LUMINOUS SOUND ABSORBING CEILING

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2 Claims

ABSTRACT OF THE DISCLOSURE

Finely perforated, limp, light transmitting and sound absorbent plastic film material, preferably fire resistant, is stretched over the upper and lower sides of rigid window frames to make panels adapted for support below ceiling lights and thereby provide glare reducing lighting, thermal insulation and sound absorption. Panels may be of any convenient size such as two feet by two feet, two feet by four feet, three feet by three feet, four feet by four feet, etc.

This invention is intended to provide improved sound absorption for luminous ceiling panels by the use of vertically spaced perforated, limp, light transparent plastic film material stretched across and peripherally secured to rigid window frames supported by the usual sub-ceiling grid. Although the limp material is much too weak to be used by itself, when stretched across the window frame, it inherently maintains the desired flatness even though used in relatively large spans. The construction permits sound absorption by attenuation of the waves passing through the perforations and by over-all vibration of the films. This results in a material reduction in reflected sound which is particularly desirable in office buildings and other locations where luminous ceilings are commonly used.

In the drawings, FIG. 1 is a fragmentary section through a luminous ceiling panel suspended below a ceiling, FIG. 2 is a perspective of the panel broken away at one corner, and FIGS. 3 and 4 are fragmentary sections of alternative ceiling panel constructions.

In the drawing, 1 and 2 indicate two of the beams of a framework for supporting luminous ceiling panels. Customarily there are longitudinally and crosswise extending beams intersecting to form a grid of a plurality of window openings of modular sizes such as two feet by four feet, four feet by four feet, etc. For this purpose, the beams may be of T-section with vertical flanges 3 suitably suspended six or more inches below the ceiling 4 by wires 5 and horizontal flanges 6, 7 each supporting an edge of one of the panels. In the complete suspension system there will be a plurality of rectangular window openings bounded by flanges 6, 7 for receiving and supporting the edges of luminous ceiling panels. The framework is of common construction.

The purpose of the luminous ceiling panels is to diffuse light from fluorescent or other light sources 8 suitably arranged between the ceiling and the panels so as to provide over-all high intensity illumination without objectionable glare or contrast. For this purpose, the luminescent ceiling panels are made of translucent material which diffuses the light and thereby prevent objectionable bright spots. Suitable materials for this purpose are flexible plastic films such as polyester, vinyl, acrylic polyethylene, terephthalate, etc. These films are available in a wide range of thicknesses but in order to obtain adequate light diffusion should be in the range of 1 to 20 mils. To minimize flame spread and smoke development, factors affecting the fire rating, the sheets are kept as thin as possible. In the claims the term limp film is used to describe a sheet too thin to be used by itself. Polyvinyl chloride is a preferred material which has a low flame spread rating and good lighting properties. In the particular panel shown where there are vertically spaced upper and lower films 9, 10 of flexible vinyl 7 mils thick, the lower film becomes of substantially uniform brilliancy so that high intensity illumination is obtained without objectionable glare. At least one of the films should be translucent, although more uniform light distribution is obtained when both films are translucent.

Each of the light transmitting panels comprises a rigid window frame suitably supported by the grid framework, for example, by resting on the flanges 6, 7 defining each window opening. The construction of the frame is not critical. It may, for example, comprise metal channel sections 11 (such as shown at 20 in Patent 3,186,129) with outwardly projecting upper and lower flanges 12 and 13 or it may comprise wood sections 14. The metal channel sections 11 and wood frame members 14 are illustrative of rigid materials suitable for making the window frames for supporting the light transmitting films. The frames may be made of any structural material. To secure adequate light diffusion, the space between the faces 16, 17 of the window frames to which the films are attached should be in the range of from ¾" to 1¾". Spacings greater than 1¾" increase the weight and space requirements without giving any additional benefit. There are also a wide variety of available structures for fastening the films to the window frames. As shown in FIG. 1, each of the upper and lower films 9, 10 may have integrally secured to its peripheral edge a heavy bead 18 of flexible plastic with a groove 19 which snaps over one of the flanges 12 or 13 of the channel 11. This structure permits easy removal and replacement of the plastic films stretched across the upper and lower surfaces of the frames. As shown in FIG. 4, the upper and lower films may be secured to the surfaces 16, 17 by adhesives while in FIG. 3 the upper and lower films may be secured to the surfaces by stapling. In FIG. 3, the upper and lower films are integrally united to form in effect a bag which may be slipped over the frame. In FIGS. 1 and 4 the films are fastened to streets which are secured to the frames at their peripheral edges.

The films are stretched with relatively light tension and the frames need be sufficiently rigid to maintain the window dimensions.

The constructions so far described have good light diffusing properties desirable for luminous ceilings. However, without more, the acoustic absorption properties are negligible. Since many of the luminous ceiling installations are in office buildings where substantial noise in generated, acoustic absorption is desirable if it does not interfere with the illumination. In the present ceiling panel construction, acoustic absorption is obtained by finely perforating the plastic films 9, 10. In a typical construction, the perforations 20 would have a diameter of substantially 10 mils and would be spaced substantially ¼" from each other. With such a distribution, there is a substantial loss of sound energy as its passes through the perforations 20. There is also a substantial loss of sound energy due to multipление reflection in the cavity between the films 9, 10 and in the cavity between the plastic film 9 and the ceiling 4. The vibration of the films also absorbs energy. The fundamental natural frequency of the films is at or below the limit of audibility and is at least as low as the lower base region (about 100 cycles per second) provided fine perforations in the transparent films 9, 10, the light diffusing properties are retained and in addition sound absorption is obtained comparable with acoustic ceilings. For example, a typical acoustical ceiling will have an NRC rating of 70–73 while the light diffusing panels of this application have an NRC rating of 65.

What is claimed is new:

1. In combination with a ceiling and associated lights...
and a sub-ceiling framework supported below the ceiling and lights and having a grid of a plurality of window openings having cross dimensions in the range of approximately two to four feet, a plurality of window frames sized to fit said window openings, means for supporting each window frame in one of the window openings, each window frame having two peripheral supporting surfaces vertically spaced from each other in the range of approximately ³⁄₁₆" to ¹⁄₄", two horizontal films of limp plastic vertically spaced from each other substantially the spacing of said surfaces and each stretched across and respectively fixed at its peripheral edges to one and the other of said surfaces, both of the films being light transmitting and at least one of the films being translucent and light diffusing, the fundamental resonant frequency of each film when mounted in its window frame being as low as the low bass region, both films having perforations approximately 10 mils in diameter and spaced approximately on ¼" centers whereby sound is dissipated partly by energy losses in passing through the perforations, partly by motion of the films and partly by multiple reflections within the cavity between the films and within the cavity between the ceiling and the panels.

2. The combination of claim 1 in which the films are flexible vinyl plastic.

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