Aug. 16, 1955 C. W. LEMMERMAN ET AL 2,715,449

COMBINED LIGHTING AND SOUND ABSORBING FIXTURE

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Fig. 1.

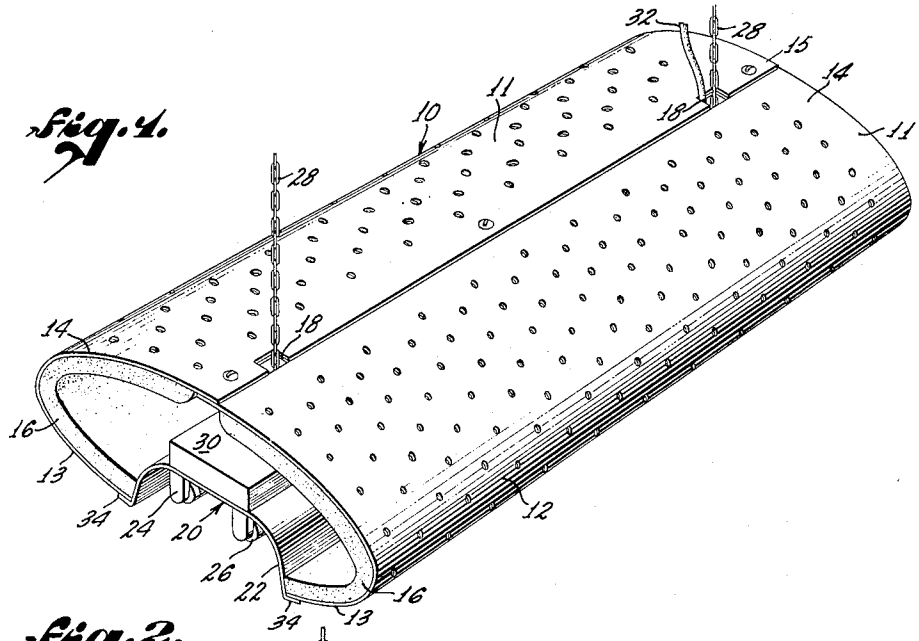



Fig. 2.

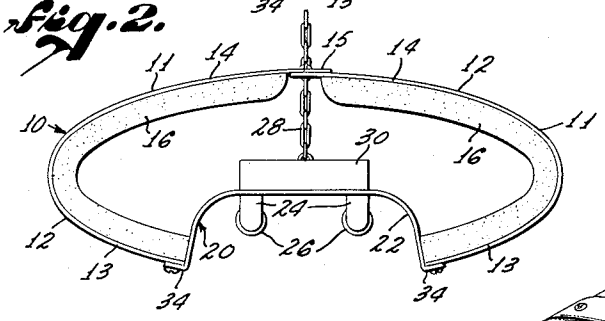



Fig. 4.

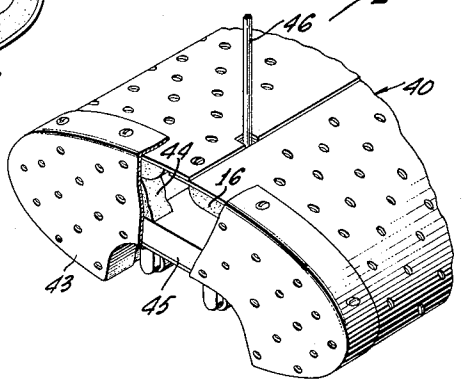
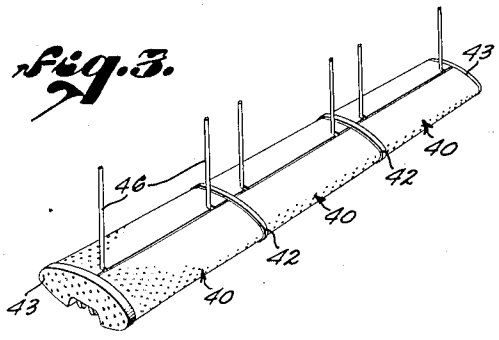



Fig. 3.




CARL W. LEMMERMAN &
CLOYD D. SMITH,
INVENTORS.

BY Reed & Lawlor
ATTORNEY.

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Fig. 5.

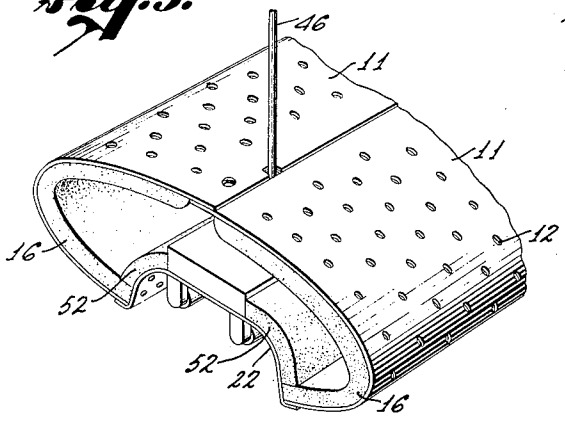



Fig. 5a.

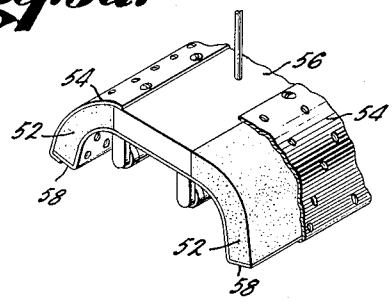



Fig. 7.

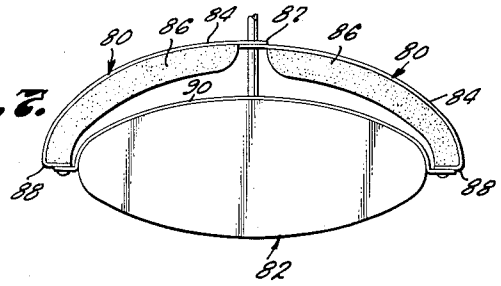



Fig. 6.

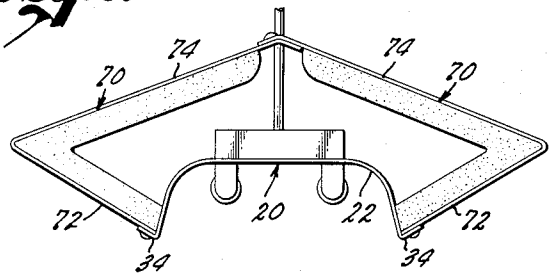



Fig. 8.

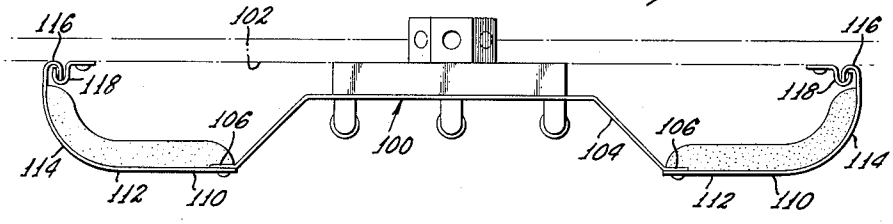
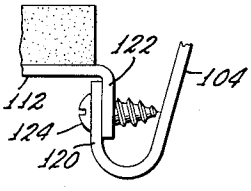



Fig. 9.




CARL W. LEMMERMAN &
CLOYD D. SMITH,
INVENTORS.

BY Reed & Lawlor
ATTORNEY.

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2,715,449

# COMBINED LIGHTING AND SOUND ABSORBING FIXTURE

Carl W. Lemmerman, Hartford, Conn., and Cloyd D. Smith, Los Angeles, Calif.

Application December 12, 1949, Serial No. 132,522

10 Claims. (Cl. 181—30)

This invention relates to sound absorbing units and more particularly to a combined lighting and sound-absorbing fixture, and especially to a sound-absorbing unit which is adapted for attachment to a lighting fixture.

After a building has been completed, it is quite common for its occupant to discover that sound-absorption treatment is required. Furthermore, the application of sound-absorption treatment to a new building at the time of its construction is quite often such a large added expense that such treatment is postponed even when the need for it is known.

For these and other reasons, it is not uncommon for an owner or other occupant of a building, whether it be a dwelling house, an office building, or a store, to add sound-absorption treatment to the building after it has been completed and has been in use for some time. The presence of lighting fixtures, especially overhead lighting fixtures such as those commonly installed in stores and offices, and the presence of other structural features, frequently render the installation of sound-absorbing material on the walls difficult and expensive.

It is therefore the principal object of this invention to provide an improved method of treating a room already containing lighting fixtures with sound-absorbing material.

Another object of this invention is to provide a combined lighting and sound-absorbing fixture which is readily mounted in a room.

A still further object of this invention is to provide a sound-absorbing unit which may be readily attached to a lighting fixture already mounted in a room.

The foregoing and other objects of the invention will appear more fully upon consideration of various embodiments of the invention which are illustrated in the accompanying drawings and described below.

In the drawings wherein like reference characters indicate like elements throughout the several views:

Figure 1 is a perspective view of a combined lighting and sound-absorbing fixture embodying the features of this invention;

Figure 2 is an end view of the fixture illustrated in Figure 1;

Figure 3 is a perspective view showing a series of such fixtures butted together in a line;

Figure 4 is a perspective view of such fixture having its end capped;

Figure 5 is a perspective fragmentary view of an alternative embodiment of the invention and Figure 5*a* is a perspective view of a modification thereof;

Figures 6, 7, and 8 are end views of other alternative embodiments of the invention; and

Figure 9 is a detailed fragmentary view of an alternative method of connecting a sound-absorbing unit to a lighting fixture.

Referring to Figures 1 and 2, there is illustrated an embodiment of the invention consisting of a fixture **10** comprising a pair of sound-absorbing units **11** attached



to a fluorescent lighting unit **20**. The lighting unit **20** which is of conventional construction, comprises an elongated trough **22** which is concave downwardly and which is provided with suitable brackets **24** for supporting elongated fluorescent tubes **26** within the concave, or lower, side thereof. The concave side of the trough **22** is coated with a suitable light reflecting paint or enamel. The lighting fixture **20** is supported from a ceiling (not shown) by means of a pair of chains **28** connected to opposite ends of trough **22**. Electrical connections to the lights **26** are made in a conventional manner through opposing contacts (not shown) supported on the brackets **24** and by means of a step-up transformer (not shown) contained in a box **30** supported on the upper, or convex, side of the trough **22**, and a cable **32** that leads upwardly to a connector (not shown) in the ceiling. Outwardly extending flanges **34** formed at the lower side edges of the trough **22** are conveniently used for supporting the lower ends of the sound-absorbing units **11**.

Each of the sound-absorbing units **11** comprises a perforated sheet **12** of U-shape in cross section. Each of the sheets **12** is provided with a relatively short leg **13** and a relatively long leg **14**. The ends of the relatively long legs **14** overlap and the overlapping portions **15** are fastened together by any suitable means such as screws. The two overlapping edges or flanges of the perforated sheets **11** are notched to provide openings **18** through which the chains **28** pass. The ends of the relatively short legs **13** rest upon the flanges **34** and are secured thereto by any suitable means such as screws. Each of the sheets **12** is provided with perforations of a suitable size and number to render the sheets acoustically transparent. The principles of designing such transparent sheets are well-known and need not be described in detail here. One method of achieving such transparency is described, for example, in Patent No. 1,726,500 issued to R. F. Norris on August 27, 1929.

A blanket or sheet **16** of fibrous sound-absorbing material is secured by means of a suitable cement to the inner side of each of the sheets **12** covering the entire interior surfaces thereof except for the overlapping portions **15**. Such blankets may be made of mineral wool, Fiberglas or any other porous material capable of absorbing sound by viscous action. While other types of sound-absorbing material might be employed, fibrous material is ideally suited to the present invention since it has been determined experimentally that a body of fibrous sound-absorbing material has an effective sound absorption area greater than the geometrical or optical cross-section at least for sound waves having a wave length less than about one half the average radius of the body. (See Journal of Acoustical Society of America, volume 17, page 322 (1946) and volume 21, page 169 (1949)). Furthermore, since such fibrous material possesses a very high sound-absorption co-efficient and the sheets **12** to which they are attached are acoustically transparent substantially all sound impinging upon the sound-absorption units **10** is absorbed.

It is to be noted that the combined lighting and sound-absorbing fixture **10** illustrated in Figs. 1 and 2 comprises a tubular sheet structure formed by the trough **22** and the two perforated sheets **11**; and that a blanket of fibrous sound-absorbing material is secured in an annular layer to the inner side of the sheet structure over all the portions thereof that are perforated. This sheet structure is of oval or elliptical configuration having a horizontal major axis of about 18 to 24 inches and a vertical minor axis of about 8 to 12 inches. As a result, the fixture possesses a large optical cross-section as viewed vertically, and a relatively small cross-section as viewed horizontally. For this reason, the unit is more effective in absorbing sound that is travelling vertically in a room

than sound which is travelling horizontally. This feature is particularly advantageous where the fixtures are mounted near the ceiling and most of the sound to be absorbed is generated near the floor of the room to be treated. Also with this type of mounting, increased effectiveness in absorbing sound is achieved in that sound reflected from the ceiling strikes the upper portion of the unit.

In Fig. 3 there is illustrated an arrangement in which three combined lighting and sound-absorbing fixtures **40** are connected in a line. In this case, the ends of the successive sound-absorbing units and lighting units are butted together and are joined by means of bands **42** which overlap the adjoining ends of adjacent perforated sheets and are secured thereto by any suitable means such as screws. If desired to improve appearances, the outer ends of the outermost fixtures in the line are closed by means of perforated caps **43** secured thereto by means of screws as illustrated in more detail in Fig. 4. For most effective sound-absorption, blankets **44** of sound-absorbing material are cemented to the inner surfaces of these caps **43**. However, these blankets **44** may, if desired, be omitted in order to facilitate the convection of air through the interior of the shells to facilitate cooling of the transformer boxes **45**. A relatively large volume remains within the tubular structure so that a large volume of air contacts the transformer boxes **45** to facilitate cooling thereof.

In case pipes **46** are employed instead of chains **28** to support the fixtures from a ceiling, the wires that supply electrical power to the lighting fixtures are led upwardly through the pipes in order to improve appearances.

The embodiment of the invention illustrated in Fig. 5 is similar to that illustrated in Figs. 1 and 2 except that the trough **22** is also perforated to render it substantially acoustically transparent and blankets **52** of fibrous sound-absorbing material are secured to the upper or convex side of the perforated portions of the trough. This enhances the sound-absorbing efficiency of the combined fixture.

Furthermore, it will be noted that some absorption of sound can be achieved with a lighting fixture of the type illustrated in Fig. 5 even if the sound-absorbing units **11** are not employed. In such a case, as large a portion of the trough as possible is covered with sound-absorbing material and the appearance of the unit is improved by covering the upper portions thereof with acoustically transparent perforated sheets **54** as indicated in Fig. 5*a*. In the case illustrated, the entire portion of the trough lying between the transformer box **56** and the side edges of the trough are covered with blankets **52** of fibrous sound-absorbing material and the perforated cover sheets **54** are attached at their lower edges to the flanges **58** at the outer edges of the trough and at their upper edges to the side edges of the transformer box **56**.

In the embodiment of the invention illustrated in Fig. 6, the trough **22** of the lighting fixture **20** is of the same configuration as that illustrated in Figs. 1, 2 and 5. In this case, however, the sound-absorbing units **70** are of V-shape in cross-section. Each of these units comprises a relatively short leg **72** which is attached to the flange **34** at the respective lower edges of the trough and a relatively long leg **74**. The two long legs **74** overlap at the top and are suitably secured together in the manner hereinbefore described.

In the embodiment of the invention illustrated in Fig. 7, a pair of sound-absorbing units **80** are supported upon the upper half of an elliptically-shaped lighting fixture **82**. In this case, the lighting fixture **82** is not provided with any outwardly directed flanges. The two sound-absorbing units **80** are of the same general type as those hereinabove described employing a perforated sheet **84** to which are secured blankets **86** of fibrous sound-absorbing material. However, in this case, the cross-sections of the units are in the form of quarter-ellipses. The perforated sheets of which these units are made are connected together in overlapping portions **86** at the top and they are provided with inwardly directed flanges **88** at the bottom. These flanges are interconnected by means of straps **90**. The straps **90** rest upon the upper side of the fixture **82** and are of just sufficient length to hold the lower edges of the units **80** close to the sides of the fixture **82**.

In the embodiment of the invention illustrated in Fig. 8, the principles of the invention are applied to a lighting fixture **100** which is fastened to a ceiling **102** in direct contact therewith instead of being hung therefrom by means of chains **28** or pipes **46**. This lighing fixture comprises an inverted trough **104** having flanges **106** at the side edges threeof. To each of the flanges **106** there is secured a sound-absorbing unit **110** which comprises a perforated sheet **112** having a straight horizontally extending portion directly attached to the corresponding flange **106** and an upwardly curving portion **114** that is provided at its upper end with an inwardly curved hook **116** which is adapted to fit within a bracket **118** in the ceiling. In the event that the inverted trough **104** is provided with an upwardly directed flange **120** at its side edge as shown in Fig. 9 instead of a horizontally directed flange **106** as indicated in Fig. 8, the perforated sheet **112** is provided with a downwardly directed flange **122** which may be attached to the trough flange **120** by means of screws **124**. In either event, the sound-absorbing units **110** are positioned on the brackets **118** by sliding them horizontally and parallel to the length of the lighting fixture **100** and then securing their lower ends to the flanges **106**.

All of the sound-absorbing units described hereinabove are of cylindrical configuration, that is, their surfaces may be generated by the movement of a generating line along a non-rectilinear line while maintaining the generating line parallel to a fixed line. For this reason by employing such units that comprise flexible blankets of fibrous sound-absorbing material secured to one side of a thin rigid sheet, the flexibility of the sound-absorbing units is enhanced because they may be readily bent to some degree at least without breaking or otherwise injuring the sound-absorbing material. Units of the general configuration described are particularly useful to employ as attachment for fluorescent lighting fixtures of conventional shape, especially since many of such fixtures are provided with cylindrical troughs bearing outwardly extending flanges at their lower side edges. Thus it is seen that a room in which such lighting fixtures have already been installed may be readily treated acoustically by employing such sound-absorbing attachments.

While the invention has been illustrated and described with particular reference to attachments suitable for installation on fluorescent lighting fixtures, it is clear that the principles of the invention are applicable to other types of lighting units as well. Furthermore, it will be obvious that though the invention is primarily directed to the provision of a sound-absorbing unit which may be attached to lighting units that are already in place, actually the invention also provides a combined lighing and sound-absorbing fixture which may be separately sold and which may be installed at the outset when a building is being constructed.

Although only certain embodiments of the invention have been illustrated and described in detail, further changes and modifications in form, material, and relative arrangement of parts, which will now be apparent to those skilled in the art, may be made without departing from the scope of the invention. It is therefore intended to cover all such modifications that fall within the scope of the appended claims.

The invention claimed is:

1. A combined lighting and sound-absorbing fixture comprising: an elongated downwardly concave trough member in said trough for supporting an elongated light source within the concave side thereof, the concave side

of said trough being adapted to reflect a substantial portion of light impinging thereon, said trough being perforated to such a degree as to render said trough substantially acoustically transparent but substantially optically opaque, and a body of fibrous sound-absorbing material secured to the convex side of said trough whereby a large proportion of the sound impinging on the lower side of the perforated portion of said trough is absorbed, and common means for hanging said trough and said body of material from a ceiling of a room.

2. A combined lighting and sound-absorbing fixture comprising: a tubular sheet structure, one portion of said sheet structure forming an elongated downwardly concave trough bearing external means for supporting an elongated light source, the remaining portion of said sheet structure being provided with perforations for rendering said remaining portion substantially acoustically transparent, a blanket of fibrous sound-absorbing material secured to the inner side of said remaining portion, said sheet and said blanket being so shaped as to form an empty space on the interior thereof, and means for hanging said sheet structure from a ceiling.

3. A combined lighting and sound-absorbing fixture comprising: a tubular sheet structure, one portion of said sheet structure forming an elongated downwardly concave trough bearing external means for supporting an elongated light source, the remaining portion of said sheet structure being provided with perforations for rendering said remaining portion substantially acoustically transparent, a body of fibrous sound-absorbing material secured within said tubular member in sound absorption relationship with said perforations, said sheet and said blanket being so shaped as to form an empty space on the interior thereof, and means attached to the inner side of said trough portion and extending through the opposite wall of said tubular sheet structure for hanging said sheet structure from a ceiling.

4. A combined lighting and sound absorbing fixture comprising: a tubular sheet structure having a cross-section of substantially oval configuration except for a reentrant portion forming an elongated trough bearing external means for supporting an elongated light source, the oval portion of said sheet structure being provided with perforations for rendering said oval portion substanitally acoustically transparent, a blanket of fibrous sound absorbing material secured to the inner side of said oval portion and enclosing a cavity, and means for hanging said sheet structure from a ceiling.

5. A fixture as defined in claim 4 wherein the major and minor axes of said oval cross-section extend horizontally and vertically respectively.

6. A combined lighting and sound-absorbing fixture comprising: a tubular sheet structure of cylindrical configuration having a reentrant portion forming an elongated trough bearing external means for supporting an elongated light source, the non-reentrant portion of said sheet structure being provided with perforations for rendering said non-reentrant portion substantially acoustically transparent, a blanket of fibrous sound-absorbing material secured to the inner side of said non-reentrant portion, and means for hanging said sheet structure from a ceiling.

7. A combined lighting and sound-absorbing fixture for use in a room comprising: holding means including a downwardly concave trough for supporting a light below a ceiling in room-illuminating position, a pair of cylindrical sheet members secured to opposite edges of said trough and extending upwardly toward said ceiling, said cylindrical sheets being provided with perforations for rendering them acoustically transparent, a blanket of fibrous sound-absorbing material secured to the upper side of each of said cylindrical sheets, and means connected to the upper edges of said sheets for supporting the same from the ceiling.



8. A combined lighting and sound absorbing fixture for use in a room comprising: means including a downwardly concave trough having lower edges thereof extending substantially laterally, said trough being adapted to support a light spaced below a ceiling in room-illuminating position, a body of fibrous sound-absorbing material contiguous with said trough adjacent said edges and substantially laterally extending from said edges and completely surrounding the side and top portions of said trough, said body being spaced above the top portion of said trough thereby to define a substantially enclosed air space between said body and said trough, said material being adapted to absorb sound waves, said material being exposed to the ambient air in said room for absorbing a large proportion of all sound waves impinging thereon, and a common structure for suspending said trough and said material from such ceiling in position to receive and absorb both direct and reflected sound waves, including the sound waves reflected from said ceiling.

9. A combined lighting and sound absorbing fixture suspended from a ceiling of a room, said fixture comprising: an elongated downwardly concave trough, members in said trough for supporting an elongated light source within the concave side thereof, a body of fibrous sound-absorbing material having edges thereof attached to lower edges of said trough on the opposite side thereof from such light and completely surrounding the convex side of said trough, said material being spaced from said convex side of said trough to define an air space between said material and the convex side of said trough, said material being exposed to the ambient air in said room and being adapted to absorb a large proportion of sound waves impinging thereon, said material being arranged to absorb direct and reflected sound waves including the sound waves reflected from said ceiling, whereby a larger proportion of the sound waves is absorbed than would be absorbed by a perfectly absorptive horizontally disposed plate having the same shape and dimensions as a horizontal plane extending through said fixture, and common means attached directly to said trough for suspending said trough and said body of material below the ceiling of said room.

10. The combination of claim 9 including a thin rigid elongated sheet conforming to the configuration of said sound-absorbing material and covering said body of sound-absorbing material, said sheet being provided with perforations for rendering it substantially acoustically transparent to sound waves.


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