

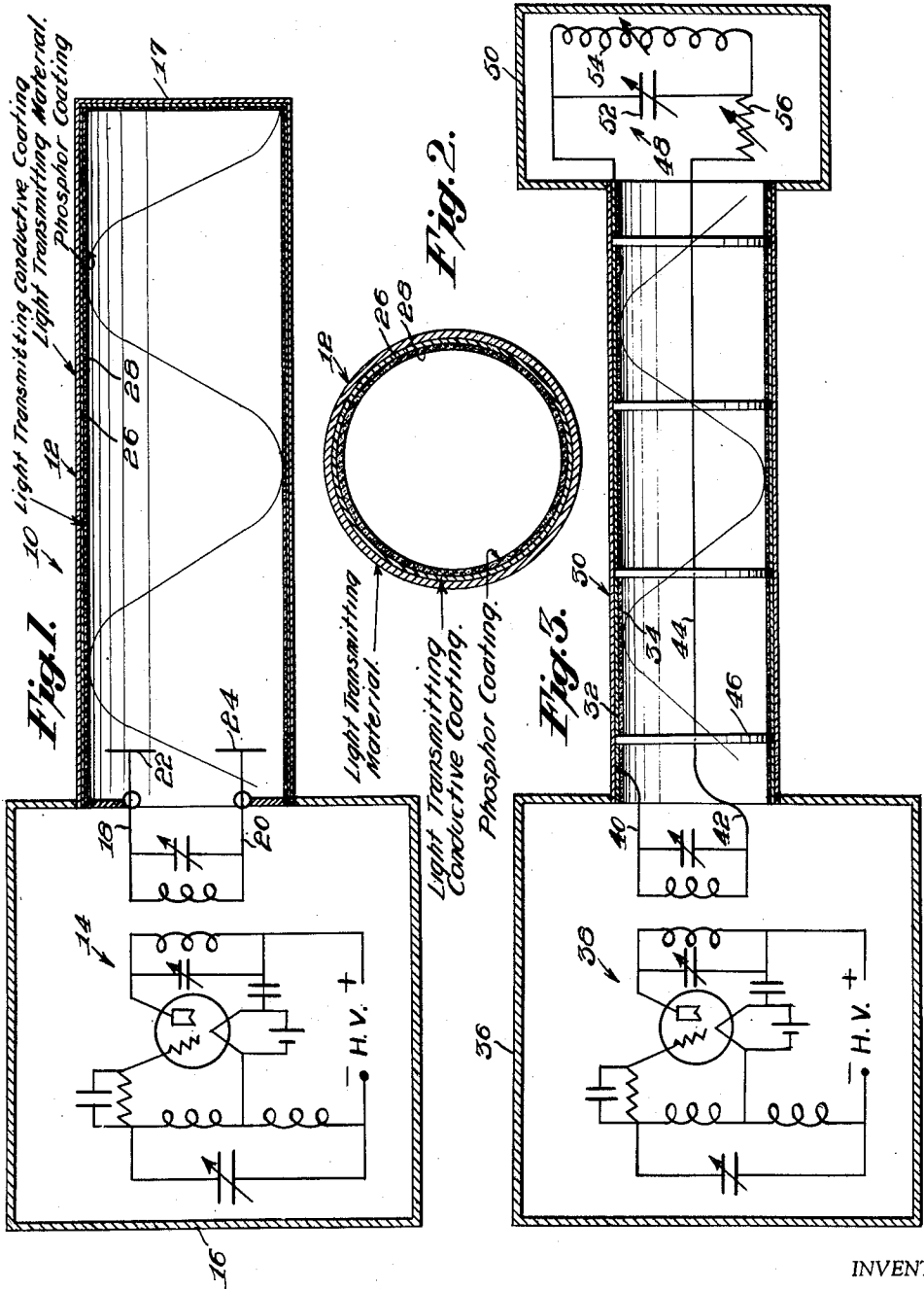
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ELECTRICAL ILLUMINATING DEVICES

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ELECTRICAL ILLUMINATING DEVICES

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This invention relates to electrical illuminating devices and more particularly to illuminating devices using radio frequency electrical energy as a source of power.

Various types of electro-luminescent cells are known in which visible light is produced by subjecting a phosphor coating to excitation by an electrical field. All of the illuminating devices of this type of which I am aware use exciting voltages at normal power frequencies. Radio frequency voltages are capable of exciting phosphor materials to a much greater extent than the non-radiant energy of normal power frequencies. However, radio frequency voltages have not been used as a source of excitation energy in electro-luminescent devices due to the problem created of preventing undesirable radiation into space which would interfere with radio and television reception.

Accordingly, it is an object of this invention to provide an illuminating device in which high frequency radiant energy is used as a source of activation or excitation for the phosphors or fluorescent materials which produce illumination.

It is another object of this invention to provide an illuminating device in which a wave guide or coaxial cable serves as the envelope of the illuminating device.

It is still another object of this invention to provide an illuminating device powered by radio frequency energy in such manner as not to interfere with radio or television reception.

It is still another object of this invention to provide an illuminating device in which the envelope of the illuminating device can be made much longer than is possible in the case of illuminating devices of the prior art.

In achievement of these objectives, there is provided in accordance with an embodiment of this invention an illuminating device including a wave guide connected to a source of very high frequency radio energy. The wave guide is formed of a material capable of light transmission, such as glass, and is coated, preferably on its interior surface, with a suitable light transmissive or transparent conductive material to retain the radio frequency energy within the interior of the wave guide. The wave guide is also coated on its interior surface with a suitable phosphor capable of emitting visible light rays when exposed to the radio frequency energy contained within the wave guide.

In a modified embodiment of the invention, a coaxial cable is employed instead of a wave guide. The coaxial cable is made of a material capable of light transmission and is provided with coatings of a light transmissive or transparent conductive material and of a phosphor similar to those used in the wave guide embodiment.

Further objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a view in longitudinal section, and partially diagrammatic, of an illuminating device in accordance with the invention;

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Fig. 2 is a view in section along line 2—2 of Fig. 1; and

Fig. 3 is a view in longitudinal section, partially diagrammatic, of a modified illuminating device in accordance with the invention.

Referring now to the drawing, and more particularly to Fig. 1, there is shown an illuminating device generally indicated at 10 including a wave guide generally indicated at 12 and a high frequency radio oscillator generally indicated at 14 contained within a housing 16. Housing 16 is of metal or is otherwise suitably shielded to prevent radiation into space of the radio frequency energy generated by the oscillator. Oscillator 14 is of a type capable of generating high frequency radio oscillations preferably in the centimeter wave length range.

Wave guide 12 which serves as the envelope for the illuminating device is made of a material capable of light transmission, such as glass, or a light transmissive plastic material, and is suitably joined at one of its ends to housing 16 of oscillator 14 in a manner which insures against any stray radiation at the junction between the wave guide and the housing. The wave guide is closed at its outer end as indicated at 17. The output circuit of oscillator 14 includes two conductors 18 and 20 which are respectively connected to dipole members 22 and 24 which extend into the end of wave guide 12 adjacent the junction of the wave guide with the oscillator housing.

The wave guide is coated on its entire interior surface, including its longitudinal wall surfaces and end wall surface, with a coating 26 of a light transmissive or transparent electrically conductive material which serves as a shielding means which retains the radio frequency energy generated by oscillator 14 within the confines of the wave guide.

Light transmissive or transparent electrically conductive coating 26 may be made of tin oxide or of other suitable materials, such as those described, for example, in U. S. Patent 2,648,754, entitled "Electroconductive Article," issued to W. O. Lytle on August 11, 1953.

A coating 28 of a phosphor capable of emitting visible light rays when excited by radio frequency energy is deposited over the light transmissive or transparent electrically conductive coating 26. Coating 28 thus lies inwardly of conductive coating 26 with respect to the longitudinal axis of the wave guide. The phosphor material may be a mixture containing 75 parts of zinc sulphide and 25 parts of zinc oxide, with a small amount of an activator such as silver, copper or lead. Other phosphors may be used instead, such as sulphides of cadmium or calcium, or zinc-cadmium sulphide phosphors, zinc-copper sulphide phosphors, or zinc-silver sulphide phosphors.

When oscillator 14 is energized, it propagates high frequency radiant energy, preferably of the centimeter wave length range, into wave guide 12. The radiant energy is confined within the wave guide due to transparent conductive coating 26. The radiant energy impinging upon the phosphor coating 28 causes the coating to luminesce, producing visible light rays. Since conductive coating 26 and wave guide 12 are both made of a light transmissive material the light rays are visible from the exterior of the wave guide, thereby causing the wave guide to illuminate the surrounding area.

There is shown in Fig. 3 a modified embodiment of the invention operating upon the same principle as the embodiment of Fig. 1. A coaxial cable generally indicated at 30 is formed of a light transmissive material, such as glass or a suitable plastic material, and is coated on its inner surface with a coating of a light transmissive or transparent conductive material similar to that described in connection with the embodiment of Fig. 1 and with a coating 34 of a phosphor similar to that described in con-

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nection with the embodiment of Fig. 1. An end of the coaxial cable 30 is connected to a metal or shielded housing 36 in which is contained a high frequency radio oscillator generally indicated at 38. One of the output leads 40 of the oscillator is connected to the light transmissive or transparent conductive coating 32, while the other output lead 42 of the oscillator is connected to the central conductor 44 of the coaxial cable. Central conductor 44 is insulatively supported in position by the spaced insulating disks 46, in accordance with conventional practice in coaxial cables.

In order to minimize power attenuation in the coaxial cable and to improve the power factor of the apparatus, a terminating impedance generally indicated at 48 may be connected at the end of the coaxial cable. The terminating impedance is positioned in a metal or shielded housing 50 which is connected to the end of the cable in a manner which prevents stray radiation. The terminating impedance includes a variable condenser 52, a variable inductance 54, and a variable resistance 56.

The operation of the embodiment of Fig. 3 as an illuminating device is similar to that described in connection with the embodiment of Fig. 1. When oscillator 36 is energized, it propagates high frequency radiant energy into the coaxial cable. The radiant energy is confined within the coaxial cable due to transparent conductive coating 32. The radiant energy impinges upon the phosphor coating 34 and causes the coating to luminesce, producing visible light rays. Since conductive coating 32 and the coaxial cable are both made of a light transmissive material, the light rays are visible from the exterior of the coaxial cable, causing the coaxial cable to illuminate the surrounding area.

The cross sectional area of the wave guide 10 and of the coaxial cable 30 should be proportioned relative to the wave length of the radio frequency energy generated by the respective oscillators 14 and 38 in accordance with the well known principles established for wave guides and coaxial cables. (See "Principles of Radar," M. I. T. Press, McGraw-Hill Book Co., 1952, page 546.) Or, conversely, to use a wave guide or coaxial cable of a predetermined desired diameter, the output frequency of the oscillator should be fixed at a value which produces a wave length consistent with the established relation between the wave length and the cross section of a wave guide or coaxial cable.

The illuminating devices hereinbefore described can be used in any installation requiring illumination, such as for residential use, for example. However, it is believed that the devices of the invention have particular utility for illuminating large floor areas, such as large floor areas in factories and the like. The wave guide and coaxial cable can be made of considerable length, and a single length of wave guide or coaxial cable can be bent into various desired configurations. Also, a plurality of wave guides or coaxial cables may radiate like spokes of a wheel from a central hub which serves as a housing for an oscillator which delivers radiant energy to all of the wave guides or coaxial cables. In a still further modified arrangement, branch wave guides communicating with the interior of wave guide 10 may extend perpendicularly, or at other desired angles, from wave guide 10. The radiant energy in wave guide 10 in such a modification passes to each of the communicating branch wave guides to excite phosphor coatings in the branch wave guides in the same manner as in the wave guide 10.

The operability of the embodiments of the invention as hereinbefore described is independent of whether the interior of the envelope is at atmospheric pressure or under vacuum conditions. The wave guide and coaxial cable illuminating devices hereinbefore described are normally operated at atmospheric pressure and do not require hermetic sealing. Where desired, the light output of the device may be augmented by sealing into the interior of

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the wave guide or coaxial cable a gas which emits light when ionized. For example, CO₂ (carbon dioxide) may be sealed into the wave guide or coaxial cable at a reduced pressure of approximately 6 to 8 mm. of mercury. Carbon dioxide when ionized glows with a pure white light whose spectrum is comparable to that of sunlight. If a light output with an ultra-violet component is desired, mercury may be placed on the interior of the wave guide or coaxial cable either alone or in combination with the carbon dioxide.

It can be seen from the foregoing that there are provided in accordance with this invention illuminating devices which have great utility in that they permit the use of high frequency radiant energy as a source of excitation for phosphor materials in place of low frequency exciting voltages, as heretofore practiced. The wave guide or coaxial cable illuminating devices hereinbefore described permit the use of radio frequency exciting voltages for the phosphor materials without any undesirable radiation into space which would interfere with radio and television reception. The devices of the invention permit the envelope of the illuminating device to be much longer than in illuminating devices of the prior art, thereby providing illuminating devices which are particularly suitable for illuminating large floor areas, such as factory areas and the like.

While there have been shown and described particular embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and, therefore, it is aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim is:

1. An illuminating device comprising a closed light transmissive envelope, means for directing high frequency radiant energy into the interior of said envelope, light transmissive shielding means carried by said envelope for confining said radiant energy within said envelope, and a coating carried by said envelope and capable of emitting visible light when excited by said radiant energy.

2. An illuminating device comprising a closed light transmissive envelope, means for directing high frequency radiant energy into the interior of said envelope, light transmissive shielding means carried by said envelope for confining said radiant energy within said envelope, and a phosphor coating carried by said envelope in overlying relation to said light transmissive shielding means and lying inwardly of said shielding means with respect to the longitudinal axis of said envelope.

3. An illuminating device comprising a hollow wave guide formed of light transmissive material, means for directing radiant energy into the interior of said wave guide, light transmissive shielding means carried by said wave guide for confining said radiant energy within said wave guide, and a phosphor coating carried by said wave guide and capable of emitting visible light when excited by said radiant energy.

4. An illuminating device comprising a coaxial cable formed of light transmissive material, means for directing radiant energy into the interior of said coaxial cable, light transmissive shielding means carried by said coaxial cable for confining said radiant energy within said coaxial cable, and a phosphor coating carried by said coaxial cable and capable of emitting visible light when excited by said radiant energy.

5. An illuminating device comprising a closed light transmissive envelope, means for directing high frequency radiant energy into the interior of said envelope, a light transmissive electrically conductive coating carried by said envelope for confining said radiant energy within said envelope, and a phosphor coating carried by said envelope and capable of emitting visible light when excited by said radiant energy.

6. An illuminating device comprising a closed light

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transmissive hollow envelope, means for directing high frequency radiant energy into the interior of said envelope, said envelope having an electrically conductive coating to confine said radiant energy within said envelope, said envelope having a coating of a phosphor capable of emitting visible light when excited by said radiant energy, said phosphor coating lying inwardly of said electrically conductive coating with respect to the longitudinal axis of the envelope.

7. An illuminating device comprising means for generating high frequency radiant energy, a closed light transmissive envelope communicating with said means for receiving radiant energy from said means, light transmissive shielding means carried by said envelope for confining radiant energy within said envelope, and a coating carried by said envelope and capable of emitting visible light when excited by said radiant energy.

8. An illuminating device comprising a radio oscillator capable of generating high frequency radiant energy, a closed light transmissive envelope, the output of said oscillator extending into said envelope to direct radiant energy into the interior thereof, light transmissive shielding means carried by said envelope for confining said radiant energy within said envelope, and a phosphor coating carried by said envelope and capable of emitting visible light when excited by said radiant energy.

9. An illuminating device comprising a radio oscillator capable of generating high frequency radiant energy, a closed wave guide formed of light transmissive material, the output of said oscillator extending into said wave guide to direct radiant energy into the interior thereof, a coating of light transmissive electrically conducting material carried by said wave guide for confining said radiant energy within said wave guide, and a phosphor coating carried by said wave guide in juxtaposition

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to said light transmissive conducting material and capable of emitting visible light when excited by said radiant energy.

10. An illuminating device comprising a radio oscillator capable of generating high frequency radiant energy, a coaxial cable formed of light transmissive material, the output of said oscillator extending into said coaxial cable to direct radiant energy into the interior thereof, a coating of light transmissive electrically conducting material carried by said coaxial cable for confining said radiant energy within said coaxial cable, and a phosphor coating carried by said coaxial cable in juxtaposition to said light transmissive conducting material and capable of emitting visible light when excited by said radiant energy.

11. An illuminating device comprising a closed light transmissive envelope, means for directing high frequency radiant energy into the interior of said envelope, light transmissive shielding means carried by said envelope for confining said radiant energy within said envelope, and a gas contained within said envelope capable of emitting visible light when subjected to the radiant energy within said envelope.

12. An illuminating device comprising a closed light transmissive envelope, means for directing high frequency radiant energy into the interior of said envelope, light transmissive shielding means carried by said envelope for confining said radiant energy within said envelope, a gas contained within said envelope capable of emitting visible light when subjected to the radiant energy within said envelope, and a phosphor coating carried by said envelope and capable of emitting visible light when excited by said radiant energy.

No references cited.