

REPLACED SHEETS SG

☒ Description : paged 1 to paged 27
☒ Claim(s) : paged 28 to paged 32
☒ Drawing(s) : paged 1 to paged 1
☒ Abstract : paged 33 to paged 1

FAR INFRARED EMITTING IMAGE DISPLAY DEVICE

The present invention is directed to a far infrared emitting image display device, and particularly to a far infrared emitting image display device manufactured by including far infrared emitting material in a cabinet for an image display device or attaching a far infrared emitting body to the cabinet to emit far infrared.

In the present society, that is, in an information-oriented society, the realisation of transmission systems for image display information is one symbol of modernity. However, image display devices malfunction and injure their operators' health because of electromagnetic waves emitted from the device, and this results, so to speak, in an exchange of health for convenience. The effects to the human body are called VDT (visual display terminal) syndrome and the symptoms are eye fatigue, ocular pain, impairment of eyesight, headache, chronic fatigue, etc. In order to remove and/or shield harmful electromagnetic waves, much effort has gone into attempts such as antistatic treatment, establishment of filters, establishing a magnetic field generators, etc. but high costs and doubts as to effectiveness still remain, and now it is considered that complete removal and/or shielding of the electromagnetic waves is impossible.

Far infrared rays are electromagnetic waves in the

This Sheet Has Been Replaced



range of 5 to 1000 μ m (There is no critical definition of a standard wavelength region of far infrared. The above range is selected for the purposes of the present invention to exclude near infrared rays.) and affect the human body in two forms: thermal effect and non-thermal. The thermal effect is the effect of the thermal energy in the peripheral vein absorbed from the skin to the deep tissue or to the whole body, and the non-thermal effect arises from photons which correspond to far infrared of a specific wavelength to stimulate the receptor in the endothelia or cell membranes. This means that far infrared radiation of specific wavelengths transmits to and activates the cell. Therefore, far infrared rays act as a thermal energy source through thermal reaction, and as a photon source through a non-thermal reaction. In conclusion, far infrared radiation shows direct thermal action, indirect action through activation of water molecules, and non-thermal action of stimulating receptors of nerve cells located 100 μ m below the skin which perceive heat, cold, pain, etc. Through these actions, acceleration of blood circulation and fast relief from exhaustion are achieved.

Far infrared, especially in the 5.5 to 15 μ m region, is used as an energy source which stimulates stretching and bending vibrations of water molecules, and when the far infrared in this region is emitted to the human body, plants, and animals, water molecules which compose most of



such living bodies are activated and this results in acceleration of blood circulation, shortening of health recovery times and food cooking time, acceleration of flower blooming, extension of flower life, etc. (See Japan illumination society Vol.72 No.12 1988, p717 "Application of far infrared to the human body", ibid Vol.74 No.12 1990, p796 "The present state of applying far infrared to the food industry and the future", Japan ceramics Vol.23 No.4 1988, p310 "Far infrared emitting materials and its application", published by Seoul Korean tourist information Co. & translated by W. S. Park "Far infrared")

A lot of research and development concerning the above-mentioned, beneficial far infrared has been done. Japanese Patent Laid-Open Publication No. Sho 63-198254, Sho 63-236284, Sho 63-248051, Hei 1-65786, Hei 1-77893 and Hei 1-169865 disclose techniques concerning the manufacture of a far infrared emitting lamp. Many applications employing these far infrared emitting lamps are also known. Japanese Patent Laid-Open Publication No. hei 2-57883 and hei 2-309169 to Hitachi disclose refrigerators employing far infrared emitting lamps, Japanese Patent Laid-Open Publication No. hei 2-306028 of Rinai discloses a microwave oven employing a far infrared emitting lamp, and Japanese Patent Laid-Open Publication No. hei 2-164365 discloses a bathtub employing a far infrared emitting lamp. In all of these publications, effects obtained by employing the far



infrared emitting lamps are also disclosed together with various experimental data, and the results are satisfactory.

Water, of which most of the human body is composed, shows the following relation to the far infrared. FIG.1 is a graph illustrating the transmittance of water in accordance with the wavelength. As shown in this figure, water has the characteristic of absorbing light near the $3\mu\text{m}$ and $6\mu\text{m}$ regions and above. Since, the O-H bond between oxygen and hydrogen in the water molecule (H_2O , H-O-H), has stretching vibrations at 2.5 to $3.5\mu\text{m}$, and bending vibrations at 10 to $14\mu\text{m}$, water absorbs light when exposed to the light in these regions, and the vibration of the water molecule is accelerated. That is to say, water molecules become activated and then reorient themselves to form an ideal structure when the light in these region is supplied from the outside.

The wavelength of a human body can be calculated from body temperature, by example, in accordance with the Wien formula relation between absolute temperature and wavelength, defined as: $\lambda = 2897/T$ (where T denotes an absolute temperature and λ denotes a wavelength μm .) Here, when 309.5 (273+36.5) is substituted for T, the wavelength becomes $9.36\mu\text{m}$ which is within the far infrared range.

FIGs. 2A and 2B are graphical representations showing a spectral transmittance (2A) and a spectral reflectance



(2B) of skin according to each wavelength, respectively. The far infrared emitted from human skin is within the range of 3 to 50 μ m, and in particular, the wavelength within the range of 8 to 14 μ m provides approximately 46% of the total emitted energy. The energy emitted to the skin is transmitted, reflected or absorbed, and therefore, the amount of the energy absorbed by the skin can be calculated considering FIGs. 2A and 2B. For example, most of the energy within 8 to 14 μ m region of which transmittance and reflectance are low, are considered to be absorbed by the skin.

Thus, upon supplying energy in this range, a living body mostly consisting of water absorbs and uses this energy as kinetic energy and is easily activated. This gives the following effects of early blossom of flowers, period shortening and early maturation of a hatching egg, prolonging cut flowers' life, etc. To the human body, the effect appears as micro massage effect, acceleration of perspiration and excretion, fast health recovery, etc.

Far infrared emitting materials are as follows: alumino-silicates ($\text{Al}_2\text{O}_3\text{-SiO}_2$), cordierites ($\text{MgO-Al}_2\text{O}_3\text{-SiO}_2$), zircons ($\text{ZrO}_2\text{-SiO}_2$), carbons, ferric oxide (Fe_2O_3), manganese dioxide (MnO_2), cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), lithium oxide (Li_2O), zinc oxide (ZnO), bismuth oxide (Bi_2O_3), barium oxide (BaO), titanium oxide (TiO_2),



boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), phosphorus pentoxide (P_2O_5), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), etc.

FIG.3 is graphical representation of emitting intensity in accordance with the wavelength for several far infrared emitting materials with relation to that of the black body (measured at $40^\circ C$). The materials emit far infrared in 5 to $25\mu m$ wavelength region.

FIGS. 4A, 4B and 4C are graphical representation of emitting intensity against wavelength for several far infrared emitting mixtures, respectively. FIG.4A corresponds to the mixture of 60 wt% of SiO_2 , 20 wt% of Al_2O_3 , 5 wt% of Fe_2O_3 and 15 wt% of $TiO_2 \cdot MnO \cdot CaO \cdot MgO$, FIG.4B corresponds to the mixture of 50 wt% of ZrO_2 , 30 wt% of SiO_2 , 8 wt% of Al_2O_3 , 3 wt% of Fe_2O_3 , 3 wt% of BaO , 2 wt% of MgO and 4 wt% of CaO , and FIG.4C corresponds to the mixture of 50 wt% of SiO_2 , 45 wt% of Al_2O_3 , 3 wt% of K_2O and 2 wt% of Na_2O . From the figures, it is shown that each material emits far infrared at each specific wavelength region. Therefore, appropriate materials can be optionally used as occasion demands.

A cabinet, or case, which is a part of an image display device and exposed to view, is a supporting means carrying interior parts of the device. The cabinet is generally manufactured from engineering plastics material and especially from ABS resin, vinyl chloride resin and



acryl resin. The cabinet is manufactured by mixing raw resin, pigment, stabilizer, etc., and injecting the mixture into a catapult and then injection molding the mixture.

5 The cabinet is most widely manufactured from ABS resin. The ABS resin is a kind of plastics material composed of styrene, acrylonitrile and butadiene, and has good impact-resistance and heat-resistance (heat-resisting temperature is 93°C). Table 1 illustrates heat-deformation temperatures for several cabinet-molding materials.

This Sheet Has Been Replaced



<Table 1>

	samples	heat-deformation temperature (°C)
thermo- plastic resins	methacrylates	65-100
	vinyl chlorides	50-75
	poly vinyl alcohols	45-75
	nylons	-180
	fluorides	120
	celluloides	50-70
	celluloses	70-110
	styrenes	70-115
	polyethylenes	40-80
	polypropylenes	80-100
	polycarbonates	130
thermo- setting resins	phenol resins	70-120
	urinous resins	100-130
	melamine resins	150-200
	unsaturated polyester	-200
	alkyd resins	80-90
	silicones	>250
	foaming polyurethans	-100
	polyethylenes	40-80



An object of the present invention is to provide a far infrared emitting image display device having various harmful factors, but which can reduce the user's uneasiness and economic burden and give a pleasant working environment.

To accomplish the above-mentioned object, there is provided in the present invention a far infrared emitting image display device comprising a cabinet for supporting and containing interior parts of the device, characterized in that the cabinet contains at least one selected from the group consisting of far infrared emitting materials, far infrared lamps and far infrared emitting devices, and so the image display device emits far infrared radiation.

The far infrared emitting materials can be contained in the cabinet through adding 1 to 30 wt% of the far infrared emitting materials into the raw materials for manufacturing the cabinet and then injection molding, or through coating the far infrared emitting material with a binder or a pigment on the surface of the cabinet.

The above-mentioned object of the present invention can also be accomplished by a far infrared emitting image display device comprising at least one far infrared emitting device containing a heating means to apply heat to a far infrared emitting material, a reflecting plate to reflect far infrared radiation which is outwardly emitted from the interior of said device, and a supporting means



including these objects.

Embodiments of the present invention will now be described, by way of example, with reference to the attached drawings, in which:

5 FIG.1 is a graph illustrating the transmittance of water versus wavelength;

 FIGs.2A and 2B are graphs showing spectral transmittance (2A) and spectral reflectance of skin (2B), versus wavelength;

10 FIG.3 is a graph showing emission intensity versus wavelength for various far infrared emitting materials with relation to that of the black body;

 FIGs.4A, 4B and 4C are graphs showing emission intensity versus wavelength for various far infrared emitting mixtures;

15 FIGs.5A and 5B illustrate injection molding process for manufacturing a cabinet;

 FIG.6 is a drawing for explaining the method of experiment 1 below;

20 FIGs.7A and 7B are photographs of chrysanthemums demonstrating the far infrared emission effect of the image display device manufactured through example 1 of the present invention;

 FIGs.8A and 8B are photographs of roses demonstrating the far infrared emission effect of the image display device manufactured through example 2 of the present



invention;

FIGs.9A and 9B are a front view (9A) and a side view (9B) of the image display device according to the second embodiment of the present invention;

5 FIG.10 is a longitudinal cross-sectional view of the far infrared emitting lamp which is preferably employed in embodiments of the present invention;

FIGs.11A and 11B are drawings for explaining experiment 3 below;

10 FIGs.12A and 12B are drawings for explaining experiment 4 below;

FIGs.13A and 13B illustrate the basic structure of a far infrared emitting device according to an embodiment of the present invention, in which FIG.13A is a perspective view of the device and FIG.13B is a cross-sectional view cut along line A-A of the device shown in FIG.13A;

15 FIG.14A is a cross-sectional view cut along line B-B of the device shown in FIG.15B illustrating another embodiment of the present invention and corresponding to FIG.13B;

20 FIG.14B is a cross-sectional view cut along line C-C of the device shown in FIG.15C which is a further another embodiment of the present invention;and

25 FIGs.15A, 15B and 15C illustrate image display devices employing the far infrared emitting devices illustrated in FIGs.13B, 14A and 14B, respectively.



Preferred embodiments of the present invention are described in detail below. The method for manufacturing far infrared emitting image display devices according to embodiments of the present invention will be explained in examples and the effect of far infrared emitting image display devices according to embodiments of the present invention will be explained in experiments.

As a first embodiment of the present invention, there is provided a far infrared emitting image display device comprising a cabinet for supporting and containing interior parts of the device, characterized in that the cabinet comprises far infrared emitting materials.

The far infrared emitting materials can be contained in the cabinet or coated on the surface of the cabinet.

Where the far infrared emitting materials are contained in the cabinet by mixing the materials with the raw materials for manufacturing the cabinet and then molding the mixture, the amount of the far infrared emitting materials added ranges from 1 to 30 wt% based on the total amount of the raw materials for manufacturing the cabinet. If the amount added is less than 1 wt%, only a weak far infrared emitting effect is obtained and if the amount added is more than 30 wt%, the impact-resistance of the resulting cabinet is too weak and formation of the cabinet becomes difficult. The preferred amount ranges from 5 to 15 wt%.



The preferred material for emitting far infrared is at least one selected from the group consisting of aluminium oxide (Al_2O_3), silicon dioxide (SiO_2), magnesium oxide (MgO), zirconium oxide (ZrO_2), carbons, ferric oxide (Fe_2O_3), manganese dioxide (MnO_2), manganese monoxide (MnO), cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), titanium oxide (TiO_2), boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), zinc oxide (ZnO), lithium oxide (Li_2O), bismuth oxide (Bi_2O_3), phosphorous pentoxide (P_2O_5), barium oxide (BaO) and composites thereof.

When a household television set, computer monitor, etc. operates, the temperature in the cabinet reaches about 40 to 70°C, and so the far infrared emitting materials contained in the cabinet emit more far infrared radiation.

FIGS. 5A and 5B illustrate injection molding process for manufacturing a cabinet. The cabinet is manufactured by putting the raw mixture materials in a hopper 1 and then sending the mixture through a nozzle outlet 4 by means of a piston 2, so that the mixture melts when passing a heating means 3 and the melted mixture is molded into the predetermined shape of a cabinet in a mould 5.



<Example 1>

70 wt% of SiO_2 , 25 wt% of Al_2O_3 , and 5 wt% of Fe_2O_3 are mixed to produce a far infrared emitting ceramic. 15 wt% of the mixture is added and homogeneously dispersed into the raw materials for manufacturing an ABS cabinet. A cabinet for supporting and containing the parts of an image display device is manufactured through a desired method, such as that shown in FIG.5.

<Example 2>

60 wt% of ZrO_2 , 25 wt% of SiO_2 , 5 wt% of Al_2O_3 , 3 wt% of Fe_2O_3 , 3 wt% of MgO and 4 wt% of TiO_2 are mixed to produce a far infrared emitting ceramic. The procedure follows the same manner described in example 1, except that the amount of the ceramic added is 10 wt% based on the amount of the raw materials for manufacturing an ABS cabinet.

<Experiment 1>

A 14" monitor is manufactured by employing the cabinet obtained through example 2. FIG.6 is a drawing for explaining the method of this experiment. In FIG.6, a vase holding a flower is located on the cabinet. Here, two chrysanthemums blooming to the same extent are put into two vases, respectively. One vase is placed as shown in Fig. 6



on a 14" monitor which employs the cabinet containing the far infrared emitting materials, and the other is placed on a 14" monitor which employs the same cabinet but does not contain far infrared emitting materials. After leaving the flowers for 10 days while the monitors are operating, the changes in the two flowers are observed. FIG.7A is a chrysanthemum photograph taken before the monitors were turned on. It can be seen that the two flowers are blooming to the same extent. FIG.7B is a chrysanthemum photograph taken after 10 days, in which on the left is the flower that was placed on the monitor employing the standard cabinet and on the right is the flower that was on the monitor with the cabinet containing far infrared emitting materials. In FIG.7B, the flower that was on the monitor employing the cabinet which contains the far infrared emitting materials is still fresh and its leaves are growing. However, the flower that was on the monitor employing the ordinary cabinet is withering.

Another method for applying far infrared emitting materials to the cabinet is by coating the materials on the inner or outer surface of the cabinet with a binder and/or sprayer.

<Example 3>

5 wt% of the same far infrared emitting ceramic as in

This Sheet Has Been Replaced



example 1 is mixed with 95 wt% of acrylic binder. The mixture is coated on the outer surface of an ABS resin cabinet and heat dried to manufacture a far infrared emitting material coated cabinet.

5 <Example 4>

3 wt% of the same far infrared emitting ceramic as in example 1 is mixed with 96 wt% of vinyl chloride-based, heat sensitive binder. To the mixture, a small amount of a surfactant and polyvinyl alcohol is added and homogeneously mixed. The mixture is coated on the inner surface of an ABS resin cabinet and heat dried at 40 to 50°C to manufacture a far infrared emitting material coated cabinet.

<Example 5>

25 wt% of the same far infrared emitting ceramic as in example 2 is mixed with 50 wt% of vinyl chloride resin, 15 wt% of acrylic ester-based plasticizer, 1 wt% of zinc-based stabilizer, 2 wt% of epoxy-based stabilizer and 7 wt% of acrylic binder. The mixture is coated on the inner and outer surface of an ABS resin cabinet and dried to manufacture a far infrared emitting material coated cabinet.



<Experiment 2>

The effect of far infrared is demonstrated in the same manner as in experiment 1 with 14" monitors employing an ordinary cabinet and the far infrared emitting material coated cabinet manufactured through example 5. Two roses blooming to the same extent are put into respective vases, and are placed on each cabinet as shown in FIG.6. The changes of the flowers were observed after turning the monitors on. FIG.8A is a photograph taken after one day. In the photograph, the left flower was exposed to the ordinary monitor and the right flower was exposed to the monitor employing the cabinet containing the far infrared emitting material. The two flowers show no difference so far. FIG.8B is a photograph taken after five days. From the photograph, it can be seen that the flower exposed to the ordinary monitor is wilted and withered, while the flower exposed to the monitor containing far infrared emitting material is still fresh.

As another embodiment of the present invention, there is provided a far infrared emitting image display device comprising a cabinet, characterized in that the cabinet includes at least one far infrared emitting lamp.

It is preferred that a black far infrared emitting material is coated on the surface of the bulb so that the transmittance of visible rays is lowered and does not



fatigue the user's eyes.

Also, it is preferred that a reflecting plate is provided to the rear of the bulb so that far infrared emission efficiency is increased. The most preferred approach is coating the far infrared emitting material on the surface of the reflecting plate so that far infrared emission efficiency is even further increased.

For the far infrared emitting materials, those used for manufacturing the cabinet can be employed. Particularly preferred are silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), manganese oxide (MnO), ferric oxide (Fe_2O_3), titanium oxide (TiO_2), zirconium oxide (ZrO_2) and magnesium oxide (MgO).

It is also preferred that coloured glass or a protector made of plastic is provided in order to protect the bulb and shield the light from the far infrared emitting lamp.

The temperature resulting from the heat from the far infrared emitting lamp should be lower than the melting temperature of the cabinet constituting materials (commonly used ABS resin: 93°C), and should preferably be lower than 90°C while maintaining the supplying power lower than 20W.

For user convenience, the far infrared emitting lamps can be installed so that their direction is changeable according to the user's orientation, and are selectively lit up according to need.



FIGS. 9A and 9B are a front view (9A) and a side view (9B) of the image display device according to this embodiment of the present invention. The device is manufactured by installing far infrared emitting lamps 8 on the front of the cabinet 7. The reference numeral 6 denotes a cathode ray tube.

FIG. 10 is a longitudinal cross-sectional view of the far infrared emitting lamp which is preferably employed in the present invention. A reflecting plate 9 is provided to the rear of the far infrared emitting bulb 11 and a protecting cover 10 is provided on the front of cabinet 7.

Any lamp that can emit far infrared radiation such as an incandescent electric lamp, a halogen lamp, etc. can be employed as the far infrared emitting lamp. These all emit heat of their own accord. The emitted heat enhances the far infrared emission intensity. However, since too much heat might melt the cabinet material, the lamp capacity should be restricted and the temperature should not exceed 90°C. (The melting point of the commonly used ABS resin is 93°C.)

In order to prevent the user's eyes from being dazzled by the emitted light, the bulb could be treated so as to have a black tinge, black far infrared emitting ceramic could be used, or a dark-coloured protecting cover can be used. Any protecting cover that can partially shield the light and thus prevent it from being too bright can be employed.



Further, in order that the far infrared emits forwardly and toward the user, and the rays are focused, a reflecting plate can be provided around the bulb as shown in FIG.10.

5 It is preferred that one or more far infrared lamps be optionally provided to each image display device and each lamp be optionally lit according to the user's need. Of course, it is desirable that the lamp is designed so that the direction in which the rays are focused is freely
10 adjustable according to the user's orientation, the chair height, the height of the user, etc.

The effect of the image display device employing the far infrared lamp is demonstrated by the following experiments.

15 <Experiment 3>

FIG.11A illustrates a 14" colour monitor employing far infrared emitting lamps, and FIG.11B illustrates a 14" colour monitor which does not employ a far infrared emitting lamp. Further details of the image display device
20 employing the far infrared emitting lamps in FIG.11A are as follows. The far infrared lamps are installed on the four corners of the front of the cabinet as illustrated in the drawings. The lamp is manufactured by coating the surface of an incandescent electric bulb with the mixture of metal

This Sheet Has Been Replaced



oxides of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), manganese oxide (MnO) and ferric oxide (Fe_2O_3) with resin. The coating layer is black. On the surface of the reflection plate, a mixture of 20 wt% of far infrared ceramic with water glass is coated. The capacity of the incandescent bulb is 110V 7W, and the temperature of the bulb center reaches 70°C 5 minutes after turning the bulb on. At a distance of 50cm in front of the two monitors, cigarettes are located as illustrated in the drawings (room temperature 25°C , humidity 60% RH). After leaving the switches of the two image display devices turned on for 24 hours, a functional test of the taste of the cigarettes was carried out with 15 persons. After the functional test, all 15 persons reported that the taste of the far infrared emitted cigarettes was different from that of the cigarettes located in front of the conventional monitor, and 12 persons among these further reported that the former was milder than the latter.

<Experiment 4>

The far infrared lamp is installed in an image display device by the same method described in experiment 3. A far infrared emitting ceramic composed of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), titanium oxide (TiO_2) and magnesium oxide (MgO) is coated on the surface of the bulb.

This Sheet Has Been Replaced



In this case, since the coating layer is near white, a protective cover is provided in order to reduce eye fatigue. The protective cover is made of coloured glass having a transmittance of 43% at 560nm.

5 FIGS.12A and 12B are drawings for explaining this experiment. In this experiment, two roses blooming at the same extent are put in front of a 14" colour monitor employing a far infrared lamp and a common 14" colour monitor, in each case at 30cm distance, and changes in the
10 flowers were observed over time. The capacity of the far infrared lamp is 7.5W 120V, and the temperature of the bulb surface reaches 65°C 5 minutes after turning the monitors on. The room temperature was 25°C and the humidity was 65% RH.

15 In the course of the experiment, the rose exposed to the conventional monitor immediately withered owing to the electromagnetic waves emitted from the cathode ray tube and circuitry thereof. However, the rose exposed to the far
20 infrared emitting monitor of the present invention remained in full bloom for a long time (about 6 days or longer) because the far infrared emitted from the device compensates for the damage owing to the harmful
25 electromagnetic waves. This means that the far infrared emission activated water molecules, provided essential energy needed for growing the plant, and extended its freshness.



As the third embodiment, there is provided in the present invention a far infrared emitting image display device employing at least one far infrared emitting devices for image display device, which comprises far infrared emitting material, a heating means to apply heat to the far infrared emitting material, a reflecting plate to reflect far infrared radiation outwardly emitted from the interior of the device, and a supporting means including these objects.

As for the far infrared emitting materials, low-temperature, high-efficiency far infrared emitting materials which can emit far infrared in high efficiency at low temperature such as aluminium oxides (Al_2O_3), silicon dioxides (SiO_2), zirconium oxides (ZrO_2), etc. are preferably used, so that they might not deform the supporting frame such as ABS resin, vinyl chloride-based resin, acrylic resin, etc.

In order to attach the far infrared emitting device to the image display device, an attaching means is required. This can be fixed through a binder or through the change of a molding design of the cabinet when manufacturing the image display device.

An embodiment will be described in detail below referring to the attached drawings.

FIGS.13A and 13B illustrate the basic structure of a far infrared emitting device according to this embodiment,



in which FIG.13A is a perspective view and FIG.13B is a cross-sectional view of the device. As a supporting and containing means 16, a commonly used material for a cabinet case of an image display device such as ABS resin is used and above it, a reflecting plate 15 is provided. Above the reflecting plate 15, a heating means 14 is provided to increase far infrared emission. The applied heat should not exceed a temperature that might change the quality of this device; up to 50°C is sufficient. Above the heating means, a far infrared emitting layer 13 manufactured by compacting, molding or coating far infrared emitting materials is prepared. As for far infrared emitting materials, low-temperature, high-efficiency far infrared emitting ceramics such as aluminium oxide, silicon dioxide, zirconium oxide, etc. are preferably employed.

The upper surface and the inner side of this far infrared emitting device is preferably provided with a transparent acryl layer 12 to maintain the efficiency of the far infrared emission. However, since a far infrared reflecting plate 15 and a heating means 14 are provided in the device, a layer made of an opaque ABS resin, vinyl chloride resin etc. shows a sufficiently good effect. The heater is connected to a source of electric power 17 external to the device.

The far infrared emitting device of this embodiment is designed so that this device does not shield the image



reproduced on an image display device, and is attached to the front side of the cabinet or installed in the cabinet which has been designed and manufactured for installing this device. A cord to a source of electric power can be connected to a external source or can be drawn out to a circuit part in the cabinet and connected to it when fabricating the set.

Since the thus obtained image display device employing the far infrared emitting device on the front of the image display device emits far infrared towards the place where an operator is located, the operator can receive the far infrared effect.

FIGs.14A and 14B illustrate other embodiments of the far infrared emitting devices (cross-sectional view) which have the same structure as the far infrared emitting device illustrated in FIG.13B, but are a stick-type (FIG.14A) and a cylinder-type (FIG.14B), and they are manufactured to be used as required. The reference numeral 18 denotes a connecting means such as a binder.

FIGs.15A, 15B and 15C illustrate the image display devices employing the far infrared emitting devices illustrated in FIGs.13B, 14A and 14B, respectively. These all emit far infrared radiation forward. In FIG.15A, the arrows indicate the emitting direction of the far infrared rays.

To demonstrate the effect of the far infrared when



employing far infrared emitting devices in image display devices, the following experiment was carried out.

<Experiment 5>

A far infrared emitting device as illustrated in FIG.13A, is provided on a 14" CDT (colour display tube) as illustrated in FIG.15A. A heater 14 is connected to a source of electric power and the far infrared emitting material is heated to 40°C. Two chrysanthemums blooming at the same extent are put in front of the 14" colour monitor employing the far infrared emitting device and an ordinary 14" colour monitor, both at 30cm distance as illustrated in Figs. 12A and 12B. After turning the monitors on, the change of the flowers are observed over time. Temperatures and other environment factors were kept equal.

In this experiment, the two chrysanthemums originally blooming equally showed distinct differences after seven days. The chrysanthemum that was located in front of the ordinary image display device withered more than that located in front of the image display device employing the far infrared emitting device. After fourteen days, the chrysanthemum that was located in front of the ordinary image display device almost completely withered. However, the chrysanthemum located in front of the image display device employing the far infrared emitting device kept



fresh and its leaves began to bud.

As shown above, the far infrared emitting device can be simply attached to the image display device and can provide far infrared effects to users. This device is adaptable for practical use and can be manufactured into any shape.

As confirmed from the above examples and experiments, since the image display device containing the far infrared emitting source emits far infrared radiation which is beneficial to a living body, the users of these kind of devices can counterbalance the damage owing to harmful electromagnetic waves, and can receive vitality and energy from the far infrared radiation.

While the present image display device has been particularly shown and described with reference to particular embodiments thereof, it will be understood by those skilled in the art that various changes in form and details. For example, a television, computer monitor, LCD, PDP, etc. may be effected thereby without departing from the scope of the invention as defined by the appended claims.

This Sheet Has Been Replaced



CLAIMS:

1. A far infrared emitting cabinet for supporting and containing interior parts of an image display device, wherein said cabinet contains far infrared emitting materials and is moulded from a mixture containing 1 to 30 wt% of said far infrared emitting materials.

2. A far infrared emitting cabinet as claimed in claim 1, wherein said amount of said far infrared emitting materials is 5 to 15 wt%.

3. A far infrared emitting cabinet for supporting and containing interior parts of an image display device, wherein said cabinet contains far infrared emitting materials in the form of a mixture of said far infrared emitting materials with a binder or a pigment coated on the surface of said cabinet.

4. A far infrared emitting cabinet as claimed in any preceding claim, wherein said far infrared emitting material is at least one selected from the group consisting of aluminium oxide (Al_2O_3), silicon dioxide (SiO_2), magnesium oxide (MgO), zirconium oxide (ZrO_2), carbons, ferric oxide (Fe_2O_3), manganese dioxide (MnO_2), cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), titanium oxide (TiO_2), boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), lithium





oxide (Li_2O), zinc oxide (ZnO), bismuth oxide (Bi_2O_3), phosphorous pentoxide (P_2O_5), barium oxide (BaO) and composite thereof.

5 5. A far infrared emitting cabinet for supporting and containing interior parts of an image display device comprising a far infrared lamp mounted on the front-side of the cabinet.

10 6. A far infrared emitting cabinet as claimed in claim 5, wherein said far infrared lamp comprises a reflecting plate behind a far infrared emitting bulb.

7. A far infrared emitting cabinet as claimed in claim 6, wherein the surface of said bulb of said far infrared lamp is coated with a black far infrared emitting material.

15 8. A far infrared emitting cabinet as claimed in claim 7, wherein said far infrared emitting material is at least one selected from the group consisting of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), manganese oxide (MnO), manganese dioxide (MnO_2), ferric oxide (Fe_2O_3),
20 cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), lithium oxide (Li_2O), zinc oxide (ZnO), bismuth oxide (Bi_2O_3), phosphorous
25 pentoxide (P_2O_5), barium oxide (BaO), titanium oxide (TiO_2), zirconium oxide (ZrO_2) and magnesium oxide (MgO).





9. A far infrared emitting cabinet as claimed in any of claims 6 to 8, wherein said far infrared lamp further comprises a protecting cover made of coloured glass or plastics material.

5 10. A far infrared emitting cabinet as claimed in any of claims 6 to 9, wherein the supplying power is lower than 20W and the temperature resulting from the heat from the far infrared emitting lamp is lower than 90°C.

10 11. A far infrared emitting cabinet as claimed in any of claims 6 to 10, wherein said far infrared lamp is installed so that the direction of said lamp is changeable according to the orientation of the user.

15 12. A far infrared emitting cabinet as claimed in any of claims 6 to 11, wherein said far infrared lamp is installed so as to be selectively lit up according to need.

13. A far infrared emitting cabinet as claimed in claim 6 or any of claims 7 to 12 where dependent on claim 6, wherein said reflecting plate is coated with far infrared emitting materials on the surface of said plate.

20 14. An image display device comprising a far infrared emitting cabinet as claimed in any of claims 1 to 13.

25 15. A far infrared emitting device for mounting to an image display device, said far infrared emitting device containing a heating means to apply heat to a far infrared emitting material, a reflecting plate to reflect far infrared radiation emitted from the interior of said





device, and a supporting means for these objects.

16. A far infrared emitting device as claimed in claim 15, wherein said far infrared emitting material is at least one selected from the group consisting of aluminium oxide (Al_2O_3), silicon dioxide (SiO_2), zirconium oxide (ZrO_2), magnesium oxide (MgO), carbons, ferric oxide (Fe_2O_3), manganese dioxide (MnO_2), cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), titanium oxide (TiO_2), boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), lithium oxide (Li_2O), zinc oxide (ZnO), bismuth oxide (Bi_2O_3), phosphorous pentoxide (P_2O_5), barium oxide (BaO) and composite thereof.

17. A far infrared emitting device as claimed in claim 15 or 16, wherein said supporting means is made of at least one selected from the group consisting of ABS resin, vinyl chloride-based resin and acryl resin.

18. A far infrared emitting device as claimed in any of claims 15 to 17, wherein said far infrared emitting device further comprises a connecting means for its connection to said image display device.

19. A far infrared emitting device as claimed in claim 18, wherein said connecting means is a binder.

20. An image display device comprising a far infrared emitting device as claimed in any of claims 15 to 19.

21. A far infrared emitting image display device





comprising a cabinet for supporting and containing interior parts of the device, wherein said cabinet contains at least one selected from the group consisting of far infrared emitting materials, far infrared lamps and far infrared emitting devices, to emit far infrared radiation.

5

22. A far infrared emitting image display device substantially as hereinbefore described with reference to the accompanying drawings.



ABSTRACTFAR INFRARED EMITTING IMAGE DISPLAY DEVICE

5 A far infrared emitting image display device comprising a cabinet which emits far infrared. The cabinet contains at least one of the following to emit for infrared: far infrared emitting materials, far infrared lamps and far infrared emitting devices. To counteract harmful electromagnetic waves emitted from image display devices, beneficial far infrared is emitted.

10 [FIG.15A]

This Sheet Has Been Replaced T



FIG. 1

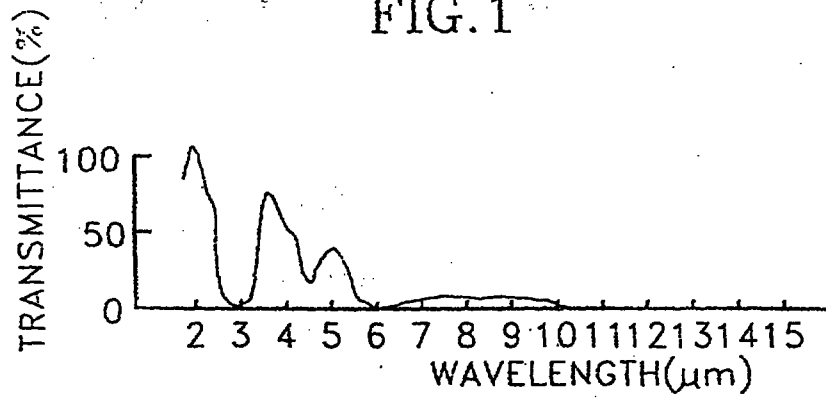


FIG. 2A

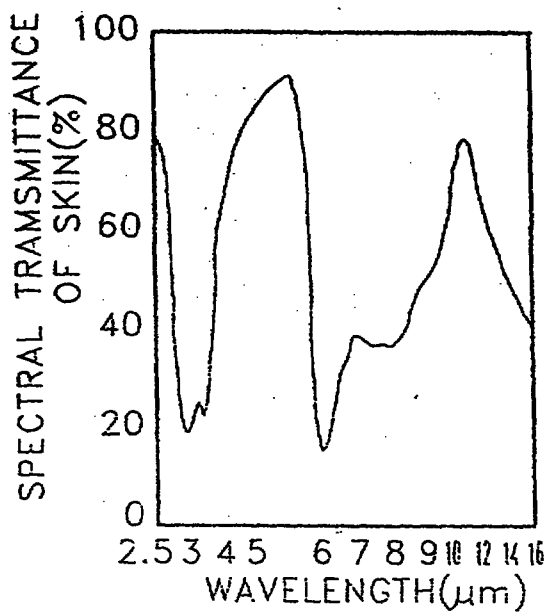


FIG. 2B

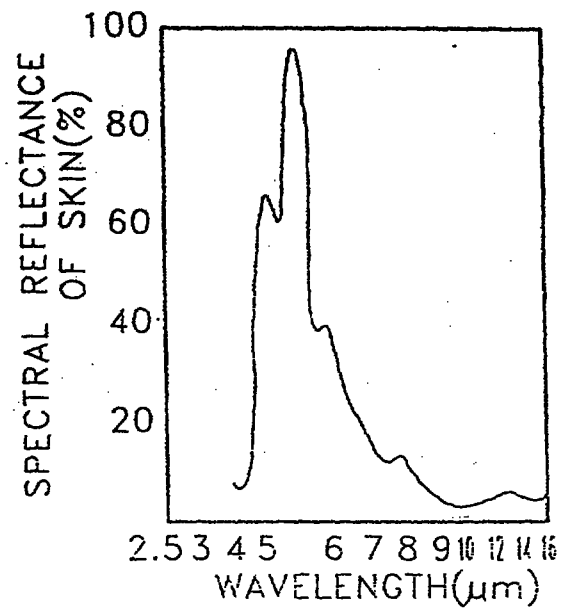


FIG. 3

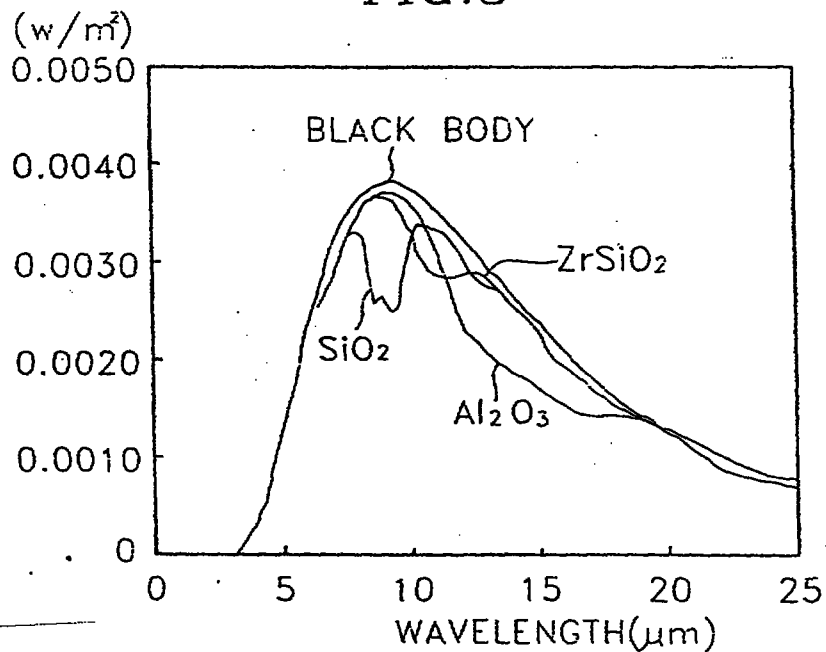


FIG.4A

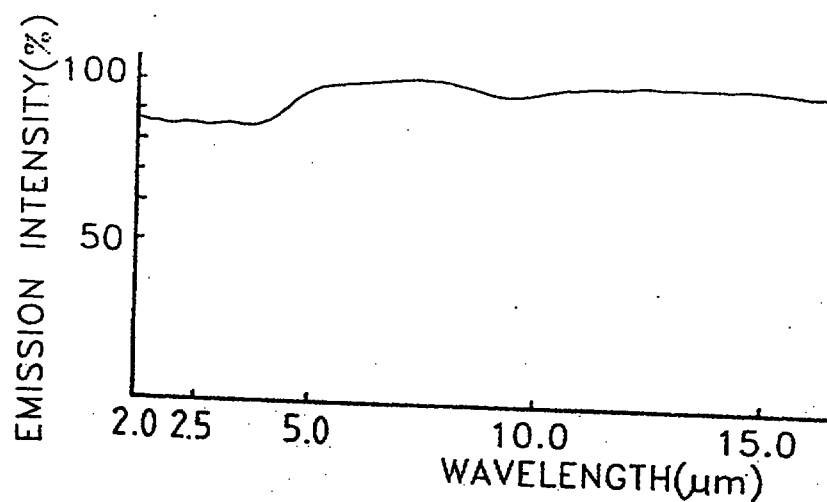


FIG.4B

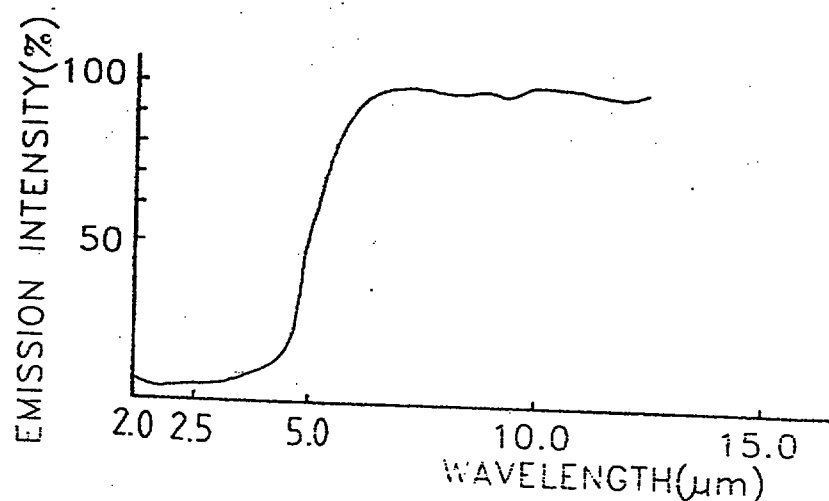
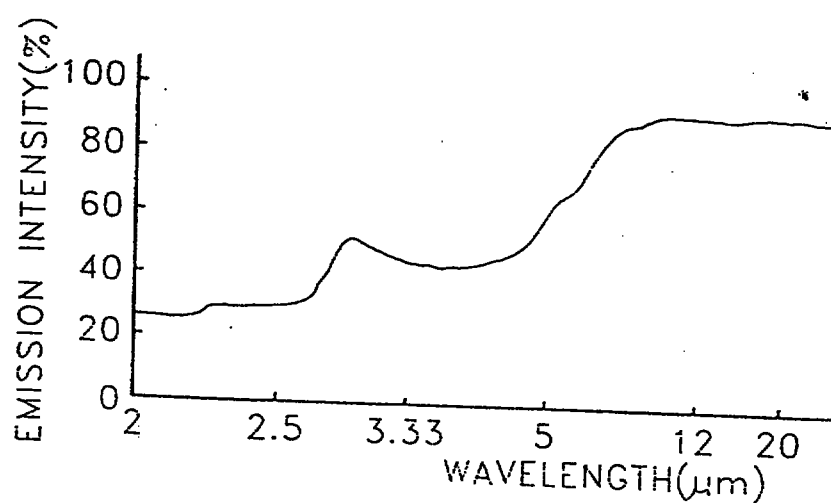


FIG.4C



This Sheet Has Been Replaced



FIG. 5A

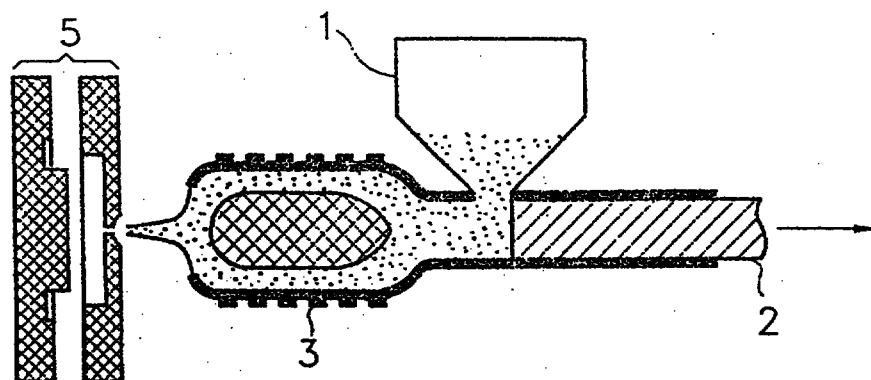


FIG. 5B

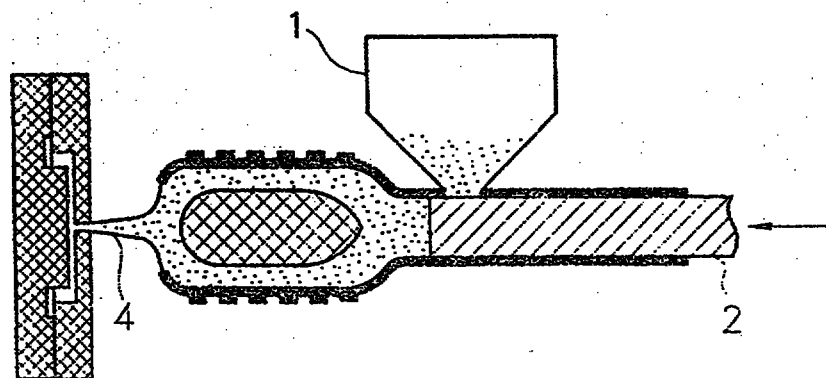


FIG. 6

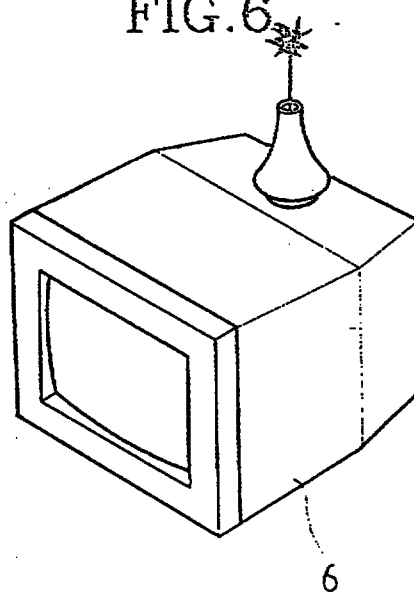


FIG. 7A



FIG. 7B



This Sheet Has Been Replaced

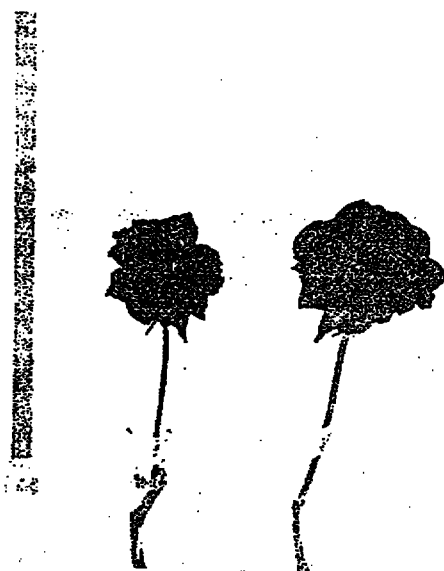
7



FIG.8A



FIG.8B



This Sheet Has Been Replaced 7



FIG.9A

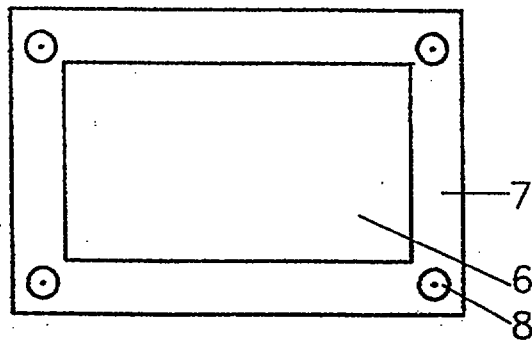


FIG.9B

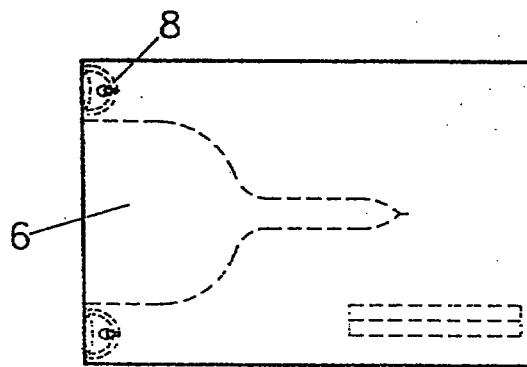
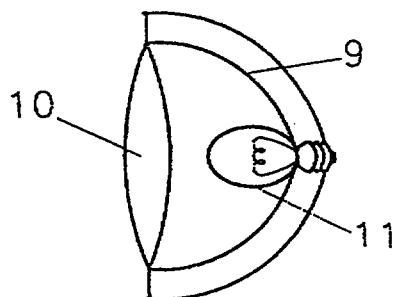


FIG.10



This Sheet Has Been Replaced



FIG.11A

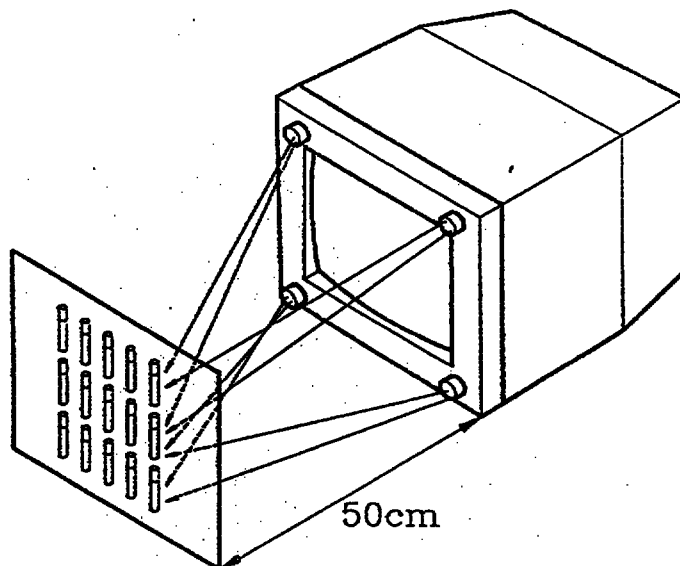


FIG.11B

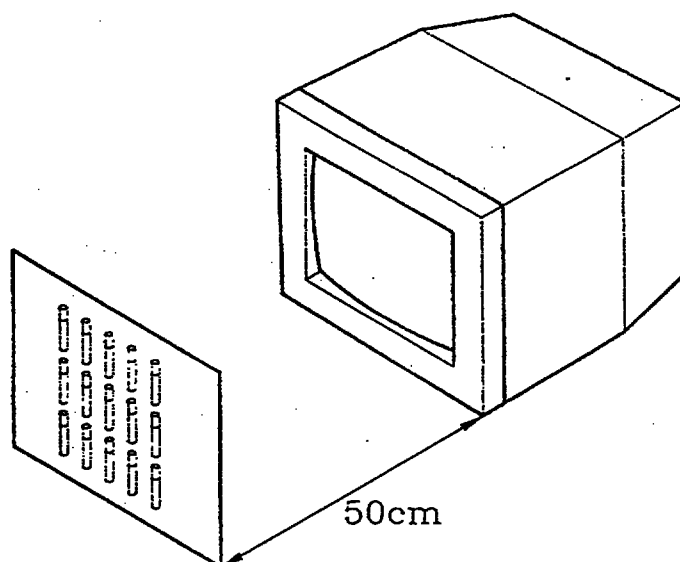


FIG.12A

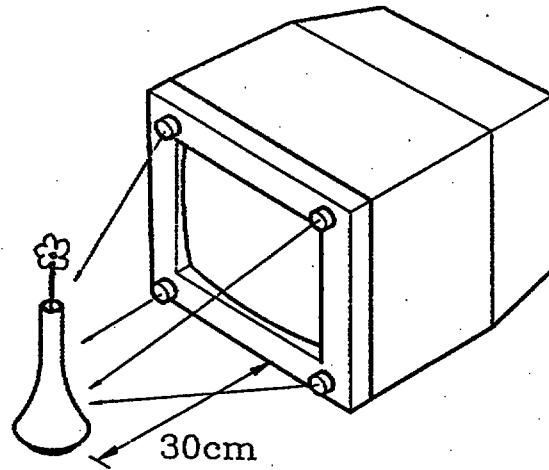


FIG.12B

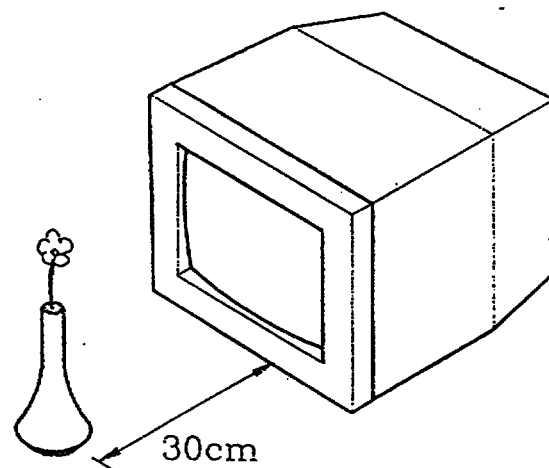


FIG. 13A

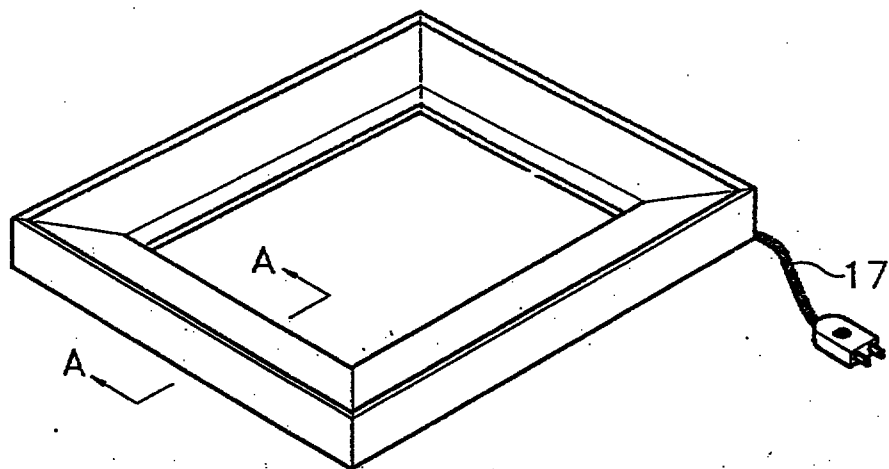


FIG. 13B

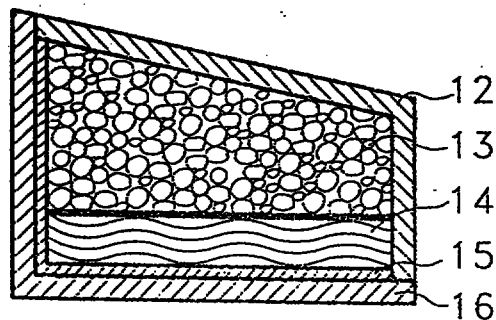


FIG. 14A

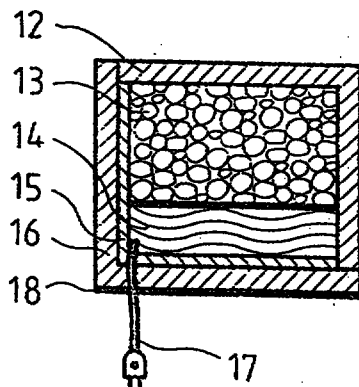


FIG. 14B

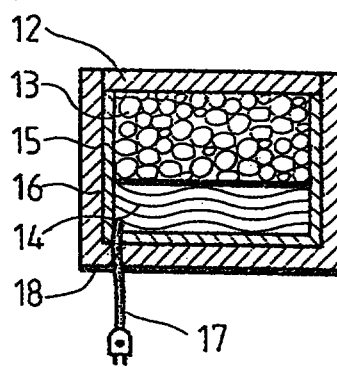


FIG. 15A

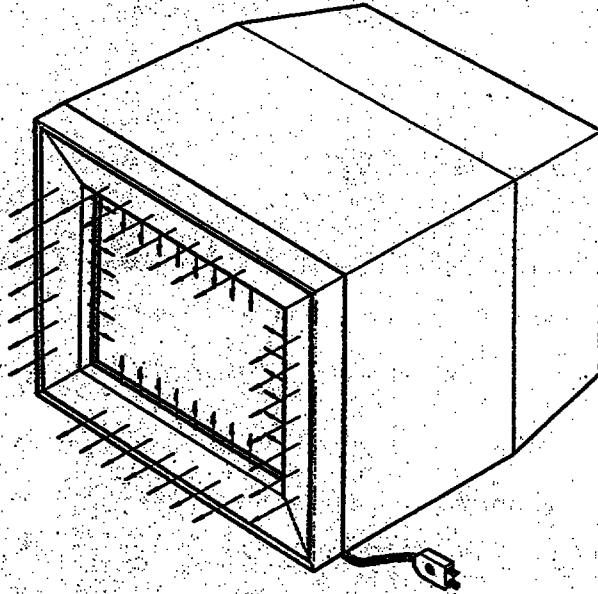


FIG. 15B

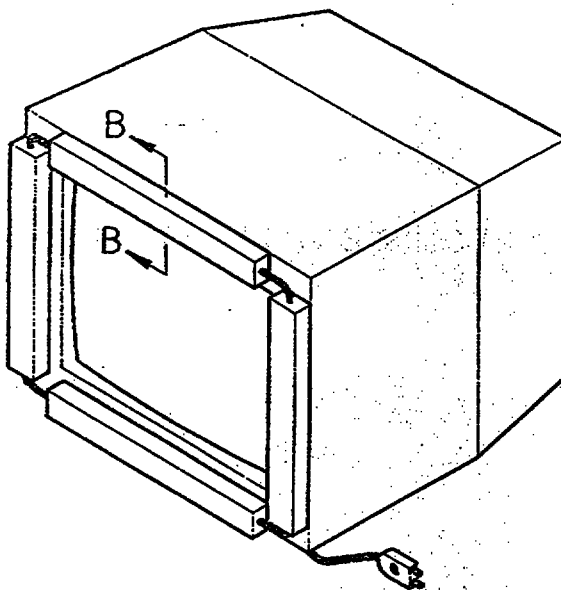
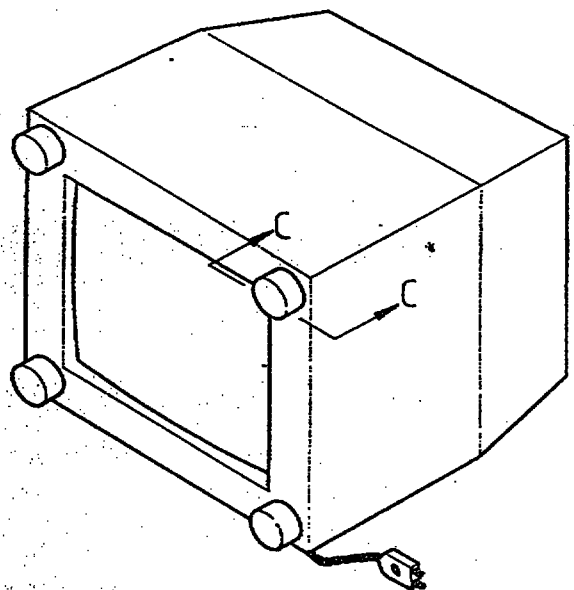


FIG. 15C



This Sheet Has Been Replaced



REPLACEMENT SHEETS		SG
☒ Description :	paged 1 to paged 27	
☒ Claim(s) :	paged 28 to paged 32	
☒ Drawing(s) :	paged 110 to paged 110	
☒ Abstract :	paged 33 to paged 33	
DATE OF RECEIPT		30 NOV 1996

FAR INFRARED EMITTING IMAGE DISPLAY DEVICE

The present invention is directed to a far infrared emitting image display device, and particularly to a far infrared emitting image display device manufactured by including far infrared emitting material in a cabinet for an image display device or attaching a far infrared emitting body to the cabinet to emit far infrared.

In the present society, that is, in an information-oriented society, the realisation of transmission systems for image display information is one symbol of modernity. However, image display devices malfunction and injure their operators' health because of electromagnetic waves emitted from the device, and this results, so to speak, in an exchange of health for convenience. The effects to the human body are called VDT (visual display terminal) syndrome and the symptoms are eye fatigue, ocular pain, impairment of eyesight, headache, chronic fatigue, etc. In order to remove and/or shield harmful electromagnetic waves, much effort has gone into attempts such as antistatic treatment, establishment of filters, establishing a magnetic field generators, etc. but high costs and doubts as to effectiveness still remain, and now it is considered that complete removal and/or shielding of the electromagnetic waves is impossible.

Far infrared rays are electromagnetic waves in the

This is the replacement sheet

Date: 30 NOV 1996

range of 5 to 1000 μ m (There is no critical definition of a standard wavelength region of far infrared. The above range is selected for the purposes of the present invention to exclude near infrared rays.) and affect the human body in two forms: thermal effect and non-thermal. The thermal effect is the effect of the thermal energy in the peripheral vein absorbed from the skin to the deep tissue or to the whole body, and the non-thermal effect arises from photons which correspond to far infrared of a specific wavelength to stimulate the receptor in the endothelia or cell membranes. This means that far infrared radiation of specific wavelengths transmits to and activates the cell. Therefore, far infrared rays act as a thermal energy source through thermal reaction, and as a photon source through a non-thermal reaction. In conclusion, far infrared radiation shows direct thermal action, indirect action through activation of water molecules, and non-thermal action of stimulating receptors of nerve cells located 100 μ m below the skin which perceive heat, cold, pain, etc. Through these actions, acceleration of blood circulation and fast relief from exhaustion are achieved.

Far infrared, especially in the 5.5 to 15 μ m region, is used as an energy source which stimulates stretching and bending vibrations of water molecules, and when the far infrared in this region is emitted to the human body, plants, and animals, water molecules which compose most of

This is the replacement sheet

Date: 30 NOV 1996

such living bodies are activated and this results in acceleration of blood circulation, shortening of health recovery times and food cooking time, acceleration of flower blooming, extension of flower life, etc. (See Japan illumination society Vol.72 No.12 1988, p717 "Application of far infrared to the human body", ibid Vol.74 No.12 1990, p796 "The present state of applying far infrared to the food industry and the future", Japan ceramics Vol.23 No.4 1988, p310 "Far infrared emitting materials and its application", published by Seoul Korean tourist information Co. & translated by W. S. Park "Far infrared")

A lot of research and development concerning the above-mentioned, beneficial far infrared has been done. Japanese Patent Laid-Open Publication No. Sho 63-198254, Sho 63-236284, Sho 63-248051, Hei 1-65786, Hei 1-77893 and Hei 1-169865 disclose techniques concerning the manufacture of a far infrared emitting lamp. Many applications employing these far infrared emitting lamps are also known. Japanese Patent Laid-Open Publication No. hei 2-57883 and hei 2-309169 to Hitachi disclose refrigerators employing far infrared emitting lamps, Japanese Patent Laid-Open Publication No. hei 2-306028 of Rinai discloses a microwave oven employing a far infrared emitting lamp, and Japanese Patent Laid-Open Publication No. hei 2-164365 discloses a bathtub employing a far infrared emitting lamp. In all of these publications, effects obtained by employing the far

This is the replacement sheet

Date: 30 NOV 1996

infrared emitting lamps are also disclosed together with various experimental data, and the results are satisfactory.

Water, of which most of the human body is composed, shows the following relation to the far infrared. FIG.1 is a graph illustrating the transmittance of water in accordance with the wavelength. As shown in this figure, water has the characteristic of absorbing light near the $3\mu\text{m}$ and $6\mu\text{m}$ regions and above. Since, the O-H bond between oxygen and hydrogen in the water molecule (H_2O , H-O-H), has stretching vibrations at 2.5 to $3.5\mu\text{m}$, and bending vibrations at 10 to $14\mu\text{m}$, water absorbs light when exposed to the light in these regions, and the vibration of the water molecule is accelerated. That is to say, water molecules become activated and then reorient themselves to form an ideal structure when the light in these region is supplied from the outside.

The wavelength of a human body can be calculated from body temperature, by example, in accordance with the Wien formula relation between absolute temperature and wavelength, defined as: $\lambda = 2897/T$ (where T denotes an absolute temperature and λ denotes a wavelength μm .) Here, when 309.5 (273+36.5) is substituted for T, the wavelength becomes $9.36\mu\text{m}$ which is within the far infrared range.

FIGS. 2A and 2B are graphical representations showing a spectral transmittance (2A) and a spectral reflectance

This is the replacement sheet

Date: 30 NOV 1996

(2B) of skin according to each wavelength, respectively. The far infrared emitted from human skin is within the range of 3 to 50 μ m, and in particular, the wavelength within the range of 8 to 14 μ m provides approximately 46% of the total emitted energy. The energy emitted to the skin is transmitted, reflected or absorbed, and therefore, the amount of the energy absorbed by the skin can be calculated considering FIGs. 2A and 2B. For example, most of the energy within 8 to 14 μ m region of which transmittance and reflectance are low, are considered to be absorbed by the skin.

Thus, upon supplying energy in this range, a living body mostly consisting of water absorbs and uses this energy as kinetic energy and is easily activated. This gives the following effects of early blossom of flowers, period shortening and early maturation of a hatching egg, prolonging cut flowers' life, etc. To the human body, the effect appears as micro massage effect, acceleration of perspiration and excretion, fast health recovery, etc.

Far infrared emitting materials are as follows: alumino-silicates ($\text{Al}_2\text{O}_3\text{-SiO}_2$), cordierites ($\text{MgO-Al}_2\text{O}_3\text{-SiO}_2$), zircons ($\text{ZrO}_2\text{-SiO}_2$), carbons, ferric oxide (Fe_2O_3), manganese dioxide (MnO_2), cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), lithium oxide (Li_2O), zinc oxide (ZnO), bismuth oxide (Bi_2O_3), barium oxide (BaO), titanium oxide (TiO_2),

This is the replacement sheet

Date: 30 NOV 1996

boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), phosphorus pentoxide (P_2O_5), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), etc.

FIG.3 is graphical representation of emitting intensity in accordance with the wavelength for several far infrared emitting materials with relation to that of the black body (measured at $40^\circ C$). The materials emit far infrared in 5 to $25\mu m$ wavelength region.

FIGs. 4A, 4B and 4C are graphical representation of emitting intensity against wavelength for several far infrared emitting mixtures, respectively. FIG.4A corresponds to the mixture of 60 wt% of SiO_2 , 20 wt% of Al_2O_3 , 5 wt% of Fe_2O_3 and 15 wt% of $TiO_2 \cdot MnO \cdot CaO \cdot MgO$, FIG.4B corresponds to the mixture of 50 wt% of ZrO_2 , 30 wt% of SiO_2 , 8 wt% of Al_2O_3 , 3 wt% of Fe_2O_3 , 3 wt% of BaO , 2 wt% of MgO and 4 wt% of CaO , and FIG.4C corresponds to the mixture of 50 wt% of SiO_2 , 45 wt% of Al_2O_3 , 3 wt% of K_2O and 2 wt% of Na_2O . From the figures, it is shown that each material emits far infrared at each specific wavelength region. Therefore, appropriate materials can be optionally used as occasion demands.

A cabinet, or case, which is a part of an image display device and exposed to view, is a supporting means carrying interior parts of the device. The cabinet is generally manufactured from engineering plastics material and especially from ABS resin, vinyl chloride resin and

This is the replacement sheet

Date: 30 NOV 1996

acryl resin. The cabinet is manufactured by mixing raw resin, pigment, stabilizer, etc., and injecting the mixture into a catapult and then injection molding the mixture.

The cabinet is most widely manufactured from ABS resin. The ABS resin is a kind of plastics material composed of styrene, acrylonitrile and butadiene, and has good impact-resistance and heat-resistance (heat-resisting temperature is 93°C). Table 1 illustrates heat-deformation temperatures for several cabinet-molding materials.

This is the replacement sheet

Date: 30 NOV 1996

<Table 1>

	samples	heat-deformation temperature (°C)
thermo- plastic resins	methacrylates	65-100
	vinyl chlorides	50-75
	poly vinyl alcohols	45-75
	nylons	-180
	fluorides	120
	celluloides	50-70
	celluloses	70-110
	styrenes	70-115
	polyethylenes	40-80
	polypropylenes	80-100
	polycarbonates	130
thermo- setting resins	phenol resins	70-120
	urinous resins	100-130
	melamine resins	150-200
	unsaturated polyester	-200
	alkyd resins	80-90
	silicones	>250
	foaming polyurethans	-100
	polyethylenes	40-80

This is the replacement sheet

Date: 30 NOV 1996

An object of the present invention is to provide a far infrared emitting image display device having various harmful factors, but which can reduce the user's uneasiness and economic burden and give a pleasant working environment.

To accomplish the above-mentioned object, there is provided in the present invention a far infrared emitting image display device comprising a cabinet for supporting and containing interior parts of the device, characterized in that the cabinet contains at least one selected from the group consisting of far infrared emitting materials, far infrared lamps and far infrared emitting devices, and so the image display device emits far infrared radiation.

The far infrared emitting materials can be contained in the cabinet through adding 1 to 30 wt% of the far infrared emitting materials into the raw materials for manufacturing the cabinet and then injection molding, or through coating the far infrared emitting material with a binder or a pigment on the surface of the cabinet.

The above-mentioned object of the present invention can also be accomplished by a far infrared emitting image display device comprising at least one far infrared emitting device containing a heating means to apply heat to a far infrared emitting material, a reflecting plate to reflect far infrared radiation which is outwardly emitted from the interior of said device, and a supporting means

This is the replacement sheet

Date: 30 NOV 1996

including these objects.

Embodiments of the present invention will now be described, by way of example, with reference to the attached drawings, in which:

FIG.1 is a graph illustrating the transmittance of water versus wavelength;

FIGs.2A and 2B are graphs showing spectral transmittance (2A) and spectral reflectance of skin (2B), versus wavelength;

FIG.3 is a graph showing emission intensity versus wavelength for various far infrared emitting materials with relation to that of the black body;

FIGs.4A, 4B and 4C are graphs showing emission intensity versus wavelength for various far infrared emitting mixtures;

FIGs.5A and 5B illustrate injection molding process for manufacturing a cabinet;

FIG.6 is a drawing for explaining the method of experiment 1 below;

FIGs.7A and 7B are photographs of chrysanthemums demonstrating the far infrared emission effect of the image display device manufactured through example 1 of the present invention;

FIGs.8A and 8B are photographs of roses demonstrating the far infrared emission effect of the image display device manufactured through example 2 of the present

This is the replacement sheet

Date: 30 NOV 1996

invention;

FIGs.9A and 9B are a front view (9A) and a side view (9B) of the image display device according to the second embodiment of the present invention;

FIG.10 is a longitudinal cross-sectional view of the far infrared emitting lamp which is preferably employed in embodiments of the present invention;

FIGs.11A and 11B are drawings for explaining experiment 3 below;

FIGs.12A and 12B are drawings for explaining experiment 4 below;

FIGs.13A and 13B illustrate the basic structure of a far infrared emitting device according to an embodiment of the present invention, in which FIG.13A is a perspective view of the device and FIG.13B is a cross-sectional view cut along line A-A of the device shown in FIG.13A;

FIG.14A is a cross-sectional view cut along line B-B of the device shown in FIG.15B illustrating another embodiment of the present invention and corresponding to FIG.13B;

FIG.14B is a cross-sectional view cut along line C-C of the device shown in FIG.15C which is a further another embodiment of the present invention;and

FIGs.15A, 15B and 15C illustrate image display devices employing the far infrared emitting devices illustrated in FIGs.13B, 14A and 14B, respectively.

This is the replacement sheet

Date: 30 NOV 1996

Preferred embodiments of the present invention are described in detail below. The method for manufacturing far infrared emitting image display devices according to embodiments of the present invention will be explained in examples and the effect of far infrared emitting image display devices according to embodiments of the present invention will be explained in experiments.

As a first embodiment of the present invention, there is provided a far infrared emitting image display device comprising a cabinet for supporting and containing interior parts of the device, characterized in that the cabinet comprises far infrared emitting materials.

The far infrared emitting materials can be contained in the cabinet or coated on the surface of the cabinet.

Where the far infrared emitting materials are contained in the cabinet by mixing the materials with the raw materials for manufacturing the cabinet and then molding the mixture, the amount of the far infrared emitting materials added ranges from 1 to 30 wt% based on the total amount of the raw materials for manufacturing the cabinet. If the amount added is less than 1 wt%, only a weak far infrared emitting effect is obtained and if the amount added is more than 30 wt%, the impact-resistance of the resulting cabinet is too weak and formation of the cabinet becomes difficult. The preferred amount ranges from 5 to 15 wt%.

This is the replacement sheet

Date: 30 NOV 1996

The preferred material for emitting far infrared is at least one selected from the group consisting of aluminium oxide (Al_2O_3), silicon dioxide (SiO_2), magnesium oxide (MgO), zirconium oxide (ZrO_2), carbons, ferric oxide (Fe_2O_3), manganese dioxide (MnO_2), manganese monoxide (MnO), cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), titanium oxide (TiO_2), boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), zinc oxide (ZnO), lithium oxide (Li_2O), bismuth oxide (Bi_2O_3), phosphorous pentoxide (P_2O_5), barium oxide (BaO) and composites thereof.

When a household television set, computer monitor, etc. operates, the temperature in the cabinet reaches about 40 to 70°C, and so the far infrared emitting materials contained in the cabinet emit more far infrared radiation.

FIGs. 5A and 5B illustrate injection molding process for manufacturing a cabinet. The cabinet is manufactured by putting the raw mixture materials in a hopper 1 and then sending the mixture through a nozzle outlet 4 by means of a piston 2, so that the mixture melts when passing a heating means 3 and the melted mixture is molded into the predetermined shape of a cabinet in a mould 5.

This is the replacement sheet

Date: 30 NOV 1996

<Example 1>

70 wt% of SiO_2 , 25 wt% of Al_2O_3 , and 5 wt% of Fe_2O_3 are mixed to produce a far infrared emitting ceramic. 15 wt% of the mixture is added and homogeneously dispersed into the raw materials for manufacturing an ABS cabinet. A cabinet for supporting and containing the parts of an image display device is manufactured through a desired method, such as that shown in FIG.5.

<Example 2>

60 wt% of ZrO_2 , 25 wt% of SiO_2 , 5 wt% of Al_2O_3 , 3 wt% of Fe_2O_3 , 3 wt% of MgO and 4 wt% of TiO_2 are mixed to produce a far infrared emitting ceramic. The procedure follows the same manner described in example 1, except that the amount of the ceramic added is 10 wt% based on the amount of the raw materials for manufacturing an ABS cabinet.

<Experiment 1>

A 14" monitor is manufactured by employing the cabinet obtained through example 2. FIG.6 is a drawing for explaining the method of this experiment. In FIG.6, a vase holding a flower is located on the cabinet. Here, two chrysanthemums blooming to the same extent are put into two vases, respectively. One vase is placed as shown in Fig. 6

This is the replacement sheet

Date: 30 NOV 1996

on a 14" monitor which employs the cabinet containing the far infrared emitting materials, and the other is placed on a 14" monitor which employs the same cabinet but does not contain far infrared emitting materials. After leaving the flowers for 10 days while the monitors are operating, the changes in the two flowers are observed. FIG.7A is a chrysanthemum photograph taken before the monitors were turned on. It can be seen that the two flowers are blooming to the same extent. FIG.7B is a chrysanthemum photograph taken after 10 days, in which on the left is the flower that was placed on the monitor employing the standard cabinet and on the right is the flower that was on the monitor with the cabinet containing far infrared emitting materials. In FIG.7B, the flower that was on the monitor employing the cabinet which contains the far infrared emitting materials is still fresh and its leaves are growing. However, the flower that was on the monitor employing the ordinary cabinet is withering.

Another method for applying far infrared emitting materials to the cabinet is by coating the materials on the inner or outer surface of the cabinet with a binder and/or sprayer.

<Example 3>

5 wt% of the same far infrared emitting ceramic as in

This is the replacement sheet

Date: 30 NOV 1996

example 1 is mixed with 95 wt% of acrylic binder. The mixture is coated on the outer surface of an ABS resin cabinet and heat dried to manufacture a far infrared emitting material coated cabinet.

<Example 4>

3 wt% of the same far infrared emitting ceramic as in example 1 is mixed with 96 wt% of vinyl chloride-based, heat sensitive binder. To the mixture, a small amount of a surfactant and polyvinyl alcohol is added and homogeneously mixed. The mixture is coated on the inner surface of an ABS resin cabinet and heat dried at 40 to 50°C to manufacture a far infrared emitting material coated cabinet.

<Example 5>

25 wt% of the same far infrared emitting ceramic as in example 2 is mixed with 50 wt% of vinyl chloride resin, 15 wt% of acrylic ester-based plasticizer, 1 wt% of zinc-based stabilizer, 2 wt% of epoxy-based stabilizer and 7 wt% of acrylic binder. The mixture is coated on the inner and outer surface of an ABS resin cabinet and dried to manufacture a far infrared emitting material coated cabinet.

This is the replacement sheet

Date: 30 NOV 1996

<Experiment 2>

The effect of far infrared is demonstrated in the same manner as in experiment 1 with 14" monitors employing an ordinary cabinet and the far infrared emitting material coated cabinet manufactured through example 5. Two roses blooming to the same extent are put into respective vases, and are placed on each cabinet as shown in FIG.6. The changes of the flowers were observed after turning the monitors on. FIG.8A is a photograph taken after one day. In the photograph, the left flower was exposed to the ordinary monitor and the right flower was exposed to the monitor employing the cabinet containing the far infrared emitting material. The two flowers show no difference so far. FIG.8B is a photograph taken after five days. From the photograph, it can be seen that the flower exposed to the ordinary monitor is wilted and withered, while the flower exposed to the monitor containing far infrared emitting material is still fresh.

As another embodiment of the present invention, there is provided a far infrared emitting image display device comprising a cabinet, characterized in that the cabinet includes at least one far infrared emitting lamp.

It is preferred that a black far infrared emitting material is coated on the surface of the bulb so that the transmittance of visible rays is lowered and does not

This is the replacement sheet

Date: 30 NOV 1996

fatigue the user's eyes.

Also, it is preferred that a reflecting plate is provided to the rear of the bulb so that far infrared emission efficiency is increased. The most preferred approach is coating the far infrared emitting material on the surface of the reflecting plate so that far infrared emission efficiency is even further increased.

For the far infrared emitting materials, those used for manufacturing the cabinet can be employed. Particularly preferred are silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), manganese oxide (MnO), ferric oxide (Fe_2O_3), titanium oxide (TiO_2), zirconium oxide (ZrO_2) and magnesium oxide (MgO).

It is also preferred that coloured glass or a protector made of plastic is provided in order to protect the bulb and shield the light from the far infrared emitting lamp.

The temperature resulting from the heat from the far infrared emitting lamp should be lower than the melting temperature of the cabinet constituting materials (commonly used ABS resin: 93°C), and should preferably be lower than 90°C while maintaining the supplying power lower than 20W.

For user convenience, the far infrared emitting lamps can be installed so that their direction is changeable according to the user's orientation, and are selectively lit up according to need.

This is the replacement sheet

Date: 30 NOV 1996

FIGS. 9A and 9B are a front view (9A) and a side view (9B) of the image display device according to this embodiment of the present invention. The device is manufactured by installing far infrared emitting lamps 8 on the front of the cabinet 7. The reference numeral 6 denotes a cathode ray tube.

FIG. 10 is a longitudinal cross-sectional view of the far infrared emitting lamp which is preferably employed in the present invention. A reflecting plate 9 is provided to the rear of the far infrared emitting bulb 11 and a protecting cover 10 is provided on the front of cabinet 7.

Any lamp that can emit far infrared radiation such as an incandescent electric lamp, a halogen lamp, etc. can be employed as the far infrared emitting lamp. These all emit heat of their own accord. The emitted heat enhances the far infrared emission intensity. However, since too much heat might melt the cabinet material, the lamp capacity should be restricted and the temperature should not exceed 90°C. (The melting point of the commonly used ABS resin is 93°C.)

In order to prevent the user's eyes from being dazed by the emitted light, the bulb could be treated so as to have a black tinge, black far infrared emitting ceramic could be used, or a dark-coloured protecting cover can be used. Any protecting cover that can partially shield the light and thus prevent it from being too bright can be employed.

This is the replacement sheet

Date: 3.0 NOV 1996

Further, in order that the far infrared emits forwardly and toward the user, and the rays are focused, a reflecting plate can be provided around the bulb as shown in FIG.10.

It is preferred that one or more far infrared lamps be optionally provided to each image display device and each lamp be optionally lit according to the user's need. Of course, it is desirable that the lamp is designed so that the direction in which the rays are focused is freely adjustable according to the user's orientation, the chair height, the height of the user, etc.

The effect of the image display device employing the far infrared lamp is demonstrated by the following experiments.

<Experiment 3>

FIG.11A illustrates a 14" colour monitor employing far infrared emitting lamps, and FIG.11B illustrates a 14" colour monitor which does not employ a far infrared emitting lamp. Further details of the image display device employing the far infrared emitting lamps in FIG.11A are as follows. The far infrared lamps are installed on the four corners of the front of the cabinet as illustrated in the drawings. The lamp is manufactured by coating the surface of an incandescent electric bulb with the mixture of metal

This is the replacement sheet

Date: 30 NOV 1996

oxides of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), manganese oxide (MnO) and ferric oxide (Fe_2O_3) with resin. The coating layer is black. On the surface of the reflection plate, a mixture of 20 wt% of far infrared ceramic with water glass is coated. The capacity of the incandescent bulb is 110V 7W, and the temperature of the bulb center reaches 70°C 5 minutes after turning the bulb on. At a distance of 50cm in front of the two monitors, cigarettes are located as illustrated in the drawings (room temperature 25°C , humidity 60% RH). After leaving the switches of the two image display devices turned on for 24 hours, a functional test of the taste of the cigarettes was carried out with 15 persons. After the functional test, all 15 persons reported that the taste of the far infrared emitted cigarettes was different from that of the cigarettes located in front of the conventional monitor, and 12 persons among these further reported that the former was milder than the latter.

<Experiment 4>

The far infrared lamp is installed in an image display device by the same method described in experiment 3. A far infrared emitting ceramic composed of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), titanium oxide (TiO_2) and magnesium oxide (MgO) is coated on the surface of the bulb.

This is the replacement sheet

Date: 30 NOV 1996

In this case, since the coating layer is near white, a protective cover is provided in order to reduce eye fatigue. The protective cover is made of coloured glass having a transmittance of 43% at 560nm.

FIGs.12A and 12B are drawings for explaining this experiment. In this experiment, two roses blooming at the same extent are put in front of a 14" colour monitor employing a far infrared lamp and a common 14" colour monitor, in each case at 30cm distance, and changes in the flowers were observed over time. The capacity of the far infrared lamp is 7.5W 120V, and the temperature of the bulb surface reaches 65°C 5 minutes after turning the monitors on. The room temperature was 25°C and the humidity was 65% RH.

In the course of the experiment, the rose exposed to the conventional monitor immediately withered owing to the electromagnetic waves emitted from the cathode ray tube and circuitry thereof. However, the rose exposed to the far infrared emitting monitor of the present invention remained in full bloom for a long time (about 6 days or longer) because the far infrared emitted from the device compensates for the damage owing to the harmful electromagnetic waves. This means that the far infrared emission activated water molecules, provided essential energy needed for growing the plant, and extended its freshness.

This is the replacement sheet

Date: 30 NOV 1996

As the third embodiment, there is provided in the present invention a far infrared emitting image display device employing at least one far infrared emitting devices for image display device, which comprises far infrared emitting material, a heating means to apply heat to the far infrared emitting material, a reflecting plate to reflect far infrared radiation outwardly emitted from the interior of the device, and a supporting means including these objects.

As for the far infrared emitting materials, low-temperature, high-efficiency far infrared emitting materials which can emit far infrared in high efficiency at low temperature such as aluminium oxides (Al_2O_3), silicon dioxides (SiO_2), zirconium oxides (ZrO_2), etc. are preferably used, so that they might not deform the supporting frame such as ABS resin, vinyl chloride-based resin, acrylic resin, etc.

In order to attach the far infrared emitting device to the image display device, an attaching means is required. This can be fixed through a binder or through the change of a molding design of the cabinet when manufacturing the image display device.

An embodiment will be described in detail below referring to the attached drawings.

FIGs.13A and 13B illustrate the basic structure of a far infrared emitting device according to this embodiment,

This is the replacement sheet

Date: 30 NOV 1996

in which FIG.13A is a perspective view and FIG.13B is a cross-sectional view of the device. As a supporting and containing means 16, a commonly used material for a cabinet case of an image display device such as ABS resin is used and above it, a reflecting plate 15 is provided. Above the reflecting plate 15, a heating means 14 is provided to increase far infrared emission. The applied heat should not exceed a temperature that might change the quality of this device; up to 50°C is sufficient. Above the heating means, a far infrared emitting layer 13 manufactured by compacting, molding or coating far infrared emitting materials is prepared. As for far infrared emitting materials, low-temperature, high-efficiency far infrared emitting ceramics such as aluminium oxide, silicon dioxide, zirconium oxide, etc. are preferably employed.

The upper surface and the inner side of this far infrared emitting device is preferably provided with a transparent acryl layer 12 to maintain the efficiency of the far infrared emission. However, since a far infrared reflecting plate 15 and a heating means 14 are provided in the device, a layer made of an opaque ABS resin, vinyl chloride resin etc. shows a sufficiently good effect. The heater is connected to a source of electric power 17 external to the device.

The far infrared emitting device of this embodiment is designed so that this device does not shield the image

This is the replacement sheet

Date: 30 NOV 1996

reproduced on an image display device, and is attached to the front side of the cabinet or installed in the cabinet which has been designed and manufactured for installing this device. A cord to a source of electric power can be connected to a external source or can be drawn out to a circuit part in the cabinet and connected to it when fabricating the set.

Since the thus obtained image display device employing the far infrared emitting device on the front of the image display device emits far infrared towards the place where an operator is located, the operator can receive the far infrared effect.

FIGs.14A and 14B illustrate other embodiments of the far infrared emitting devices (cross-sectional view) which have the same structure as the far infrared emitting device illustrated in FIG.13B, but are a stick-type (FIG.14A) and a cylinder-type (FIG.14B), and they are manufactured to be used as required. The reference numeral 18 denotes a connecting means such as a binder.

FIGs.15A, 15B and 15C illustrate the image display devices employing the far infrared emitting devices illustrated in FIGs.13B, 14A and 14B, respectively. These all emit far infrared radiation forward. In FIG.15A, the arrows indicate the emitting direction of the far infrared rays.

To demonstrate the effect of the far infrared when

This is the replacement sheet

Date: 30 NOV 1996

employing far infrared emitting devices in image display devices, the following experiment was carried out.

<Experiment 5>

A far infrared emitting device as illustrated in FIG.13A, is provided on a 14" CDT (colour display tube) as illustrated in FIG.15A. A heater 14 is connected to a source of electric power and the far infrared emitting material is heated to 40°C. Two chrysanthemums blooming at the same extent are put in front of the 14" colour monitor employing the far infrared emitting device and an ordinary 14" colour monitor, both at 30cm distance as illustrated in Figs. 12A and 12B. After turning the monitors on, the change of the flowers are observed over time. Temperatures and other environment factors were kept equal.

In this experiment, the two chrysanthemums originally blooming equally showed distinct differences after seven days. The chrysanthemum that was located in front of the ordinary image display device withered more than that located in front of the image display device employing the far infrared emitting device. After fourteen days, the chrysanthemum that was located in front of the ordinary image display device almost completely withered. However, the chrysanthemum located in front of the image display device employing the far infrared emitting device kept

This is the replacement sheet

Date: 30 NOV 1996

fresh and its leaves began to bud.

As shown above, the far infrared emitting device can be simply attached to the image display device and can provide far infrared effects to users. This device is adaptable for practical use and can be manufactured into any shape.

As confirmed from the above examples and experiments, since the image display device containing the far infrared emitting source emits far infrared radiation which is beneficial to a living body, the users of these kind of devices can counterbalance the damage owing to harmful electromagnetic waves, and can receive vitality and energy from the far infrared radiation.

While the present image display device has been particularly shown and described with reference to particular embodiments thereof, it will be understood by those skilled in the art that various changes in form and details. For example, a television, computer monitor, LCD, PDP, etc. may be effected thereby without departing from the scope of the invention as defined by the appended claims.

This is the replacement sheet

Date: 30 NOV 1996

CLAIMS:

1. A far infrared emitting cabinet for supporting and containing interior parts of an image display device, wherein said cabinet contains far infrared emitting materials and is moulded from a mixture containing 1 to 30 wt% of said far infrared emitting materials.

2. A far infrared emitting cabinet as claimed in claim 1, wherein said amount of said far infrared emitting materials is 5 to 15 wt%.

3. A far infrared emitting cabinet for supporting and containing interior parts of an image display device, wherein said cabinet contains far infrared emitting materials in the form of a mixture of said far infrared emitting materials with a binder or a pigment coated on the surface of said cabinet.

4. A far infrared emitting cabinet as claimed in any preceding claim, wherein said far infrared emitting material is at least one selected from the group consisting of aluminium oxide (Al_2O_3), silicon dioxide (SiO_2), magnesium oxide (MgO), zirconium oxide (ZrO_2), carbons, ferric oxide (Fe_2O_3), manganese dioxide (MnO_2), cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), titanium oxide (TiO_2), boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), lithium

This is the replacement sheet



Date: 30 NOV 1995

oxide (Li_2O), zinc oxide (ZnO), bismuth oxide (Bi_2O_3), phosphorous pentoxide (P_2O_5), barium oxide (BaO) and composite thereof.

5. A far infrared emitting cabinet for supporting and containing interior parts of an image display device comprising a far infrared lamp mounted on the front-side of the cabinet.

6. A far infrared emitting cabinet as claimed in claim 5, wherein said far infrared lamp comprises a reflecting plate behind a far infrared emitting bulb.

7. A far infrared emitting cabinet as claimed in claim 6, wherein the surface of said bulb of said far infrared lamp is coated with a black far infrared emitting material.

8. A far infrared emitting cabinet as claimed in claim 7, wherein said far infrared emitting material is at least one selected from the group consisting of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), manganese oxide (MnO), manganese dioxide (MnO_2), ferric oxide (Fe_2O_3), cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), lithium oxide (Li_2O), zinc oxide (ZnO), bismuth oxide (Bi_2O_3), phosphorous pentoxide (P_2O_5), barium oxide (BaO), titanium oxide (TiO_2), zirconium oxide (ZrO_2) and magnesium oxide (MgO).



This is the replacement sheet

Date: 30 NOV 1998

9. A far infrared emitting cabinet as claimed in any of claims 6 to 8, wherein said far infrared lamp further comprises a protecting cover made of coloured glass or plastics material.

10. A far infrared emitting cabinet as claimed in any of claims 6 to 9, wherein the supplying power is lower than 20W and the temperature resulting from the heat from the far infrared emitting lamp is lower than 90°C.

11. A far infrared emitting cabinet as claimed in any of claims 6 to 10, wherein said far infrared lamp is installed so that the direction of said lamp is changeable according to the orientation of the user.

12. A far infrared emitting cabinet as claimed in any of claims 6 to 11, wherein said far infrared lamp is installed so as to be selectively lit up according to need.

13. A far infrared emitting cabinet as claimed in claim 6 or any of claims 7 to 12 where dependent on claim 6, wherein said reflecting plate is coated with far infrared emitting materials on the surface of said plate.

14. An image display device comprising a far infrared emitting cabinet as claimed in any of claims 1 to 13.

15. A far infrared emitting device for mounting to an image display device, said far infrared emitting device containing a heating means to apply heat to a far infrared emitting material, a reflecting plate to reflect far infrared radiation emitted from the interior of said

This is the replacement sheet

Date:

30 NOV 1996



device, and a supporting means for these objects.

16. A far infrared emitting device as claimed in claim 15, wherein said far infrared emitting material is at least one selected from the group consisting of aluminium oxide (Al_2O_3), silicon dioxide (SiO_2), zirconium oxide (ZrO_2), magnesium oxide (MgO), carbons, ferric oxide (Fe_2O_3), manganese dioxide (MnO_2), cupric oxide (CuO), tricobalt tetroxide (Co_3O_4), nickel monoxide (NiO), chromic oxide (Cr_2O_3), titanium oxide (TiO_2), boron oxide (B_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O), molybdenum sesquioxide (Mo_2O_3), calcium oxide (CaO), lithium oxide (Li_2O), zinc oxide (ZnO), bismuth oxide (Bi_2O_3), phosphorous pentoxide (P_2O_5), barium oxide (BaO) and composite thereof.

17. A far infrared emitting device as claimed in claim 15 or 16, wherein said supporting means is made of at least one selected from the group consisting of ABS resin, vinyl chloride-based resin and acryl resin.

18. A far infrared emitting device as claimed in any of claims 15 to 17, wherein said far infrared emitting device further comprises a connecting means for its connection to said image display device.

19. A far infrared emitting device as claimed in claim 18, wherein said connecting means is a binder.

20. An image display device comprising a far infrared emitting device as claimed in any of claims 15 to 19.

21. A far infrared emitting image display device



This is the replacement sheet

Date: 30 NOV 1996

comprising a cabinet for supporting and containing interior parts of the device, wherein said cabinet contains at least one selected from the group consisting of far infrared emitting materials, far infrared lamps and far infrared emitting devices, to emit far infrared radiation.

22. A far infrared emitting image display device substantially as hereinbefore described with reference to the accompanying drawings.



This is the replacement sheet

Date: 30 NOV 1996

ABSTRACTFAR INFRARED EMITTING IMAGE DISPLAY DEVICE

A far infrared emitting image display device comprising a cabinet which emits far infrared. The cabinet contains at least one of the following to emit for infrared: far infrared emitting materials, far infrared lamps and far infrared emitting devices. To counteract harmful electromagnetic waves emitted from image display devices, beneficial far infrared is emitted.

[FIG.15A]

This is the replacement sheet

Date: 30 NOV 1996

FIG.1

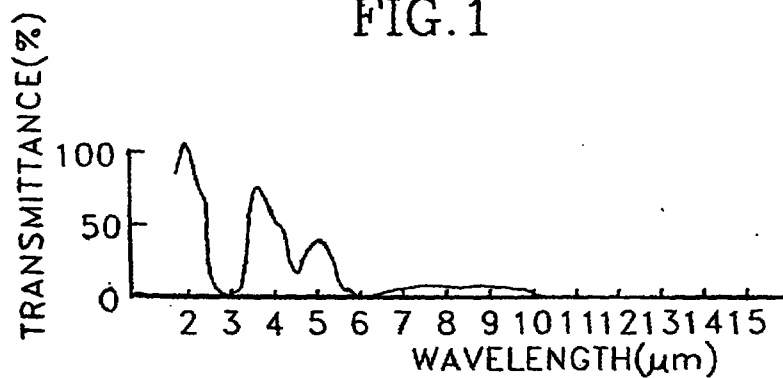


FIG.2A

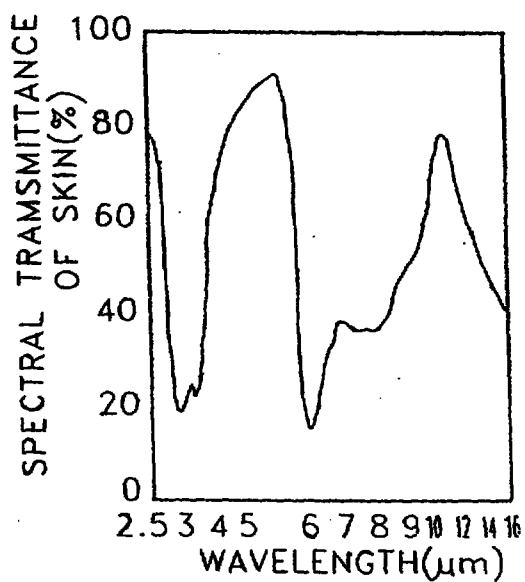


FIG.2B

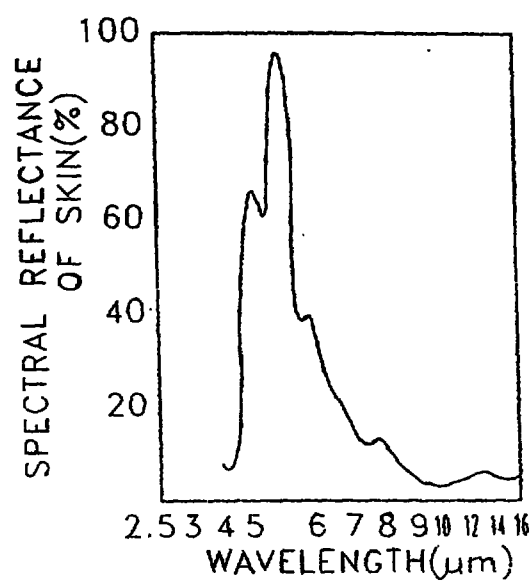
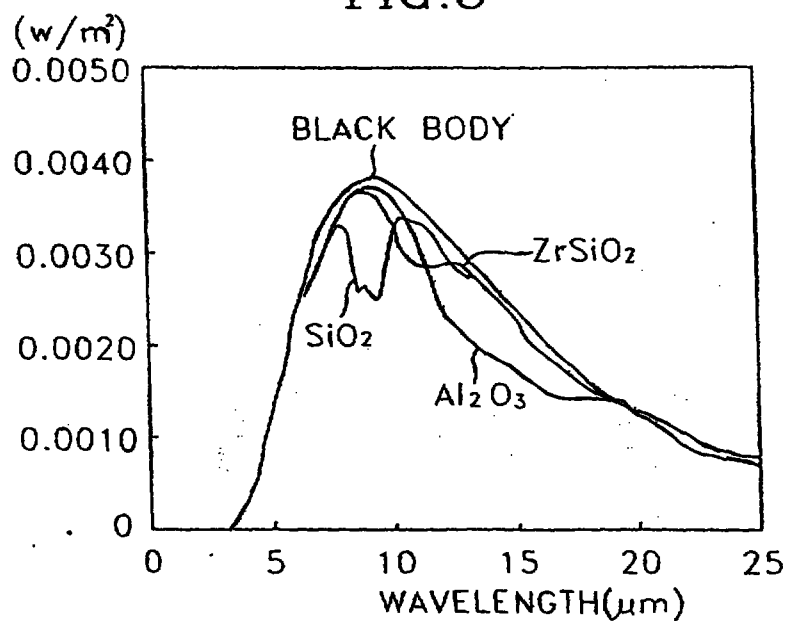


FIG.3



This is the replacement sheet

30 NOV 1996

Date:

FIG.4A

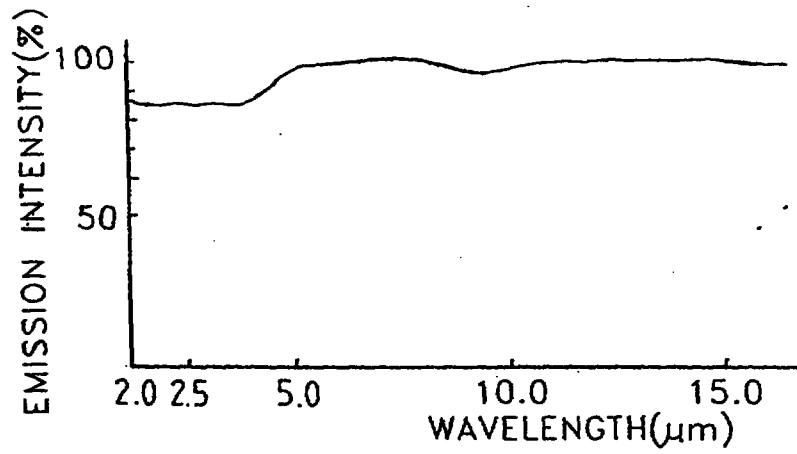


FIG.4B

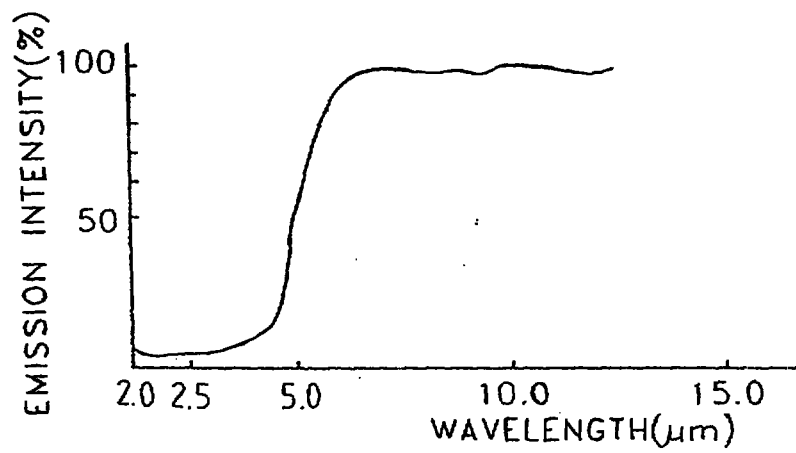
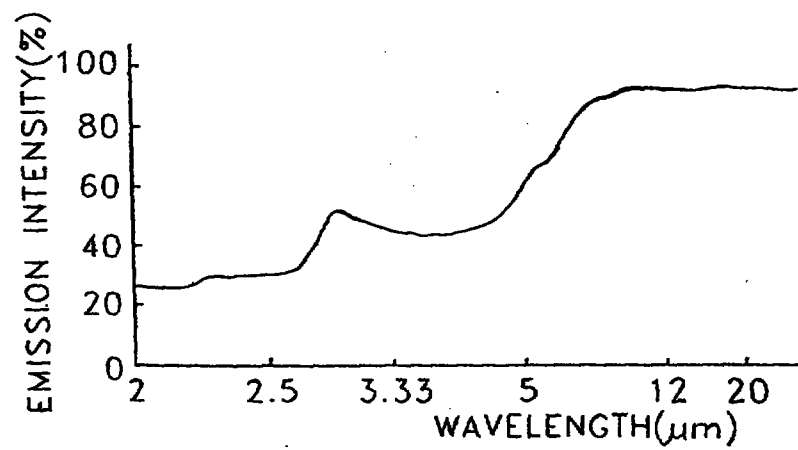


FIG.4C



This is the replacement sheet

30 NOV 1996

Date:

FIG.5A

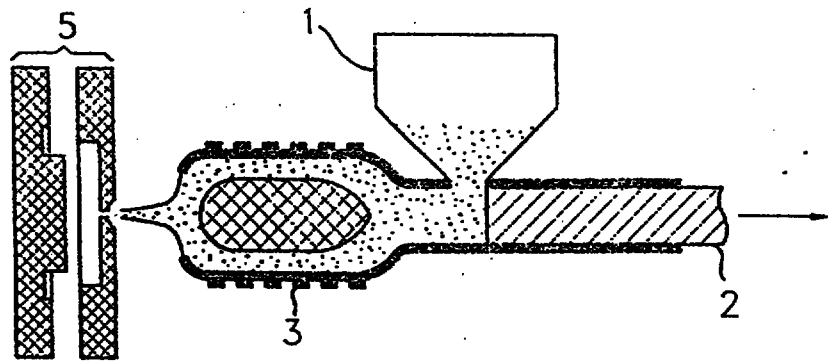


FIG.5B

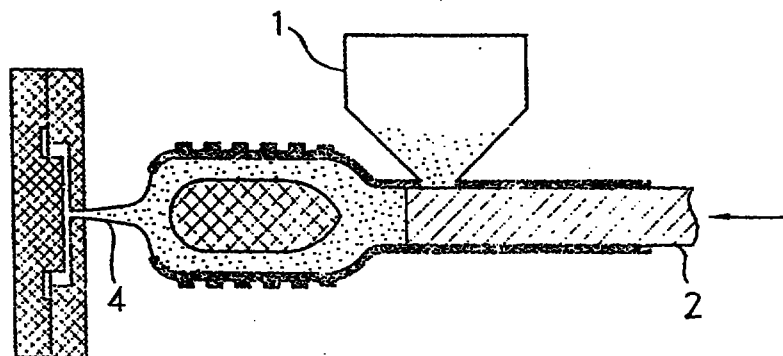
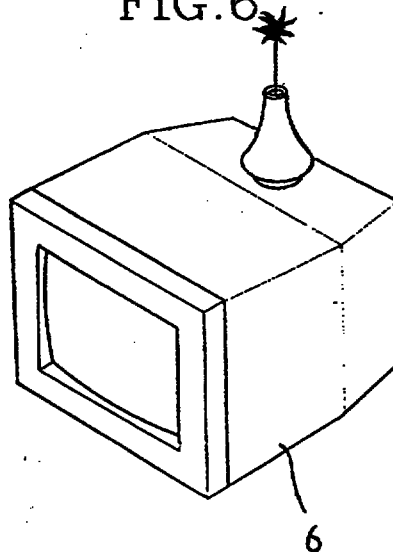


FIG.6



This is the replacement sheet

Date: 3 0 NOV 1996

4/10

FIG.7A

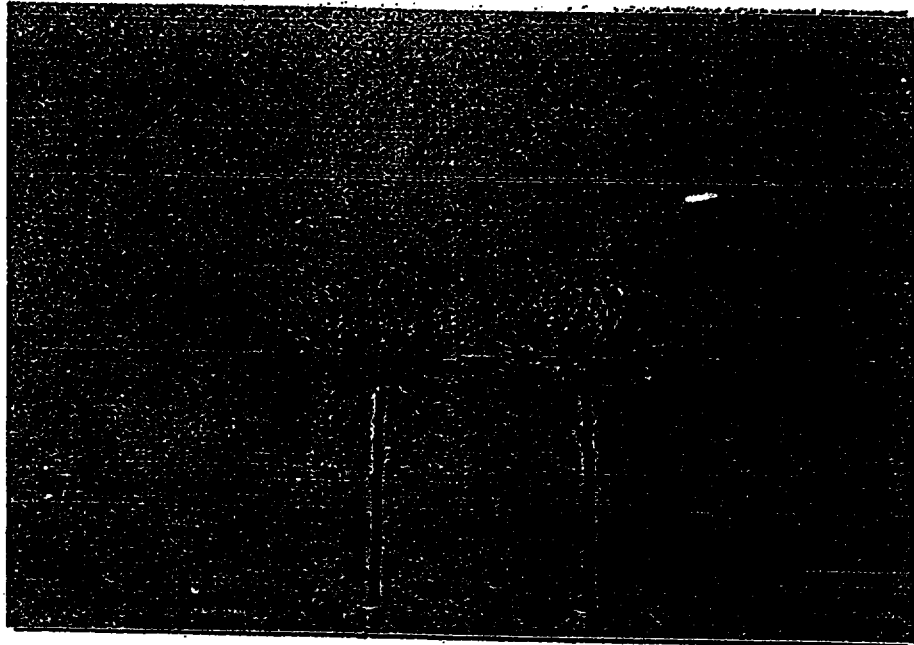
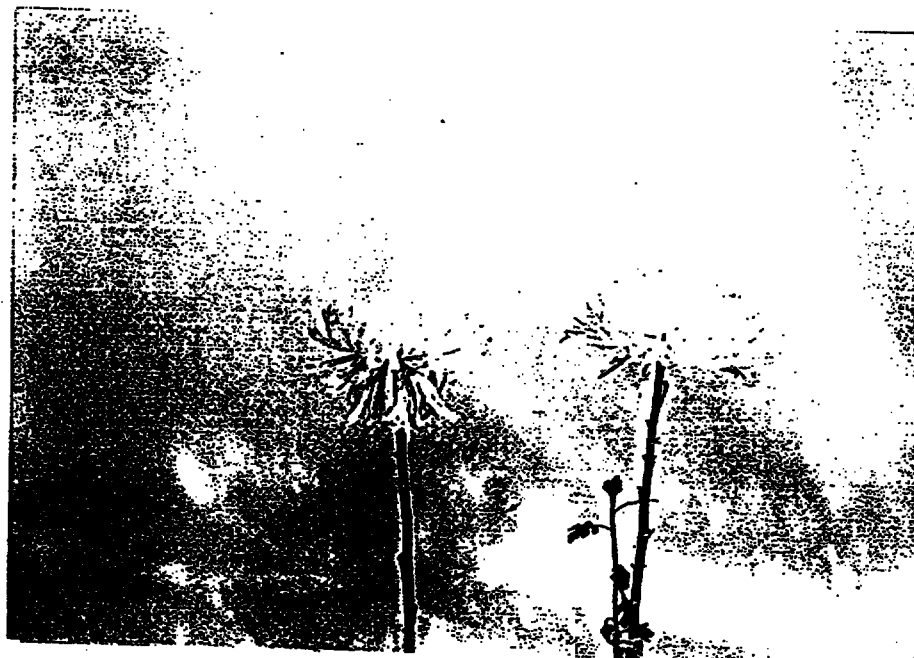


FIG.7B



This is the replacement sheet

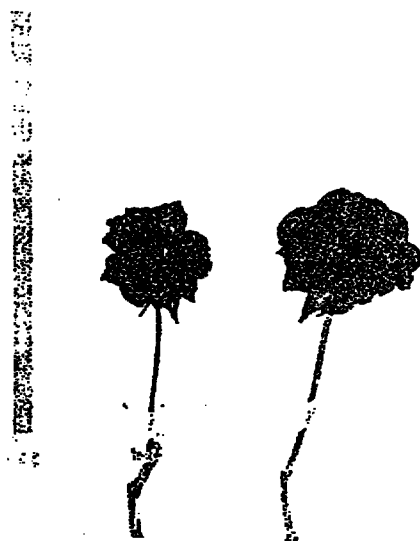
Date: 30 NOV 1996

5/10

FIG.8A



FIG.8B



This is the replacement sheet

Date: 30 NOV 1996

FIG.9A

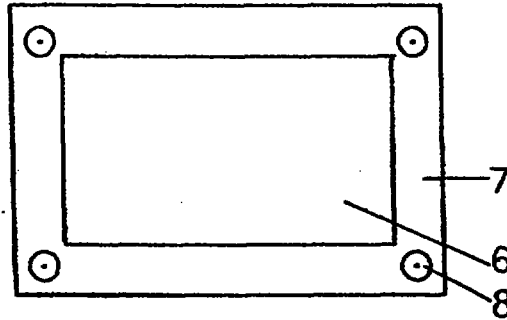


FIG.9B

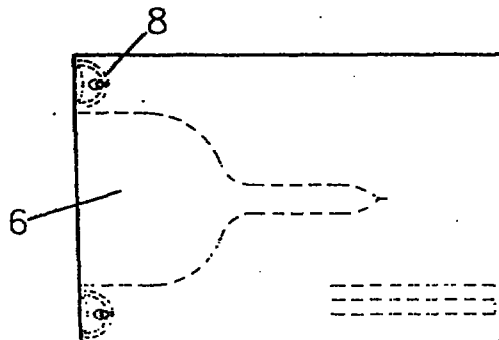
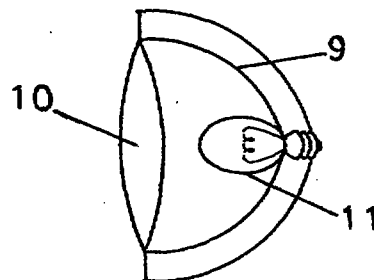


FIG.10



This is the replacement sheet

Date: 30 NOV 1996

7/10

FIG.11A

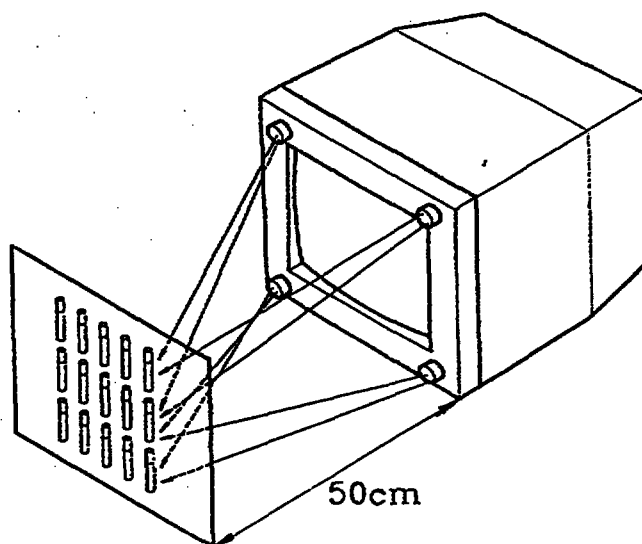
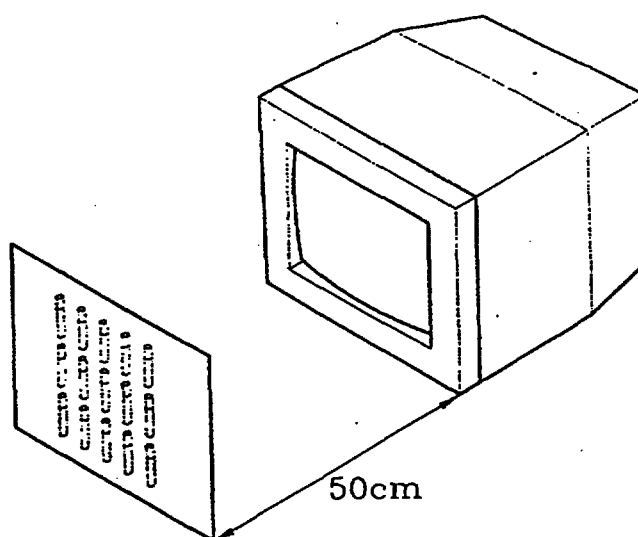


FIG.11B



This is the replacement sheet

Date: 30 NOV 1996

FIG.12A

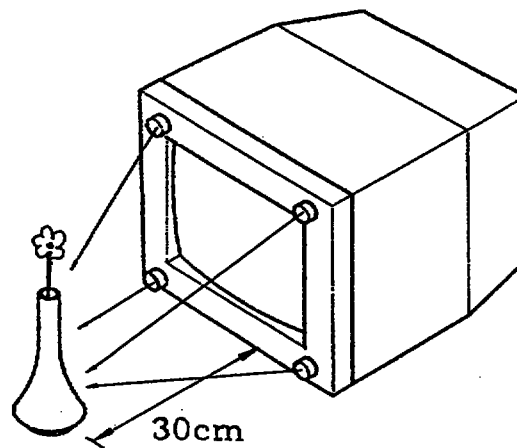
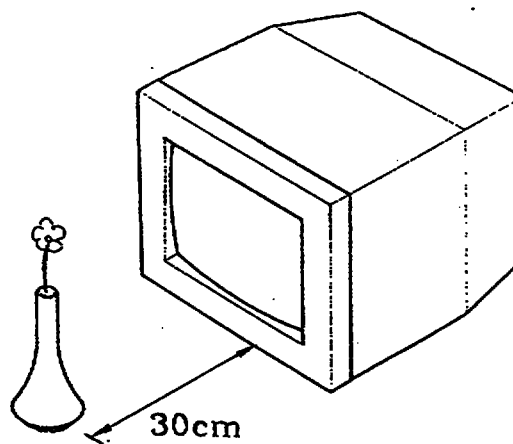


FIG.12B



This is the replacement sheet

Date: 30 NOV 1996

FIG. 13A

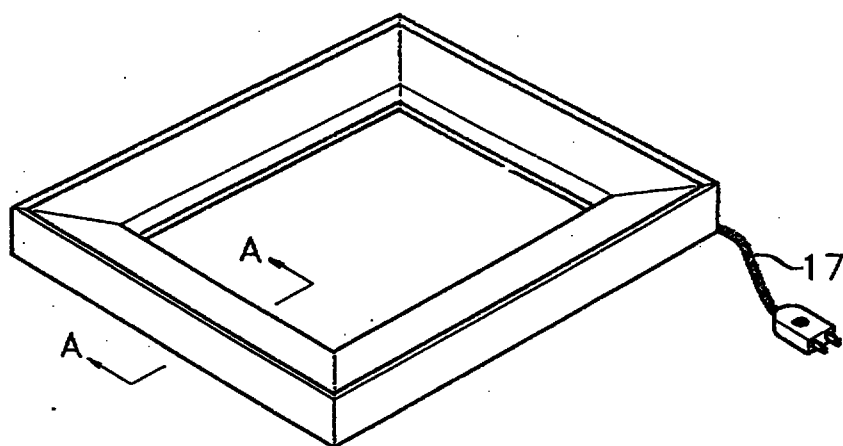


FIG. 13B

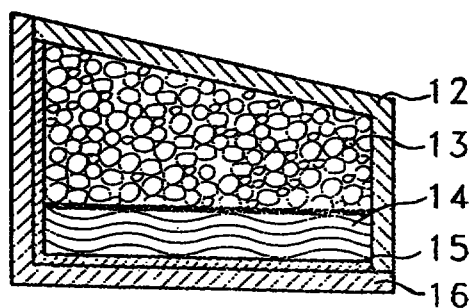


FIG. 14A

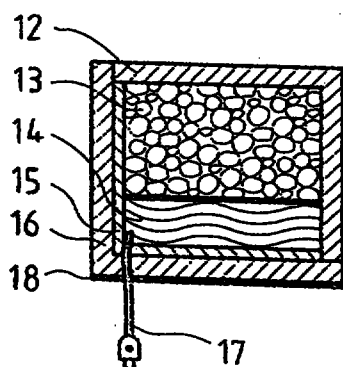
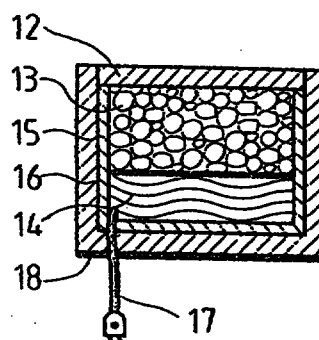


FIG. 14B



This is the replacement sheet

Date: 30 NOV 1996

FIG.15A

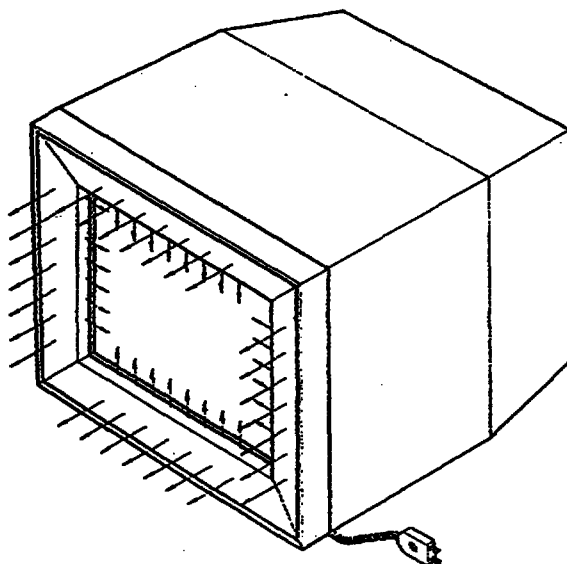


FIG.15B

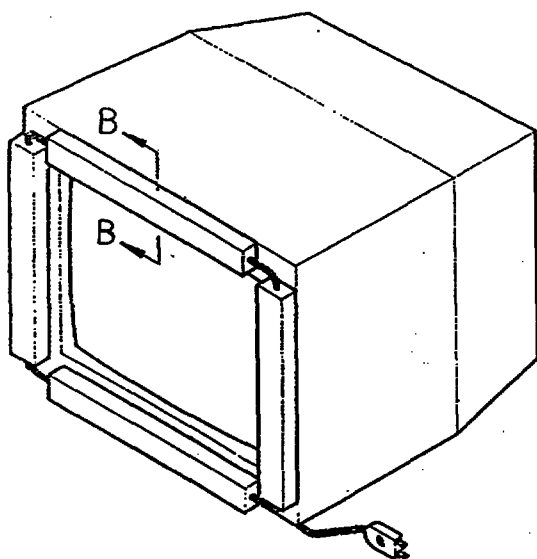
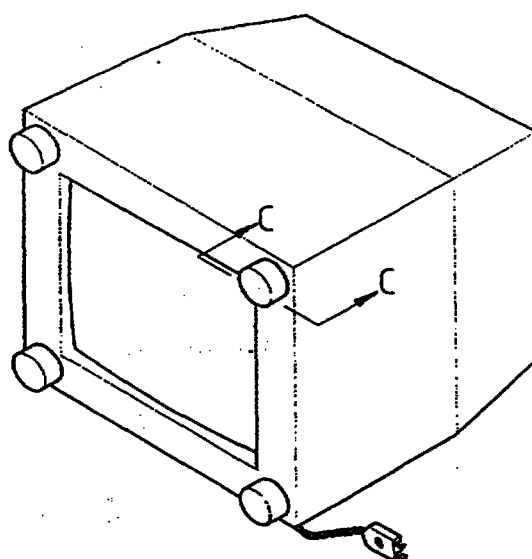


FIG.15C



This is the replacement sheet

Date: 30 NOV 1996