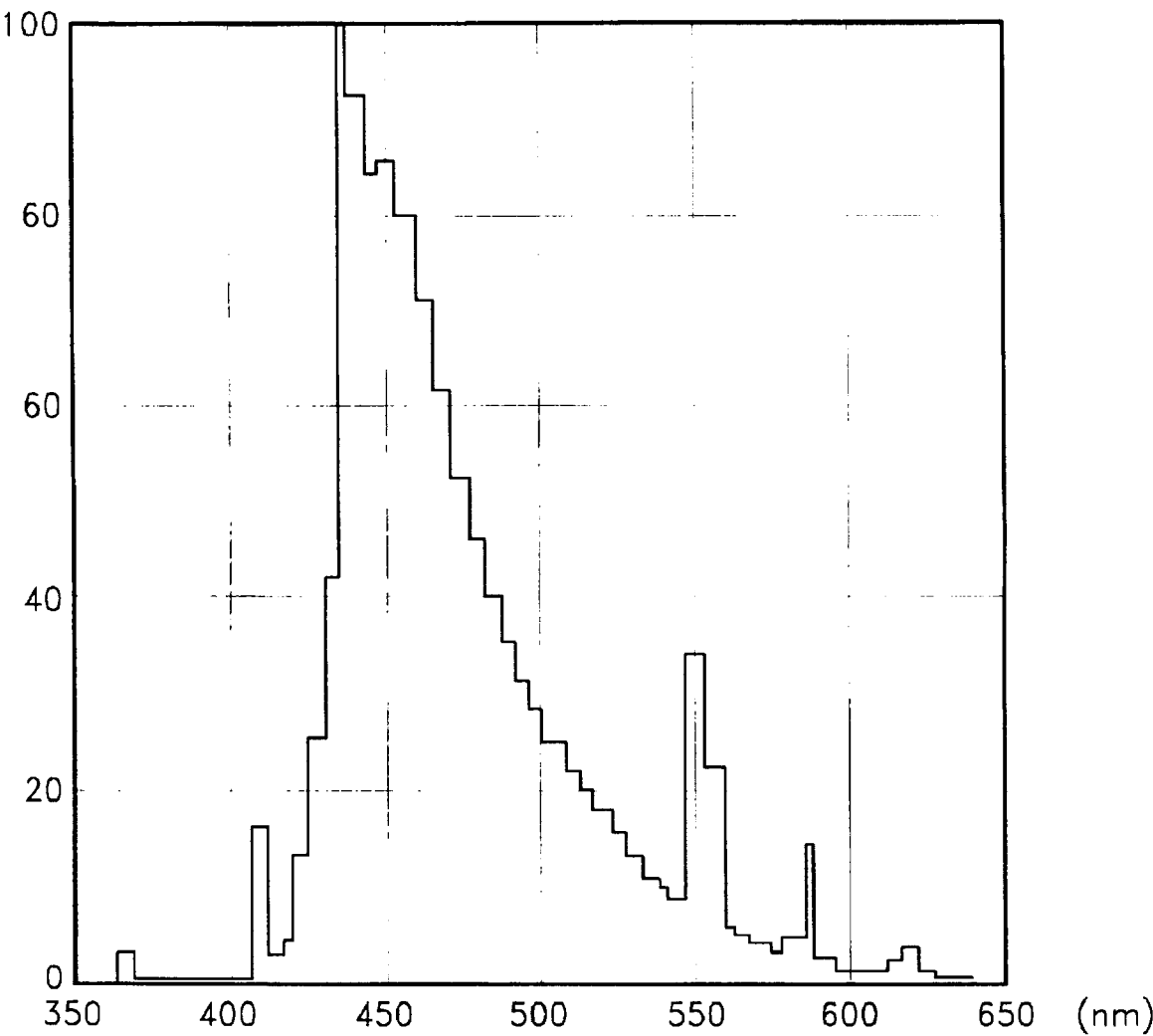
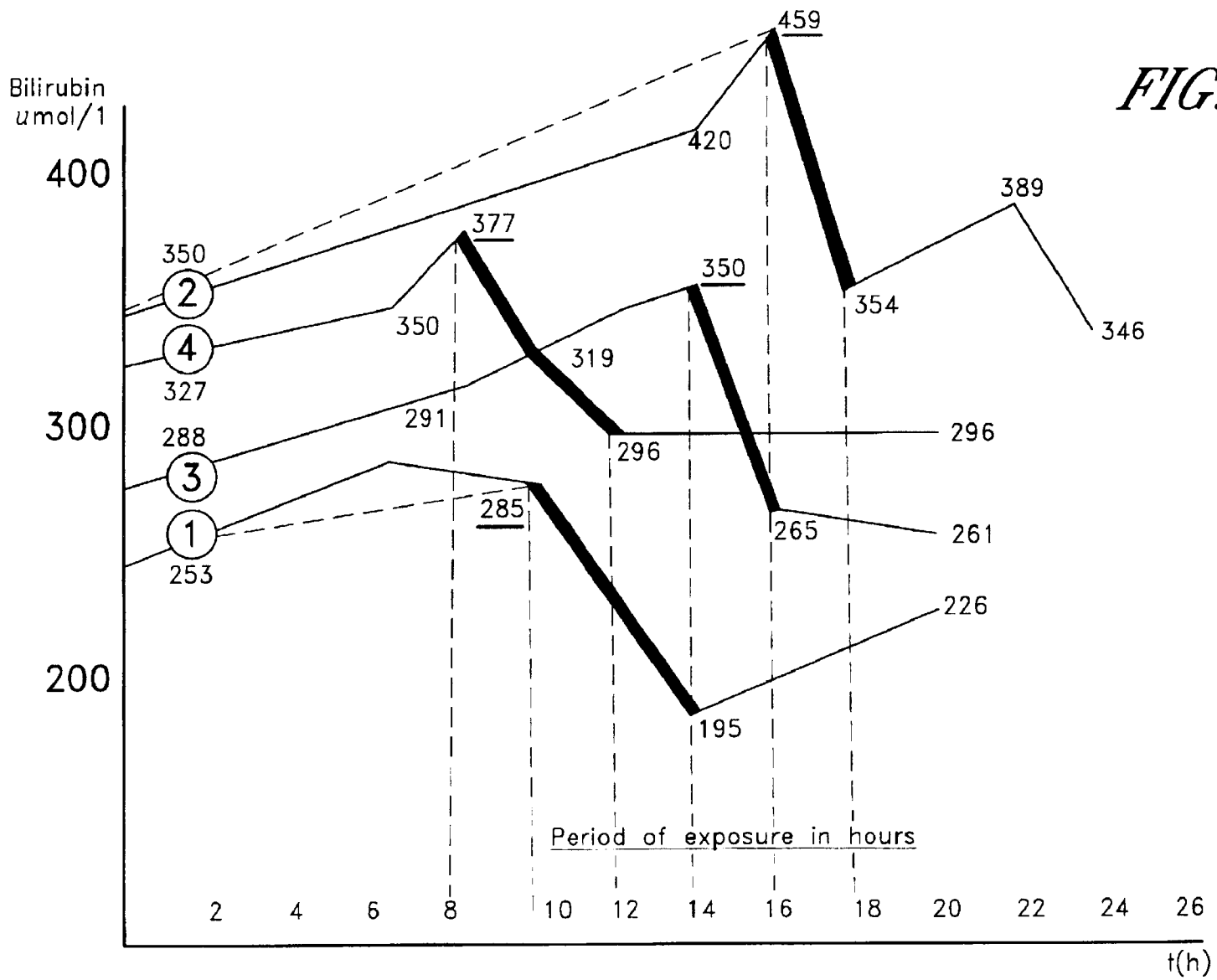


FIG. 8



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**INTENSIVE MULTIDIRECTIONAL
PHOTOTHERAPY DEVICE**

This is the U.S. National Phase under 35 U.S.C. §371 of International Application PCT/BE98/00164, filed Oct. 30, 1998, which claims priority of Belgian application BE 9700872, filed Oct. 30, 1997.

SUBJECT OF THE INVENTION

The present invention relates to a so-called intensive multidirectional phototherapy device intended for treating a premature or full-term newborn suffering from severe icterus or liable to develop this.

**TECHNOLOGICAL BACKGROUND AT THE
BASIS OF THE INVENTION**

The number of premature babies displaying serious icterus requiring exchange transfusion is on the increase. Since icterus can develop rapidly and exponentially, it is necessary to intervene very quickly if it is desired to prevent irreversible neurological damage. These premature babies must receive uninterrupted intensive care in incubators.

Until now, the treatment of icterus has consisted of an exchange transfusion making it possible to dissociate bilirubin which forms a poison before the transfusion of the newborn.

Given that most hyperbilirubinaemias are due to parental blood incompatibilities (incompatibilities with regard to rhesus factors, A, B, O, etc.), it is impossible to take blood from the parent in order to transfuse it to the newborn.

PRIOR ART

Neo-natal icterus has also been treated for many years in paediatric clinics by phototherapy of the skin of the newborns.

Document GB-A-2,216,012 describes an apparatus comprising an incubator made of a transparent material, provided in its upper part with a complex of fluorescent tubes placed parallel to one another beneath a reflecting surface so as to illuminate the newborn lying inside the incubator from above.

A support comprising such an incorporated reflecting surface is also described in Patent Application DE-A-3,910, 238. This type of apparatus and of support requires the service personnel to turn the newborn frequently so as to irradiate his skin as uniformly as possible on all sides. This entails increasing the duration of the therapy and a certain amount of discomfort for the newborn, with the difficulty of obtaining truly uniform treatment over all parts of his skin.

Document FR-A-2,193,628 describes a particularly complex and bulky phototherapy apparatus comprising a compartment entirely made of a transparent material, including a bed on which the newborn is laid out and two groups of light sources placed respectively above and below the compartment. However, such an apparatus requires the use of large light tubes consuming a great deal of energy, given that the treated newborn is placed much too far from the light sources. However, the blue-light tubes normally used (Sansville et al., Journal of IES (January 1972)), which are effective in the treatment of icterus, are too long (possibly having a length of up to 520 mm for a 30 mm diameter) to create a device fitting in incubators. They require the use of ballasts and of on/off buttons to light them, these being liable to form a spark each time they are switched on. This is particularly dangerous during treatment in an incubator,

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which often requires oxygen concentrations exceeding 21% and possibly even up to 40 and 60%. As a result of the sparks generated, these apparatuses are excluded from being used for this purpose.

The desire of specialists is to have available a system which makes it possible to care for infants in serious distress having to undergo both intensive care, in an incubator or closed chamber, and effective intensive phototherapy that can be tailored according to the seriousness of the icterus they are developing, while still maintaining suitable monitoring of the treated newborn.

Aim of the Invention

The aim of the present invention is to provide a novel phototherapy apparatus or device which does not have the drawbacks of the devices of the prior art and which is of simple and modular design, so as to be able to be used for the safe treatment of a newborn that is liable to develop icterus or has icterus already, particularly in an incubator or closed chamber, so as to limit or avoid any traumatism in the newborn, particularly from exchange-transfusion operations.

Characteristic Elements of the Invention

The present invention relates to a so-called intensive phototherapy device making it possible to treat a newborn (either premature or full-term) suffering from serious icterus, in a maternity ward, in his mother's room and even in a closed environment such as an incubator or closed chamber, while limiting or avoiding exchange transfusion and guaranteeing optimum safety of the newborn being treated.

The phototherapy device of the invention is intended to comprise, advantageously fastened to the same frame, a light box which includes at least one light source (the said light source being designed in the light box to illuminate the said patient) and a support for the patient to be laid out on, the said support being at least partially (but essentially) transparent or tinted so as to let the light coming from the light box through.

In the phototherapy device of the invention, the support is placed above the light box so as to expose the patient (held on the support from below with respect to the direction of gravity), thus allowing better exposure of the areas having a high bilirubin concentration which are present in the patient's body and which tend to follow the direction of gravity.

According to the invention, the term "light box" should be understood to mean a hermetically sealed assembly capable of containing one or more light-emitting sources, such as tube lamps (or possibly other light sources connected to optical fibres), as well as all the components allowing these light sources to be modulated or turned off. The light box of the invention also incorporates various means ensuring that any excessive heating of fluids or gases which is caused by these light-emitting sources does not affect the patient to be treated and allows only the emission of light (which is preferably filtered, with no infrared and no ultraviolet) towards the newborn to be treated.

Furthermore, the light box of the invention includes external electrical connectors and air inlets/outlets making it possible to supply the various electrical, mechanical or electronic components of the device of the invention, particularly the light box, such as fans, air intake ducts and ducts for extracting air via suction cones, etc.

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The thermal regulation system consists of an air extraction device comprising fans placed in the corners of the light box and allowing effective air flow towards the air suction and extraction cones.

The frame holding the light box and the support in an orientation allowing the patient to be exposed to the light is designed to allow the incorporation of the phototherapy device of the invention in an incubator or in a closed chamber.

For optimum safety, the light box is perfectly sealed and avoids any electrical or mechanical contact with components placed in the incubator or closed chamber. Such an arrangement prevents any spark or shock occurring which could have serious consequences for the patient.

According to the invention, the light sources are designed to generate light of greater than 3 mW per cm² of skin, preferably greater than 5 mW per cm² of skin, of the patient being treated. These light sources consist, for example, of lamps emitting blue or green light preferably having a spectrum of blue light mixed with green, these being tailored to any type of skin of a patient, including black or mulatto infants.

According to a preferred embodiment of the invention, use is made of light sources consisting of lamps whose spectral analysis reveals blue and green light in three bands (preferably of a wavelength ranging from 420 to 650 nm) and making it possible to deliver greater power of intense illumination than that in conventional tubes, with a broader available band and more rapid dissociation of bilirubin (particularly tube lamps of the $\frac{1}{2}$ D.Z.C type with a four-pin 2.G.7.4 cap and with a wavelength of 420 to 700 nm (such as those stipulated in the Commission Internationale d'Eclairage (code 1931) diagram)) (see FIG. 8).

These small tube lamps do not have an igniter and can be easily fitted into the light box of the invention. They allow them to be arranged in a geometry (see FIG. 2) which ensures effective emission of light onto the patient to be treated.

The phototherapy device of the invention may also include one or more domes which also incorporate light sources, the said domes being capable of exposing the patient (who is resting on the support) from above with respect to the direction of gravity of the said patient and are placed on the opposite side from the light box with respect to the support. Advantageously, the walls of the domes, of the light box and possibly of the frame comprise components which reflect the light emitted by the sources towards the patient to be treated, so as to ensure that all of the patient's skin is treated.

Furthermore, the light sources placed in the domes or in the light box are advantageously arranged in an alternating fashion along mutually opposed sides of the light box or of the dome, so as to allow crossed emission of light, conducive to the quality of the patient's illumination and allowing optimum air circulation in the light box or in the dome, thus avoiding any temperature change liable to affect the patient.

The device of the invention may also comprise one or more means for controlling the emission of the light depending on the distribution of the bilirubin in the body of the patient to be treated, and/or an additional light source or device level with the position of the patient's head, which is an area liable to have a higher bilirubin concentration.

This control means may, for example, be a thermostat which automatically stops or reduces the illumination or which triggers fans, making it possible to lower the temperature within the light box, within the dome or within the

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closed environment in which the newborn being treated lies. This thermostat system may be combined with a second means fastened directly to the new-born patient, such as a precision thermometer connected to an electronic thermostat fastened directly to the newborn (a cutaneous probe fastened to the patient's abdomen), which will control the temperature variations of the newborn. In the case of hyperthermia exceeding 39.5° C., a full-term newborn, and most particularly a premature newborn, may undergo convulsions. The device of the invention will make it possible to trigger various mechanisms for preventing such complications or will allow the medical personnel or nurses to be alerted (alarms able, where appropriate, to be connected to a central monitoring station).

Other systems for controlling the components involved in the device of the invention or the patient being treated may be designed by those skilled in the art according to improvements made to the apparatus for the treatment of newborns, or according to the disorders liable to affect the newborn.

According to the invention, the support of the device of the invention is made of a material which filters out or blocks the passage of ultraviolet and infrared radiation.

According to a preferred embodiment of the invention, the support includes a mattress, preferably a gel-type mattress, having a shape optimized for comfort and for ergonomics. Preferably, this gel-type mattress has one or more grooves, preferably in a criss-cross orientation, favouring the outflow of excrement from the new-born patient.

According to an alternative embodiment, the support includes or consists of a hammock, the meshes of which let through the light emitted by the light box or possibly reflected by the walls of the frame or of one or more domes.

According to another alternative embodiment, the support may include or consist of a sheet made of a material such as plexiglas which allows filtering (preferably of the "total screen" type) of the ultraviolet and infrared.

The other parts of the light box, of the domes or of the frame may be made of a conventional plastic such as polyurethane, which other parts are obtained by moulding or low-pressure injection moulding or are produced in a monobloc fashion. These various parts may be produced as a single piece or be adapted in a modular and ergonomic manner so as to favour the use and maintenance of the phototherapy device of the invention by the technical staff or nurses.

The light box may also be covered with a sheet forming a peripheral sealing skirt for the said box, the volume of which is designed so as to allow forced-air circulation in an incubator or chamber without impediment. In particular, the height of the walls of the end of the light box or of the frame incorporating in the light box 10 corresponds substantially to the height of the head of a patient lying down (a height of between 15 and 20 cm) so that the said wall slightly extends beyond the head of the patient lying down, thus forcing air to circulate above the patient without the latter being directly exposed thereto.

As mentioned above, the device may include one or more domes possibly integral with the frame of the phototherapy device of the invention or possibly fastened to an independent upright mounted on wheels. Advantageously, the domes fastened to an upright leave a space for the incorporation of other supply means or other means for treating the patient (a baxter, heating system, fans, etc.).

The height or the angle of the domes or the uprights supporting these domes may advantageously be adjusted, depending on the type of treatment to be given to the patient.

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Another aspect of the present invention relates to a method of treatment and/or of prevention of icterus, characterized by a high bilirubin concentration in a premature or full-term newborn, which consists in treating the said newborn with sufficient emission of light by the phototherapy device of the invention so as to cause a drop in the bilirubin concentration in the patient being treated, as shown in FIG. 9.

Further features and characteristics of the invention will appear in the detailed description of the invention and the following examples with reference to the appended figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 represents a full view of the device of the invention.

FIGS. 2 and 3 show schematic plan views of the particular arrangements of the light box of the device of the invention.

FIGS. 4 and 5 show perspective views of the light box of the invention.

FIG. 6 shows a perspective view of the domes of the device of the invention.

FIG. 7 shows the upright supporting the domes and the support of the device of the invention.

FIG. 8 shows the emission diagram for the light used in the device of the invention.

FIG. 9 shows a summary of the results obtained by the device of the invention.

EXAMPLES

Example 1

The phototherapy device 1 as shown in FIGS. 1 to 8 comprises a frame 2 supporting a light box 10 and a support 3 for the patient to be treated (which consists, in FIG. 1, of a hammock 6 suitable for the patient to be treated). Above the patient, the frame 2 also supports a single dome 5 illuminating the newborn from above.

The light box 10 as shown in FIGS. 2 to 5 has a succession of lamps 11, 12 arranged along the mutually opposed sides 15, 16 of the light box 10. Incorporated into the corners 8 and 9 of the light box 10 are fans 7 allowing effective flow of air towards extraction ducts 14, optionally via extraction cones as shown in FIG. 7.

Advantageously, the light box 10 also includes a temperature-control device, triggering a thermostat 17 which causes the lamps 11, 12 to be turned on or off and causes the aforementioned fans 7 to be operated.

As shown in FIG. 6, the device may include several domes 5 which can be adjusted by a knob 18 and leaves between the said domes 5 a space 13 into which may be incorporated a heating device, a Baxter, etc.

The domes 5 may be held by an upright 15 independent of the frame 2 supporting the light box 10 and the support 3 or they may be integral with the said frame 2.

The bottom or the side walls of the light box 10 or of the domes 5 may include one or more reflective elements 15 placed so as to ensure optimum illumination of the patient (preferably the entire surface of the patient's skin should be illuminated).

The light sources consist of tube lamps 11, 12, the light spectrum of which is shown in FIG. 8 (a spectrum of blue light mixed with green). However, other types of spectra tailored to the skin of a patient, such as a black infant or a mulatto infant, may be used with a greater amount of green light.

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Example 2

The phototherapy device of the invention was used to treat various newborns suffering from serious icterus, allowing intense illumination of light, particularly of the blue component delivered by the tube lamps, having values of greater than 2 mW per cm², preferably values greater than 4 mW per cm², of skin. The newborns being treated were kept under supervision by the monitoring means of the invention and under medical supervision, which guarantee that the infant is exposed to the light correctly.

The device of the invention makes it possible to fulfil the conditions in circular BH No. 21 from the French Ministry of Social Affairs, Health and Life, since it meets the main parameters required, namely a suitable light source, a suitable distance from the source to the infant, a treatment of the entire cutaneous surface of the infant with the proviso that no retinal lesion shall affect the newborn being treated, suitable centring of the infant beneath the light source, and a high-performance modular apparatus which is easy to maintain.

FIG. 9 shows that 4 patients treated by the device of the invention exhibited, after a short period of exposure, a drop in their bilirubin concentration (bold black line). The patients were then treated according to conventional phototherapy. The short period of time during which the infants are treated by the phototherapy method of the invention is sufficient to allow a significant drop (of 23 to 30%) in bilirubin and to bring the patient out of the danger zone. Following this treatment, what is observed is either a steady bilirubin content or a new rise in this content following a switch to a conventional phototherapy, demonstrating the difference in effectiveness between these two types of phototherapy.

What is claimed is:

1. A phototherapy device for the treatment of icterus in new-born patients, comprising a light box comprising at least one light source arranged in the box so as to illuminate said patient, and a support for the patient to be laid out on, wherein said support is at least partially transparent or tinted so as to let the light coming from the light box through, wherein said support is placed above the light box to expose the patient held on this support from below with respect to his direction of gravity, making it possible to expose the areas having a high bilirubin concentration which tend to follow the direction of gravity, wherein the intensity of the light is greater than 3 mW per cm² of patient's skin.

2. The device according to claim 1, wherein the intensity of the light is greater than 5 mW per cm² of patient's skin.

3. The device according to claim 1 wherein the support comprises a material which filters out or blocks the passage of ultraviolet and infrared radiation.

4. The device according to claim 1 wherein the support comprises a mattress.

5. The device according to claim 1, comprising a hammock, with meshes which let the light emitted by the light box through.

6. The device according to claim 1 further comprising an additional light sources wherein said additional light source is level with the head of the patient to be treated.

7. The device according to claim 1 wherein the support comprises a sheet of polymethyl methacrylate.

8. An incubator or closed chamber comprising the phototherapy device according to claim 1.

9. The device according to claim 1, wherein said at least one light source comprises lamps having a spectrum selected from the group consisting of blue light, green light, and a mixture of blue and green light.

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10. The device according to claim 9, wherein said at least one light source comprises lamps with a maximum intensity in the blue spectrum and the green spectrum having three bands, wherein said bands are of a wavelength between 420 and 650 nm.

11. The device according to claim 9, wherein the lamps do not have an igniter.

12. The device according to claim 9, wherein said at least one light source is arranged in an alternating fashion along mutually opposed sides of the light box.

13. The device according to claim 1 further comprising an external frame made of polyurethane.

14. The device according to claim 13, wherein the external frame is tinted in a color compatible with the spectrum of the light emission.

15. The device according to claim 14, wherein the external frame is tinted in a color such as white or pink.

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16. The device according to claim 1, wherein the light box comprises a fan and a thermostat which modulates the emission of light by the said at least one light source.

17. The device according to claim 16, wherein the light box comprises an air suction and extraction device placed at the ends of the light box.

18. The device according to claim 1 further comprising one or more domes placed on the opposite side from the light box with respect to the support wherein said domes comprise one or more sources emitting light towards the patient to be treated.

19. The device according to claim 18, wherein the internal walls of the light box or the internal walls of the domes reflect the light emitted by the sources.

* * * * *

Industria y Comercio
SUPERINTENDENCIA

Espacio reservado para el adhesivo de radicación

FORMULARIO UNICO DE OPOSICIÓN

1. OPOSICIÓN A:

- ☐ Patente de invención
- ☒ Patente de Modelo de Utilidad
- ☐ Diseño Industrial
- ☐ Esquema de Trazados para Circuitos Integrados
- ☐ Marcas de Productos o Servicios
- ☐ Marca Colectiva
- ☐ Marca de Certificación
- ☐ Lema Comercial

2.

Número de Expediente: 07-002270
Solicitante: DANIEL ADOLFO MAYA JIMENEZ

SOLICITUD
PUBLICADA

Apoderado:
Título de la nueva creación o denominación del signo:
UNIDAD DE CUIDADOS ESPECIALES INTERMEDIO PARA NEONATOS
Gaceta: 591 DE ABRIL 30 DE 2008, BAJO EL NP 28

3. OPOSICIÓN PRESENTADA POR

SOLICITANTE	Nombre: FUNDACION CARDIOVASCULAR DE COLOMBIA Dirección CALLE 155A No. 23-58 EL BOSQUE Nacionalidad o Domicilio FLORIDABLANCA, SANTANDER, COLOMBIA Lugar de Constituci FLORIDABLANCA, SANTANDER, SANTANDEF COLOMBIA Teléfono Fax E-mail:	IDENTIFICACION C.C. ☐ NIT ☒ C.E. ☐ Otro ☐ Cual Número: 890,212,568-0
	Nombre: CARLOS ORLANDO MAYA RODRIGUEZ Dirección: Cr. 13 A No 28-38, Mz 2 Bufete 245. Parque Central Bavaria Teléfono 3419841 Fax 3368592 E-mail: carlos.tamayo@tmtamayo.net	IDENTIFICACION C.C. ☒ NIT ☐ C.E. ☐ Otro ☐ Cual Número: 17.117.818 TP: 17.402

4. FUNDAMENTOS DE LA OPOSICIÓN:

Causal Artículos 16, 81, 42 de la Decisión 486 de la C.A.N.,

Signo opositor:
Justificación: Se encuentra en documento adjunto.

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5.

Comprobante de pago No. 08-47103 JUNIO 12/2008
08-48210 Fecha JUNIO 17/2008

6. Anexos

- ☒ Comprobante de pago de la tasa.
☒ Poderes, si fuere el caso.
☒ Pruebas de los fundamentos de la oposición
☐ Documentos que acrediten el legítimo interés, si fuere el caso.
☒ Documento que acredita la existencia y representación legal de las partes, cuando sean personas jurídicas.

7.

NOMBRE: CARLOS ORLANDO MAYA RODRIGUEZ

FIRMA:

C.C 17.117.818 TP 17.402



TM TAMAYO & ASOCIADOS
INTERNATIONAL PATENT AND TRADEMARK OFFICE

TRASLADO

Trademark	Marcas
Patent	Patentes
Health Permit	Registros Sanitarios
Software	Soporte Lógico
Commercial Name	Nombres Comerciales
Design	Diseños

CARLOS ORLANDO MAYA RODRÍGUEZ, mayor de edad, vecino de esta ciudad, identificado con la cédula de ciudadanía número 17.117.818 de Bogotá, Abogado en ejercicio y portador de la Tarjeta Profesional N°.17.402 del C.S.J., obrando en calidad de apoderado de la FUNDACIÓN CARDIOVASCULAR DE COLOMBIA S, atentamente manifiesto a usted que dentro del término legal Presento

I.- PETICIÓN:

Solicito a su despacho negar el beneficio patentario a la solicitud radicada bajo el expediente 07-002.270, por no cumplir con los requisitos de los artículos 16 y 81 de la Decisión 486 de la Comunidad Andina de Naciones, con base en los fundamentos de hechos y derecho que se exponen a continuación.

II.- LEGITIMO INTERÉS

A mi representada la sociedad **FUNDACIÓN CARDIOVASCULAR DE COLOMBIA S.A.**, le asiste legítimo interés para presentar ésta oposición, ya que la eventual concesión de la solicitud del expediente citado, impedirían tanto a mi representada como a otros hospitales usar las incubadores de calor radiante; humidificador; cámara de control de temperatura y esterilización bajo UV; tratamiento de fototerapia para la ictericia; generador de iones negativos, así como la pesa para bebé, el que carece de novedad, en detrimento de sus legítimos intereses comerciales y de la libre competencia, lo anterior basados en los artículos 23 de la Constitución Política de Colombia y Art. 5° del C.C.A.

III.- FUNDAMENTOS DE LA OPOSICIÓN

CON RESPECTO DE LA NOVEDAD:

La solicitud del expediente No.07-002.270 que se encuentra actualmente en trámite y que se refiere a: "UNIDAD DE CUIDADOS ESPECIALES INTERMEDIOS PARA NEONATOS" que consiste en la unión de varios equipos utilizados en el área de atención en neonatología, este contiene los siguientes sub-equipos

- Incubadora de Calor Radiante, manteniendo así la temperatura del bebe estable.
- Humidificador con control de temperatura, evitando el enfriamiento del niño por la baja temperatura del oxígeno suministrado.
- Cámara con control de temperatura y Esterilización bajo UV, manteniendo asépticos y con una temperatura estable los elementos de apoyo y ayuda clínica tales como cobijas. guantes y elementos de procedimiento.
- Tratamiento de Fototerapia, para el tratamiento de Ictericia en niños con bajo peso al nacer.
- Generador de Iones Negativos, que ayudan a mejorar la calidad de aire reduciendo el efecto de partículas dispersas en el aire que causan enfermedades respiratorias y alergias ocasionadas por: virus, bacterias, polen, polvo y humo.
- Pesa Bebe, llevando un monitoreo del peso del bebe para evaluar el mejoramiento o decaimiento del mismo.



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Patent	Patentes
Health Permit	Registros Sanitarios
Software	Soporte Lógico
Commercial Name	Nombres Comerciales
Design	Diseños

No cumple con los requisitos necesarios para otorgársele el privilegio de patente de Modelo de Utilidad, tal y como se argumenta a continuación.

La patente de Modelo de Utilidad, solicitada con el expediente 07-002270, no cumple con el requisito de Novedad por cuanto antes de la fecha de solicitud 11 de enero de 2007, ya existían en el estado de la técnica y en el mercado todos los aparatos que pretende reivindicar el Modelo de utilidad, por:

1. La Patente US6,845,217 publicada en mayo 20 de 2004 revela las lámparas de calor radiante usadas en las incubadoras (ver anexo 1)
2. La patente US7,217,936 publicada en agosto 11 de 2005 enseña un método y aparato para esterilización usando una fuente de luz ultravioleta (ver anexo 2)
3. la patente US6,703,785 publicada en enero 2 de 2003 revela un generador de iones negativos (ver anexo 3)
4. la patente 6, 464, 715 publicada en agosto 15 de 2000 revela el tratamiento y aparato de fototerapia para la ictericia, (ver anexo 4)
5. Tanto el Humidificador como la pesa bebé son de dominio público en Colombia.

Todo lo reivindicado por el solicitante ya existía en el estado de la técnica al momento de la solicitud, por lo tanto no cumple con el requisito de novedad del Art. 16 de la decisión 486, que a la letra dice:

“Artículo 16.- Una invención se considerará nueva cuando no está comprendida en el estado de la técnica.

El estado de la técnica comprenderá todo lo que haya sido accesible al público por una descripción escrita u oral, utilización, comercialización o cualquier otro medio antes de la fecha de presentación de la solicitud de patente o, en su caso, de la prioridad reconocida.

Sólo para el efecto de la determinación de la novedad, también se considerará dentro del estado de la técnica, el contenido de una solicitud de patente en trámite ante la oficina nacional competente, cuya fecha de presentación o de prioridad fuese anterior a la fecha de presentación o de prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido esté incluido en la solicitud de fecha anterior cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40.”



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INTERNATIONAL PATENT AND TRADEMARK OFFICE

Trademark Marcas
Patent Patentes
Health Permit Registros Sanitarios
Software Soporte Lógico
Commercial Name Nombres Comerciales
Design Diseños

CON RESPECTO DE LA DEFINICIÓN DE MODELOS DE UTILIDAD:

"DE LOS MODELOS DE UTILIDAD

Artículo 81.- Se considera modelo de utilidad, a toda nueva forma, configuración o disposición de elementos, de algún artefacto, herramienta, instrumento, mecanismo u otro objeto o de alguna parte del mismo, que permita un mejor o diferente funcionamiento, utilización o fabricación del objeto que le incorpore o que le proporcione alguna utilidad, ventaja o efecto técnico que antes no tenía. (SUBRAYADO PARA DESTACAR)

Los modelos de utilidad se protegerán mediante patentes"

Aunque puede cumplir con la primera parte "nueva forma o configuración", no cumple con: "*que permita un mejor o diferente funcionamiento*" porque el funcionamiento es exactamente igual al funcionamiento de los antecedentes mencionados y por lo tanto no cumple con la definición de Modelo de Utilidad dada por el Art. 81 de la decisión 486.

7.- FUNDAMENTOS DE DERECHO

Fundamento mis argumentos en los artículos 16 y 81 (requisitos de patentabilidad), el artículo 42, en concordancia con el artículo 85, de la Decisión 486 de la Comunidad Andina, Artículos 23 de la Constitución Política de Colombia y Art. 5º del C.C.A. y demás normas concordantes.

10- PETICIÓN DE PRORROGA PARA APORTAR PRUEBAS.

De conformidad con el artículo 42, Inciso 2º de la Decisión 486 de la Comisión de la Comunidad Andina, atentamente solicito prórroga por el término de 30 días para presentar pruebas, que sustentan la Oposición.

Anexo con este el recibo de pago No. 08-48,210 fecha Junio 17/2008.

8.- PRUEBAS

Ruego a su Despacho tener como pruebas, sin perjuicio de las que se presentaran antes del vencimiento de prórroga solicitada y de las que su Despacho oficiosamente considere, las siguientes:

- Anexo 1. Lámpara de calor radiante, aparato y método para producir rayos infrarrojos, US6,845,217



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INTERNATIONAL PATENT AND TRADEMARK OFFICE

Trademark	Marcas
Patent	Patentes
Health Permit	Registros Sanitarios
Software	Soporte Lógico
Commercial Name	Nombres Comerciales
Design	Diseños

- Anexo 2.- Sistema y método para esterilizar usando rayos ultravioleta, US7,217,936.
- Anexo 3.- Generador de iones negativos, US6,703,785
- Anexo 4.- Tratamiento Intensivo de Fototerapia para la ictericia en neonatos, US6,464,715

9- ANEXOS

- 1.- Poder para actuar
- 2.- Certificado de existencia y representación legal
- 3.- Copia de la oposición para traslado
- 4.- Recibo por concepto de la tasa correspondiente a la oposición
- 5.- Recibo por concepto de prórroga para sustentar la oposición.
- 6.- Las pruebas relacionadas. En el párrafo anterior

11.- NOTIFICACIONES

La solicitante y su apoderado en la dirección por ellos indicada en la solicitud de registro.

Mi representado y yo, recibiremos notificaciones en la secretaría de su despacho y/o en mi oficina ubicada en la Carrera 13A No. 28-38 Ofc. 245 Parque Central Bavaria.