May 30, 1967 S. T. ALEXIEFF 3,321,877

ACOUSTIC CEILING

Filed Feb. 24, 1964

3 Sheets-Sheet 1

Fig. 1

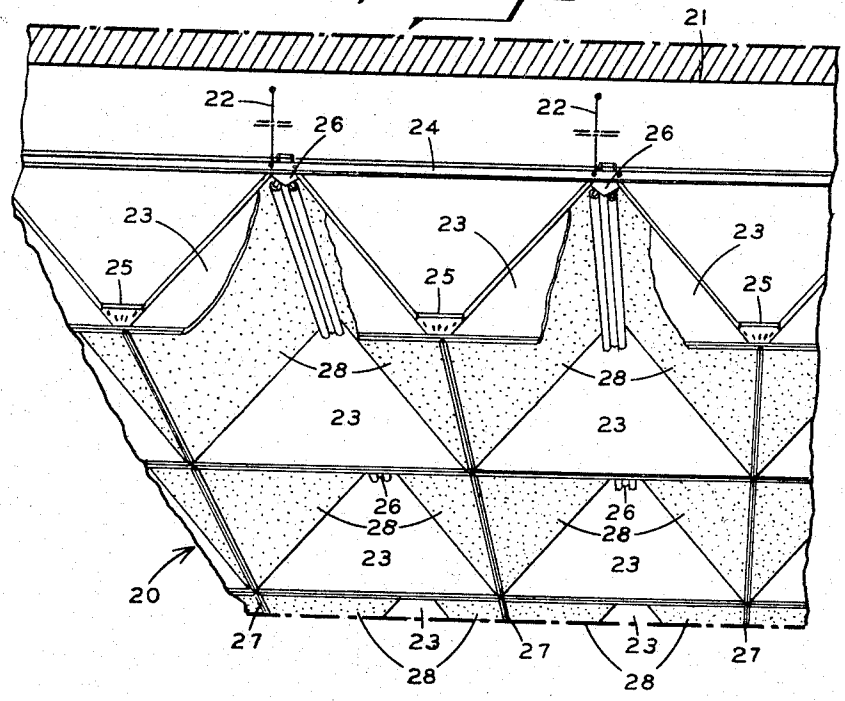
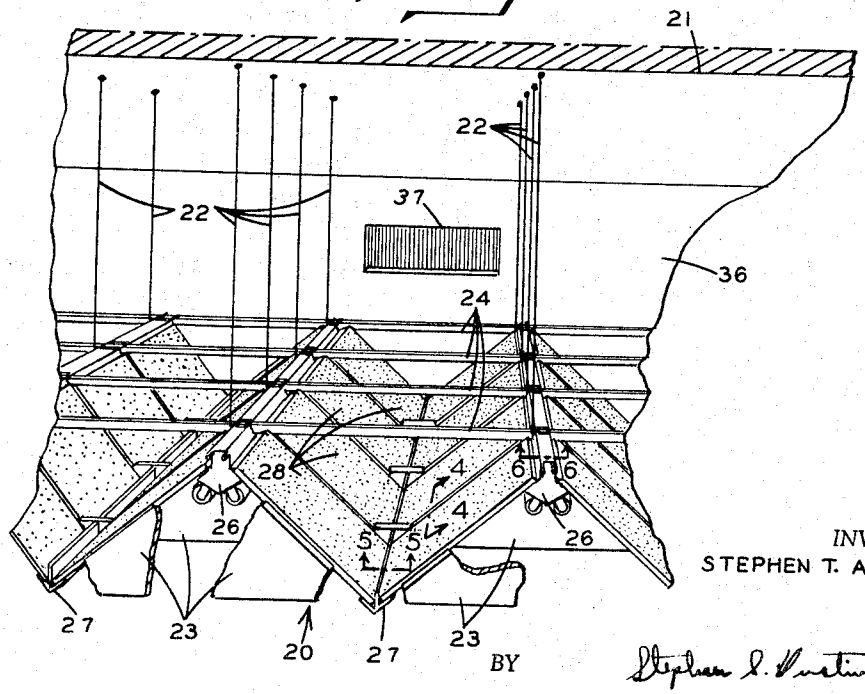


Fig. 2



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May 30, 1967 S. T. ALEXIEFF 3,321,877

ACOUSTIC CEILING

Filed Feb. 24, 1964 3 Sheets-Sheet 2

Fig. 3

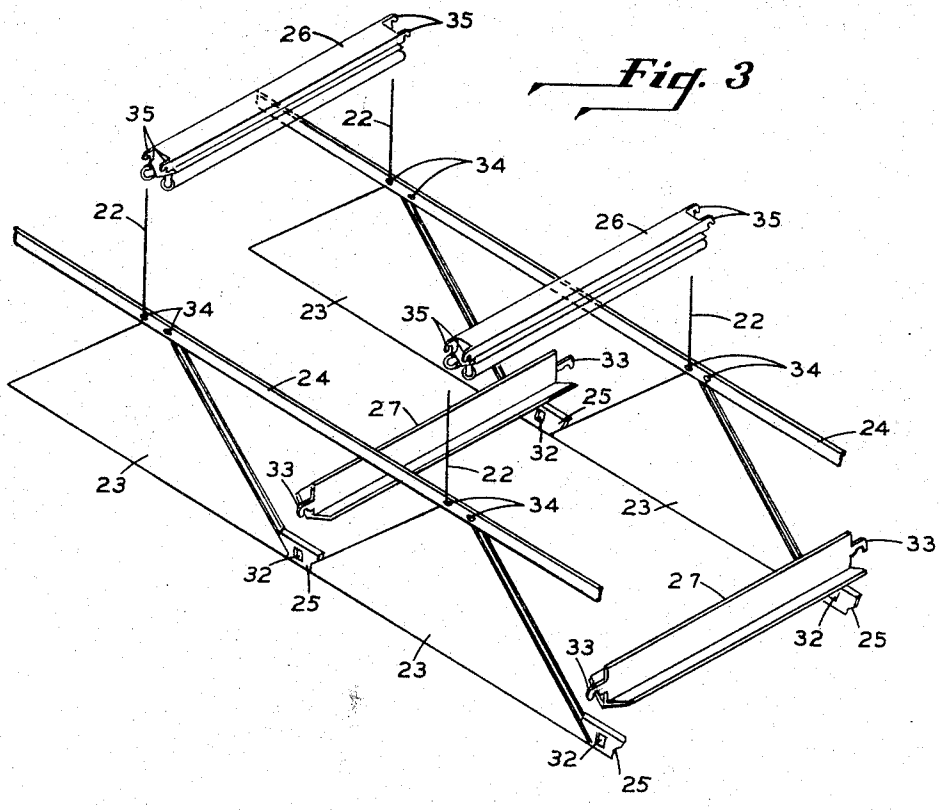


Fig. 4

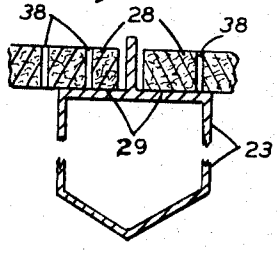


Fig. 5

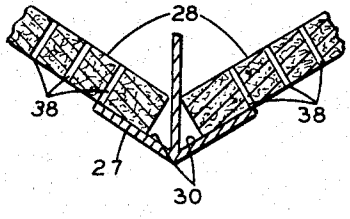
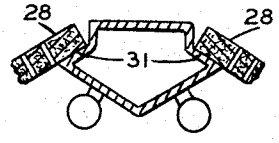


Fig. 6



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May 30, 1967 S. T. ALEXIEFF 3,321,877

ACOUSTIC CEILING

Filed Feb. 24, 1964 3 Sheets-Sheet 3

Fig. 7

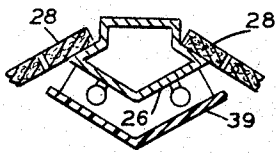


Fig. 8

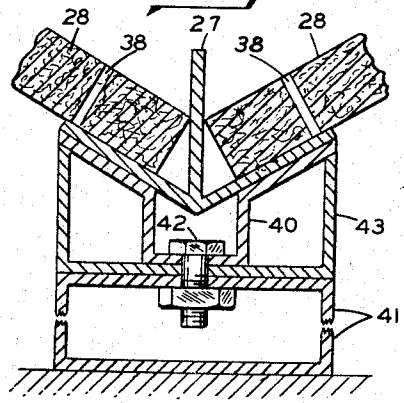


Fig. 9

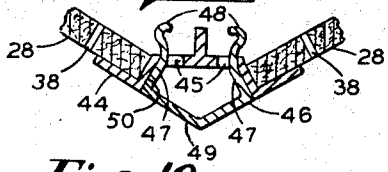


Fig. 10

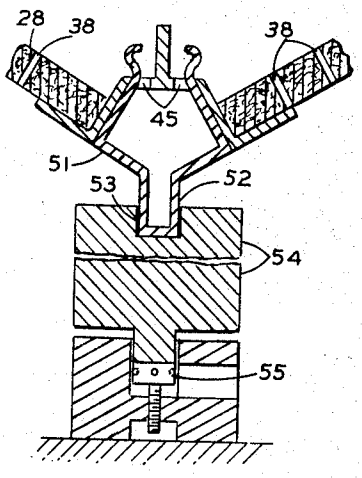


Fig. 11

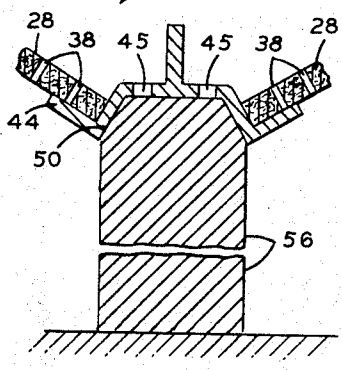
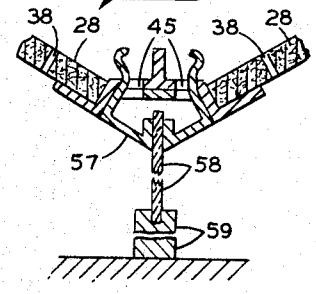


Fig. 12



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3,321,877

ACOUSTIC CEILING

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Filed Feb. 24, 1964, Ser. No. 346,651
3 Claims. (Cl. 52—144)

This invention relates to building construction and more particularly to a new and improved acoustic ceiling construction.

It has been a common practice in building and acoustic ceiling construction to suspend acoustic panels from a main ceiling so that all of the acoustic panels lie in the same plane which is usually horizontal and parallel to the main ceiling. With this type of construction, a substantial portion of the area of the ceiling was lost insofar as the use of acoustic panels was concerned, since certain areas of the ceiling were occupied by lighting and ventilating fixtures. Also, as a result of these fixtures, lighting and ventilation distribution problems arose.

One solution to the problem has been to form the acoustic panels of translucent material and to mount the illumination means between the acoustic panels and the main ceiling. This solution created maintenance problems since the illumination means were not directly accessible from the floor of the room.

An object of the present invention is to provide a new and improved acoustic ceiling wherein a plurality of individually removable acoustic panels are each arranged at an angle to a plane passing through the lower portion of the acoustic panels to form a downwardly opening space of increasing cross-sectional area between the acoustic panels to provide increased acoustic panel area and resultant increased sound absorption.

Another object of the present invention is to arrange acoustic ceiling panels in a manner so as to provide a recessed space into which illuminating means may be placed to allow easy access from the floor of a room and wherein the panels will serve as reflectors to increase the uniformity of light distribution, the amount of illumination, the efficiency of illumination, and to substantially eliminate objectionable direct glare.

Another object of the present invention is to provide a ventilating ceiling wherein increased air distribution efficiency is afforded.

Another object of the present invention is to provide an improved acoustic ceiling having support runners which support acoustic panels in an angled relationship, and which may cooperate with partition means to hold same in position.

Further objects of the the present invention will be readily apparent from the detailed discussion of the device noted below with reference to the drawings wherein

FIG. 1 shows a view in perspective of a ceiling according to the invention;

FIG. 2 shows a different view in perspective of a ceiling according to the invention wherein the end panels have been partially broken away;

FIG. 3 shows a view in perspective of a support assembly for acoustic panels and light fixtures according to the invention wherein the major portions of said assembly are illustrated in relative, disassembled locations;

FIG. 4 shows a sectional view of an end panel including a cross runner taken on line 4—4 of FIG. 2;

FIG. 5 shows a sectional view of a main runner taken on line 5—5 of FIG. 2;

FIG. 6 shows a sectional view of the lighting fixture taken on line 6—6 of FIG. 2;

FIG. 7 shows a sectional view of a lighting fixture similar to that shown in FIG. 6 with a diffuser;

FIG. 8 shows a sectional view of a runner similar to

that of FIG. 5 but including a partition adapter and cooperating partition;

FIG. 9 shows a sectional view of a modified main runner including a removable trim attachment;

FIG. 10 shows a sectional view of a modified main runner, removable partition adapter, and partition;

FIG. 11 shows a sectional view of a modified main runner with a cooperating partition; and

FIG. 12 shows a sectional view of a modified main runner, removable glass adapter and cooperating partition.

Referring now to FIGS. 1 and 2, there is shown an acoustic ceiling assembly **20** suspended in spaced relationship from a ceiling **21** of a building structure by any well known means such as wires **22**, for example. As shown in FIGS. 1, 2 and 3, the acoustic ceiling **20** comprises support means including triangular end panels **23** which depend from beams **24** so that all end panels on each beam lie substantially in the plane of the beam in juxtaposed relationship. The lower ends of adjacent end panels are connected by any suitable means such as plates **25**. Beams **24** are attached to the lower ends of wires **22**, the upper ends of which are anchored in ceiling **21**. The composite beam and end panel assemblies are suspended in spaced, substantially parallel relationship by wires **22**. Lighting fixtures **26** extend substantially normal to end panels **23** at the apices thereof and are supported by beams **24**. Main runners **27** extend substantially normal to the planes of the end panels **23** and are connected to directly opposed, corresponding plates **25** to be supported thereby. The composite assembly forms a grid support system for acoustic panels **28** which are individually and removably held in position by runner means or flange-like surfaces **29**, **30**, and **31** on end panels **23**, main runners **27**, and lighting fixtures **26**, respectively, as will be apparent from FIGS. 4 to 6.

Referring now to FIG. 3, the support structure is shown disassembled into its major components, the connections between which are accomplished by any well known means, such as hooks and slots, for example. As shown in FIG. 3, the end panels **23** and beams **24** are pre-assembled into sections, each of which includes two adjacent, co-planar end panels **23** attached at their upper apices to a beam **24**. The lower adjacent and opposed corners of adjacent end panels are connected by perforate plates **25** having slots **32** to receive hooks **33** on the ends of main runners **27**. At the end of each section an additional plate **25** is mounted. This plate contains appropriate and well known connection means (not shown herein) to allow additional sections to be connected thereto. The beams **24** contain perforations **34** which receive suspension wires **22**. The lighting fixtures **26** have notched extensions **35** which rest on beams **24**. Any conventional means may be used to secure the fixtures **26** to beams **24**. Any conventional splicing means may be used to connect adjacent ends of the beams of adjacent co-planar modules. With these components, it is apparent that an acoustic ceiling support structure may be constructed, stored, shipped, assembled, and disassembled in a simple, efficient, and economical manner. It is to be understood that the composition of the support structure may be varied as to size, shape, number of panels, etc., and that any suitable connection means between support elements may be used. The runner means or flange-like surfaces may have different shapes and sizes. The dimensions of each component may be varied. In other words, the invention is not limited to the support arrangement shown and described, and any support means which will removably retain the acoustic panels **28** in an angled or non-planar relationship may be used.

As mentioned above, the acoustic panels **28** are in-

dividually and removably supported in angled relationship with respect to a plane passing through the lower portion of each acoustic panel. This plane may be the overall plane of the acoustic ceiling, may be horizontal, and/or may be parallel to the ceiling of a building structure. This plane may pass through the lowest edge of each acoustic panel. The angled relationship between the acoustic panels is such that each pair of acoustic panels have corresponding portions which are closer together at one end than at another to form a space therebetween of generally increasing cross-sectional area. Adjacent pairs of acoustic panels form a corrugated pattern across the overall plane of the acoustic ceiling.

As seen in FIG. 2, the space **36** between the acoustic ceiling **20** and the building ceiling **21** may be utilized as a plenum for air supply purposes, in which case a conditioned air supply duct **37** would terminate in such space.

The acoustic panels **28** may have perforations **38** extending therethrough to allow air supplied from duct **37** to pass therethrough and be distributed in an even manner into the area on the side of the acoustic panels opposite the plenum.

The top of beams **24** may be spaced from the building ceiling as shown in the drawings or may be mounted directly adjacent thereto. In the latter case, individual stub ducts opening into the end of the space or valley between each pair of angled acoustic panels and the building ceiling would be required to obtain distribution of air to the opposite side of the acoustic panels.

The end panels **23** are preferably triangular, and the acoustic panels are preferably rectangular, since the maximum utilization of lamp output is obtained when adjacent acoustic panels each have a pitch of 33° with respect to the plane of the lower face of the ceiling, although a different angle or angles, end or acoustic panel shape, or number of acoustic panels may be used. Each acoustic panel may have a different angle with respect to a reference plane. The triangular end panel and rectangular module arrangement provide a larger reflective area (as much as 50%) than units heretofore used. The angled acoustic panel relationship with the lighting fixture nestled in the apex formed by the inclined acoustic panels delivers approximately 10% more light than most recessed fixtures of the prior art. This arrangement also provides low brightness, large area lighting which has more uniform light distribution but avoids objectionable direct glare. The lamps may have removable diffusers or shields, but these elements are not required. Many shapes of such diffusers may be used; however, a V-shaped diffuser **39** mounted by any well known means beneath the lamps as shown in FIG. 7 seems to provide the most attractive and efficient arrangement. In any event, since the lighting unit and lamps are exposed to and readily accessible from the "room" side of the acoustic panels, lamp replacement and lighting unit maintenance including that concerned with wiring are more easily accomplished. When perforate acoustic panels are used in the ceiling, conditioned air constantly passes over the lamps and lighting unit thereby keeping them at an optimum operating temperature. This condition results in the lamps holding their correct color, emitting the most light, and having the longest life. The air constantly passing through the ceiling also forms a barrier which keeps dust and dirt away from the lamps and the acoustic panels, thereby maintaining a clean ceiling without periodic cleaning operations. The individual acoustic panels are easily inserted and removed from the runner means whether or not the lamps or diffuser are mounted on the lighting unit. It is apparent that in any of the modifications of the invention noted heretofore, more acoustic panel area is afforded than in the device of the prior art, since the acoustic panels of the present invention are mounted in an angular relationship across the entire ceiling without the loss of acoustic panel area normally required for lighting and ventilating fixtures. The increased acoustic panel area afforded by the device of the present invention results in increased sound absorption, light distribution, and lighting efficiency.

Where the plane of the apices of the acoustic panels is not located below all the obstructions in a building, some of the acoustic panels may be supported in a horizontal, planar arrangement to provide utility, conduit, and girder spaces to cover such obstructions, thereby concealing them from the working spaces to cover such obstructions, thereby concealing them from the working spaces of the building. In this case no lighting fixture would normally be placed between adjacent co-planar, acoustic panels. It is to be understood that the end panels **23** may be omitted, in which case continuous valleys of light are provided.

If desired the main runners or end panels may be suitably modified to accommodate springler supply pipes and fixtures by providing ports extending through the runners or panels and appropriate support means.

Referring now to FIG. 8, there is shown a main runner **27** having adapter piece **40** connected thereto by any well known means not shown herein. Partition **41** may be connected to adapter piece **40** by nut and bolt means **42**. Trim piece **43** may be mounted between the partition **41** and the adapter piece **40** to provide a relatively smooth surface over the adapter connection. The partition **41** may be supported directly on the floor of a room or on any other suitable building structure. Partition adjustment means similar to that shown in FIG. 10 may be provided for the partition.

Referring now to FIG. 9, there is shown a modified main runner **44** having apertures **45** and a removable trim piece **46**. The trim piece **46** has upright, resilient legs **47** with outwardly extending lips **48** near their ends and inclined surfaces **49** on the lower portion thereof. The trim piece fits into a recess **50** in the main runner **44** and may be disengaged from the runner by moving resilient legs **47** toward each other to a point where said legs **47** and lips **48** will clear and may be withdrawn through apertures **45** in main runner **44**. Reassembly will be afforded by reversing these steps. It is noted that the resilience in legs **47** will maintain said legs **47** and the lips **48** in an engaged position with respect to apertures **45**.

FIGS. 10 to 12 show various modifications of runners which cooperate with partitions and adapters therefor to hold said partitions in position.

FIG. 10 shows a removable, male adapter **51** which is similar in most respects to the trim piece **46** of FIG. 9 except that adapter **51** has a depending portion **52** which may cooperate with a slot **53** in a partition **54** to hold said partition **54** in position. The slot **53** may be moved in and out of registry with portion **52** by means of jack screw assembly **55** which rests against a permanent surface. The adapter **51** may be inserted into and removed from the main runner **44** in the same manner as trim piece **46**. It is noted that this adapter also may be of the female type (not shown herein) which incorporates a slot into which a portion of partition may be inserted.

FIG. 11 shows a modified main runner **44** having a recess **50** on one side thereof into which the cooperating upper portion of a partition **56** may be inserted whereby the upper portion of partition **56** will be held against lateral movement. The partition **56** may be raised into and lowered out of the recess **50** in runner **44** by jack screw means (not shown) similar to that shown in FIG. 10.

FIG. 12 shows a removable adapter **57** for glass partitions which is similar to trim piece **46** except that adapter **57** has a slot in the outer portion thereof to receive the edge of a piece of glass **58** which may be a portion of partition **59**. The partition **59** may have jack screw adjusting means similar to that of FIG. 10.

It is to be understood that the shapes of the runners, adapters, and trim may take various forms and are not

limited to those shown in the drawings. The lower edges of the end panels in each embodiment may have the same configuration as the main runners therein. Thus, the adapters, partitions, trim pieces, etc. in each case may also be used in cooperation with the lower edges of the end panels. The lower edge portions of the end panels may be constructed in detachable runner form.

Various modifications will occur to those skilled in the art without departing from the spirit and scope of the invention as defined in the claims.

I claim:

1. An acoustic ceiling for use with a room having a main ceiling from which said acoustic ceiling is to be suspended comprising a plurality of acoustic panels, means to individually and removably support each of at least two of said acoustic panels at an angle to a plane passing through the lower portions of said removably supported acoustic panels and in spaced relationship to one another with the distance between the lower portion of each of said removably supported acoustic panels being greater than that distance between the upper portion of each of said removably supported acoustic panels whereby a downwardly opening space of increasing cross-sectional area is defined between said removably supported acoustic panels, said supporting means including runner means extending along the lower portions of said removably supported acoustic panels, said runner means including adapter means, partition means for sub-dividing said room including means cooperating with said adapter means to support said partition means, illuminating means located in the downwardly opening space between said removably supported acoustical panels, said acoustic panels including ventilating apertures therethrough and said support means individually and removably supporting all of said acoustic panels in a corrugated manner across the extent of said ceiling.

2. An acoustic ceiling for use with a room having a main ceiling from which said acoustic ceiling is to be suspended comprising a plurality of acoustic panels, means to individually and removably support each of at least two of said acoustic panels at an angle to a plane passing through the lower portions of said removably supported acoustic panels and in spaced relationship to one another with the distance between the lower portion of each of said removably supported acoustic panels being greater than that distance between the upper portion of each of said removably supported acoustic panels whereby a downwardly opening space of increasing cross-sectional area is defined between said removably supported acoustic panels, said support means including runner means extending along the lower portion of said removably supported acoustic panels, said runner means including adapter means, partition means for sub-dividing said room including means cooperating with said adapter means to support said partition means, illuminating means located in the downwardly opening space between said removably supported acoustic panels, said acoustic panels including ventilating apertures therethrough, said support means individually and removably supporting all of said acoustic panels in a corrugated manner across the extent of said ceiling, and said support means including generally V-shaped main runners extending substantially normal to triangularly shaped end supports.

3. An acoustic ceiling for use with a room having a main ceiling from which said acoustic ceiling is to be suspended comprising a plurality of acoustic panels, means to individually and removably support each of at least two of said acoustic panels at an angle relative to each other and at an angle to a plane passing through the lower portions of said removably supported acoustic panels and in spaced relationship to one another facing each other with their sound absorbing surfaces and with the distance between the lower portion of each of said removably supported acoustic panels being greater than that distance between the upper portion of each of said removably supported acoustic panels whereby a downwardly opening space of increasing cross-sectional area is defined between said removably supported acoustic panels to increase the acoustic panel area and resulting sound absorption of the ceiling, said support means including runner means extending along the lower portions of said removably supported acoustic panels, said runner means being generally V-shaped in cross-section and forming the main runner structure, said support means further including at least two end support means that are substantially normal to the main runner and cooperate with said main runner to provide part of the support for the panels, said support means further including means cooperating with main runner and end support means to suspend the panel from the main ceiling, whereby said panels are supported relative to the main ceiling and carried by said support means so that the panels are readily removable, and elongated illuminating means located in the downwardly opening space between said removably supported acoustic panels, said illuminating means being placed in the area near the upper portion of the acoustic panels where the acoustic panels are closest together so that all the acoustic panels are individually and removably supported from the main ceiling in a corrugated manner with illuminating means to provide an improved sound absorption and indirect lighting effect.

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REINALDO P. MACHADO, *Primary Examiner.*

KENNETH DOWNEY, *Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,321,877 May 30, 1967

Stephen T. Alexieff

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 28, after "obtain" insert -- uniform --; line 71, for "device" read -- devices --; column 4, lines 8 and 9, strike out "thereby concealing them from the working spaces to cover such obstructions,"; line 17, for "springler" read -- sprinkler --.

Signed and sealed this 2nd day of January 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents