March 10, 1970 R. O. HEVERLY ETAL 3,499,257

CEILING STRUCTURE

Filed Dec. 29, 1967 3 Sheets-Sheet 1

FIG. 1

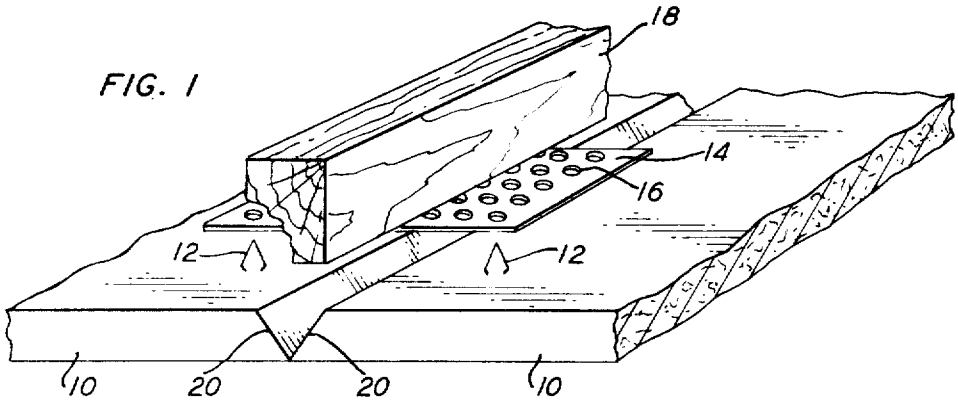


FIG. 2A

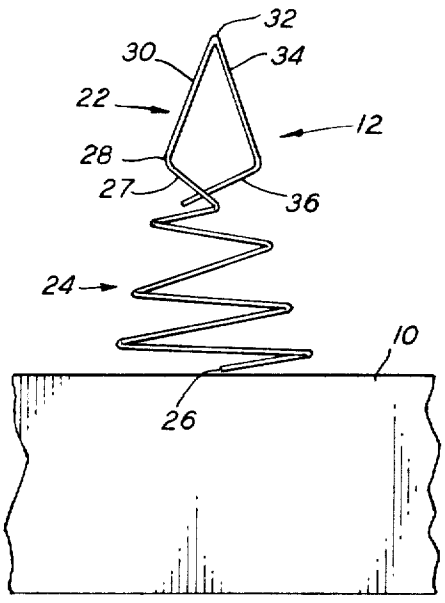


FIG. 2B

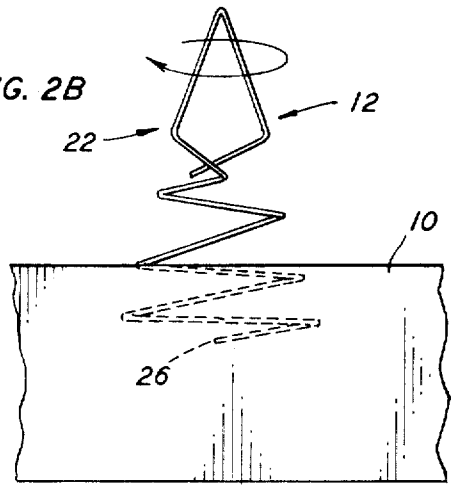
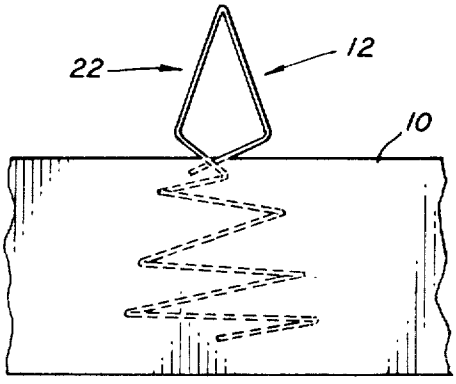


FIG. 2C



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March 10, 1970 R. O. HEVERLY ETAL 3,499,257

CEILING STRUCTURE

Filed Dec. 29, 1967 3 Sheets-Sheet 2

FIG. 3A

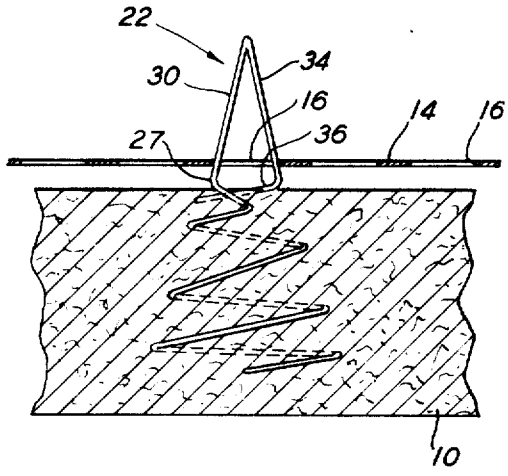


FIG. 3B

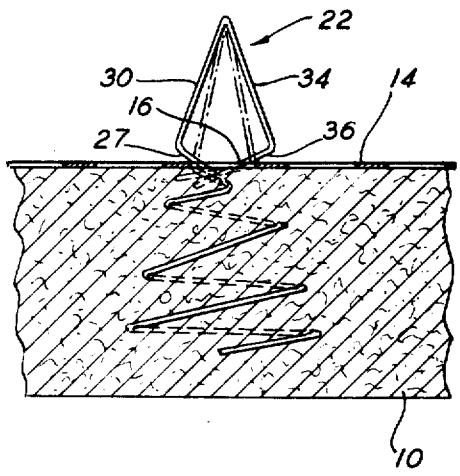


FIG. 4

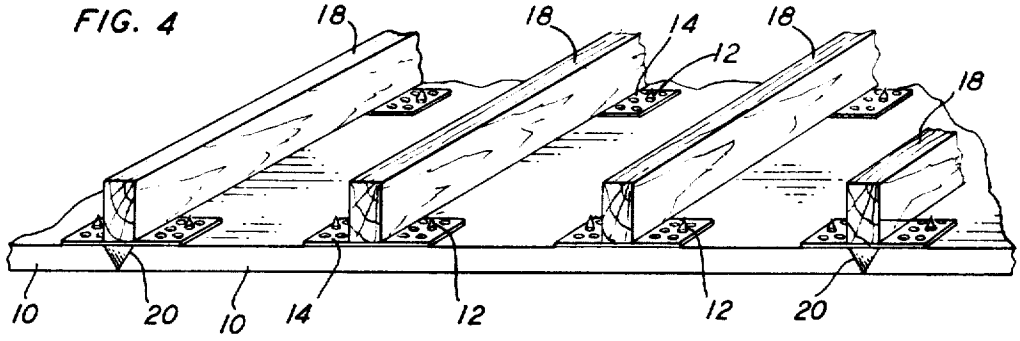
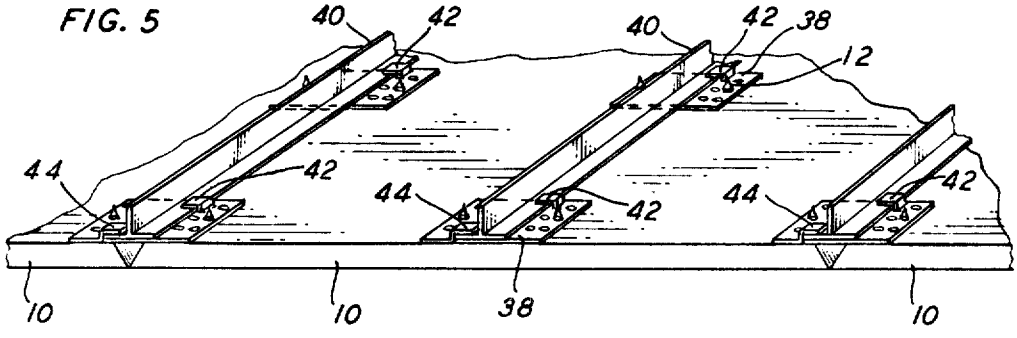


FIG. 5



March 10, 1970 R. O. HEVERLY ETAL 3,499,257

CEILING STRUCTURE

Filed Dec. 29, 1967 3 Sheets-Sheet 3

FIG. 6

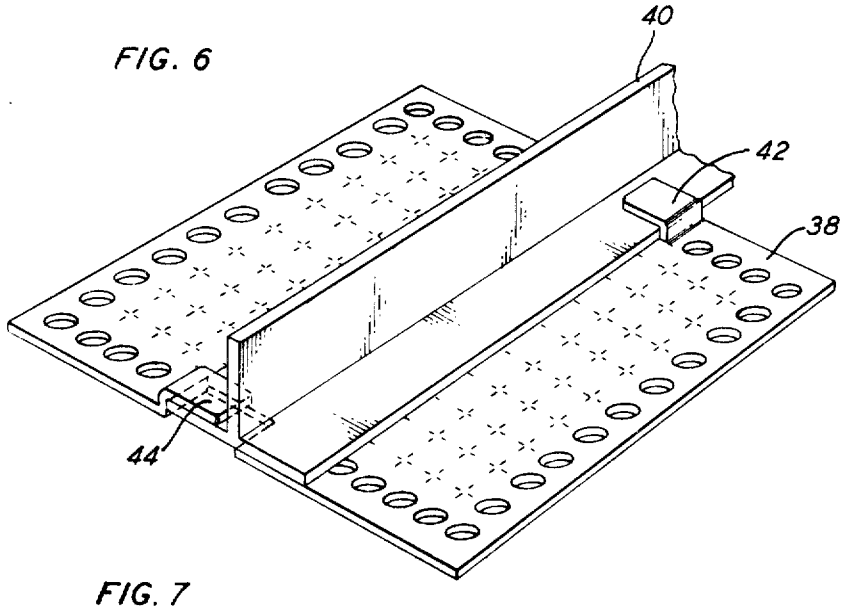
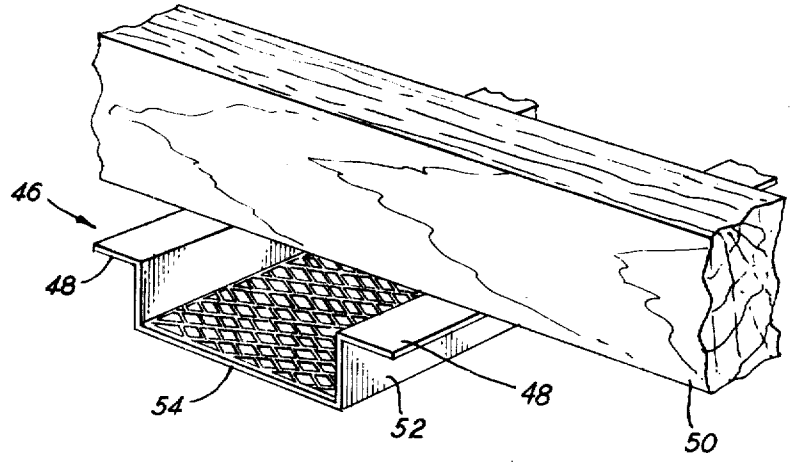


FIG. 7



United States Patent Office 3,499,257 Patented Mar. 10, 1970

3,499,257

CEILING STRUCTURE

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Int. Cl. E04b 5/57, 1/40
U.S. Cl. 52—484 4 Claims

ABSTRACT OF THE DISCLOSURE

A fastener embedded in a structurally weak, low density ceiling panel projects beyond the back surface of the panel and through an opening in a complementary fastening member to hold the panel in place.

BACKGROUND OF THE INVENTION

Decorative ceiling panels are widely used in homes, offices, stores and other buildings. They are generally held in place at their edges by support structure attached to and spaced from the ceiling itself, and the space between the panels and ceiling generally is used to house electrical wiring, pipes and ducts. Panel arrangements permitting individual panels to be removed from the ceiling without first necessitating removal of other panels are preferred in order to provide ready access to the utility space.

Panels of the type mentioned above are capable of being supported at their edge portions without appreciable sagging because they are rigid and strong, or because they span only a short distance or because of a combination of these two factors. Panels of relatively low density have been used, but not in large sizes due to their inability to span substantial distances. It would be economical and desirable from an esthetic standpoint to form large size panels from low density material, particularly from relatively thick material which would provide the added benefit of improved acoustical performance. Heretofore, however, no suitable panel support system has been available for such an installation. Typical prior art systems utilize an exposed grid of support beams or runners having horizontally extending flanges on which the edge portions of the panel faces are supported. Support systems which are not exposed to view require the panels to fit together by means of tongue and groove construction or to be supported by the flanges of a hidden grid system which engage kerfs in the panel edges. Because low density panels do not lend themselves to such hidden grid constructions, their use has previously been limited to exposed grid systems.

OBJECTS OF THE INVENTION

The main object of the invention is to provide a concealed fastening arrangement for supporting relatively large, low density panels, without sagging, in a suspended panel ceiling in a manner that permits ready removal of any panel.

Another object of the invention is to provide such an arrangement which can be economically manufactured and easily and quickly installed.

SUMMARY OF THE INVENTION

The present invention does not contemplate supporting a low density panel in the conventional manner along its edges. Instead, each panel is suspended from the ceiling by fastener elements secured at spaced locations to the panel and held in place by complementary fastener elements or plates secured to the ceilinig structure. In the preferred embodiment the fasteners are embedded in the body of the panel and, surprisingly, even panels of very

low density can be supported without sag and without the weight of the panel causing the panel material to tear and fail. This is accomplished by employing a fastener which engages substantial portions of the interior of the panel, thus increasing the area of contact between the embedded portion of the fastener and the panel material. The fasteners are attached to their complementary fastener elements merely by pushing the panel, with the fasteners secured thereto, up against the complementary fastener elements. In addition, the fasteners and complementary fastener elements are so constructed that they can be disengaged by being moved away from each other. Thus any panel in a panel ceiling arrangement can be readily removed and the space between the panel and ceiling structure made accessible. The invention is not limited to use with low density material, but can be used to support panels of greater density, as discussed more fully below.

DESCRIPTION OF THE DRAWINGS

The nature of the invention will be more fully understood and other objects may become apparent when the following detailed description is considered in connection with the accompanying drawings, wherein:

FIG. 1 is a pictorial representation of portions of two ceiling panels vertically spaced from a fastener plate to which they are to be attached;

FIG. 2A is an end view of a portion of a ceiling panel, with a preferred embodiment of the fastener shown in position to be inserted into the panel;

FIG. 2B is a view similar to that of FIG. 2A, but showing the body portion of the fastener partially embedded in the panel;

FIG. 2C is a view similar to that of FIG. 2A, but showing the body portion of the fastener fully embedded in the panel;

FIG. 3A is a transverse cross-sectional view of a portion of a panel showing the projecting portion of the fastener being inserted through the opening of a fastener plate secured to the ceiling structure;

FIG. 3B is a view similar to that of FIG. 3A, but showing the panel secured in place against the under surface of the fastener plate;

FIG. 4 is a pictorial representation of a portion of a ceiling installation in which the fastener plates are attached to wooden joists;

FIG. 5 is a view similar to that of FIG. 4, but showing the fastener plates attached to the flanges of metal T-bars;

FIG. 6 is a pictorial representation of a fastener plate adapted for use with a metal T-bar; and

FIG. 7 is a pictorial representation of a modified type of fastener plate shown in connection with a wooden joist.

DETAILED DESCRIPTION OF THE INVENTION

In the following description and in the claims, the word "panel" shall be construed to include a sheet or board the length of which is considerably greater than its width, that is, greater than in the usual size of panel wherein the length typically is twice the width. For example, with this invention, panels having a length of 16 feet or more and a width of 4 feet or less are entirely practical. The size is limited mainly by the length of panel that can be handled easily by workmen.

Referring to FIG. 1, a typical ceiling installation constructed in accordance with the invention is illustrated by panels **10** carrying fastening elements **12** which project from the back surface of the panel. A plate **14**, provided with a plurality of openings **16**, shown for purpose of illustration as circular in shape, is secured to the bottom of a wooden joist **18** by suitable means, such

as by nails or staples, not shown. The panels are illustrated as being vertically spaced from the plate **14**, in position to be pushed up against the plate in order to insert the fastener **12** into one of the openings **16**, thereby connecting the fastener to the plate and securing it in place in a manner to be described hereinafter. As will also be explained later, a force of sufficient amount exerted on a secured in place fastener in a direction away from the ceiling will cause the fastener to become disengaged, thus permitting the panel to be readily removed. The panels preferably are provided with sloping edge portions **20** so that the corners between the faces and side edges of adjacent panels will abut in substantially line contact to avoid a gap between the panels.

Referring to FIGS. 2A, 2B and 2C, the fastener **12** is illustrated in its preferred form as comprising two parts, a head portion **22** and a body portion **24**, the latter formed from helically shaped wire. When the fastener is turned in the direction of the arrow, as indicated in FIG. 2B, the lowermost end **26** of the wire cuts into the material of panel **10**, and the helical wire threads its way into the panel in the manner of a screw. As shown in FIG. 2C, the fastener is inserted into the body of the panel until the widest part of the head portion **22** is substantially at the back surface of the panel **10**.

Exemplary of low density material adapted to be supported by the fasteners of the invention is a sheet of bonded glass fibers having a density of about 1½ pounds per cubic foot. Glass fiber sheets or mats having still lower densities, in the order of ¼ pound per cubic foot, can also be secured in place by this invention. Higher density sheets or boards can also be used, such as, for example, glass fiber panels having a density of about 10 pounds per cubic foot. There is no specific density range within which the density of panels must fall in order for the panels to be installed by the support structure of this invention. Whether or not the fasteners can be used with a particular type of panel depends more on the nature of the panel material than its density. For example, a lightweight but rigid panel comprised of foamed polystyrene is not well suited for receiving the fastener, at least not with respect to fasteners formed of rather thin wire, because it is difficult for the wire to pierce and be threaded into the material. As a practical matter it is preferred that the panel material be fibrous in nature or comprised of other material into which the body portion of the fastener may readily be instered.

The thickness of the panel will vary depending upon the panel composition and density. It should be thick enough, however, to receive the body portion of the fastener. With some materials a substantial panel thickness is preferred because it adds acoustical benefits, and in some cases of thick enough, thermal insulation benefits.

Still referring to FIGS. 2A, 2B and 2C, the head portion **22** is comprised of a continuation of the helically wound wire which forms the body portion **24** of the fastener. Beginning at the top of the helical portion, the wire extends diagonally outwardly at **27**, and is bent at **28** so that it extends back toward the centerline of the fastener along diagonal section **30** until it reaches its apex **32**. Sections or legs **27** and **30** each form acute angles with respect to the general plane in which the panel **10** lies. Diagonal wire sections **34** and **36**, similar to and opposing sections **30** and **27**, complete the head portion, forming a diamond shaped configuration. The wire section **36** is bent so that it extends to one side of the section **27** and the extremity of the section **36** terminates a substantial distance beyond the adjacent wire section **27** so that there can be relative movement of sections **36** and **27** toward each other without the extremity of wire section **36** binding on the section **27**.

Referring to FIG. 3A, a fastener fully embedded in panel **10** is shown in an intermediate stage of engagement with the fastening plate **14**. The fastener head **22** has been inserted into an opening **16** until the corner portions of the fastener head, formed by the junctions of sections **34** and **36** and sections **30** and **27**, have engaged the bottom edge of the opening, the diameter of which is less than the distance between the corners of the fastener head in normal, unstressed condition. The head is shown as having been pushed up into the opening somewhat so that the arm of the fastener head formed by the sections **34** and **36** has been resiliently biased toward the opposite arm formed by sections **27** and **30**, thus in effect reducing the width of the fastener head.

As illustrated in FIG. 3B, when the widest portion of the fastener head passes through the opening **16** and is located beyond the back of the plate **14**, the arms of the fastener head resume their original position, shown by the solid lines, and the wire portions **27** and **36** rest upon the plate at the upper edge of the opening **16**. As the wire arms forming the fastener head move from the dotted line position to the full line position, the extremity of the wire arm section **36** remains extended beyond the wire section **27**, thereby precluding the end from binding against the wire section **27** and preventing subsequent return to the dotted line position. When it is desired to remove a panel it is merely necessary to apply force in the direction away from the fatsener plate **14** by pulling down on the fastener element. Because the wire sections **27** and **36** are sloped with respect to the back surface of the plate **14** the wire arms of the head **22** will in effect be cammed toward each other, eventually reaching a point where the widest portion of the head is equal to or narrower than the diameter of the opening **16**, thus permitting removal of the fastener from the plate.

Referring to FIG. 4, a typical installation is shown wherein the fastening plates **14** are secured directly to the bottom surfaces of wood joists **18**. As described in connection with FIG. 1, the side edges of the panel are preferably sloped, as indicated at **20**, to provide for proper contact of the lowermost panel corners. The panel shown in 4 feet wide, adapted to span the distance between three pairs of joists spaced apart 16 inches on center. The panel can be any reasonable length, preferably ranging from 4 feet to 16 feet. It is provided with fastener elements **12** adjacent its edge portions and at suitable locations intermediate the edges so as to engage fastening plates **14** adjacent each poist at intervals chosen to provide suitable support for the panel through its length and width. For example, typically, when installing a panel in a joist arrangement, fastening elements **12** and **14** are spaced along the width of the panel in the direction parallel to the joists about every 30 inches. If furring strips are used, as in the case where joists are not properly leveled, it is preferred to locate the strips 2 feet on center, and to also locate the fasteners 2 feet on center along the direction of each furring strip. These distances may vary depending on the strength of the panel material and the size of the panels. It should be understood that the panels can also be installed with their short dimensions parallel to the support joists, if desired.

To install such a ceiling arrangement, fastening plates are attached to the joists or furring strips at locations in accordance with the desired fastener spacing and fastener elements are inserted into the panels in accordance with the same spacing. Since there are many openings in the fastener plate, it is not necessary to exactly align the fastener element to locate it directly opposite a particular predetermined opening. It is merely necessary to locate the fastener elements so they are within an area of the panel in contact with the plate **14**. In such an arrangement, since the fastener element itself is resilient and the material of the panel is compressible and resilient enough to withstand some movement of both itself and the fastener element, the fastener element can readily be aligned with at least one of the holes in the fastener plate to permit proper installation. To install a panel it is merely necessary to raise an end of the panel to its proper position and then push upwardly at the location of the fastener elements adjacent the end of the panel, thereby forcing the head or

locking portions of the fasteners into locking engagement with the fastener plate. This procedure is continued along the length of the panel until all fastening elements are secured. After all panels are in place, molding or other trim can be applied around the perimeter of the room to finish the ceiling.

A typical installation utilizing metal T-bars is illustrated in FIG. 5. As shown, the panels **10** are provided with fastener elements **12** which cooperate with and engage fastener plates **38**. In this arrangement, the T-bars **40** are spaced on two-foot centers and the fastener elements and fastener plates are also spaced on two-foot centers in both the direction of the T-bars and along the width of the panels. As in the joist arrangement, the short dimension of the panels may be parallel to the T-bar instead of transverse to the T-bar, as shown. In order to attach the fastener plates to the metallic T-bars, each plate is provided with tabs **42** struck from the plate and bent to fit around the flanges of the T-bar and support the plate in position. This type of plate is shown in more detail in FIG. 6. As illustrated, tabs are formed at only two locations, tab **42** being located near one side edge and being adapted to fit around one of the flanges of a T-bar, and tab **44** being located at the opposite edge and being adapted to fit around the other flange of a T-bar. This arrangement, wherein the tabs are spaced apart, permits rapid installation. To install the plate it is merely necessary to bring it into place beneath the T-bar so that the T-bar extends generally across the corners of the plate. One of the tabs is moved loosely into place and the plate is then rotated to bring the other tab into place overlying the adjacent T-bar flange. With both tabs overlying the T-bar flanges the plate is firmly held in place. The T-bars may be supported by any conventional arrangement such as, for example, by hanger wires, not shown.

It is not essential that the fastener plates be formed identical to the construction illustrated in FIGS. 1 and 6. For example, as shown in FIG. 7, the plate may take the form of channel **46** having flanges **48** adapted to be secured to the lowermost surface of a support, such as a joist **50**. The flanges **48** are connected by side walls **52** to the lower horizontal portion **54** which is comprised of metal lath. It is not essential that the fastener plate be of channel section when metal lath is employed, but it is a preferred arrangement because it adds rigidity to the construction. The openings formed by the lath can be of any conventional or other desired shape, so long as the dimension of the opening aligned with the legs of the fastener head is suitably smaller than the distance between the legs, in order for the fastener to hold the panel in place as explained previously in connection with the circular openings of fastening plate **14**. Of course, suitable tabs may be provided to permit use with a T-bar support system.

Other forms of fastening elements may be conceived by those skilled in the art. Whatever the design, the projecting fastener portion should be resilient, that is, it should be capable of being squeezed together to reduced width and should have the ability to return to its original shape. Further, the portion to be embedded in the panel should be capable of being inserted into the panel material without damaging or otherwise adversely affecting the material and should be of such configuration that the embedded portion contacts a substantial amount of the material, as in the case of the helical wire of the preferred embodiment, to enable it to adequately support the panel.

The dimensions of the panel, fastener element and fastener plate can vary considerably. As a typical example, however, it has been found that with respect to a low density panel of 1½ inch thickness, a fastener element 2 inches in total length performs satisfactorily. This length breaks down to 1¼ inches for the helical spring portion and ¾ inch for the head portion, both of which portions may be formed of spring wire of suitable diameter. It has been found that a wire diameter of 0.047 inch, for example, performs well. The total diameter, or distance between the widest points on the head portion, is about 7/16 inch. With such a fastener element, holes of 5/16 inch diameter have been found to perform satisfactorily. It has been found that a plate approximately 4 inches by 4 inches, containing 5/16 inch circular holes spaced on ⅜ inch centers, provides enough openings, in the order of 100 or so, so that the fastener element can be located on the panel merely within the general area to be engaged with the fastener plate and will be able to enter one of the openings in the plate. When tabs are struck from the plate to engage the flanges of metal T-bars, the portions of the tabs parallel to the plate body need be spaced from the body only enough to fit around the flange of the T-bar. Generally, a spacing of about ⅛ inch is satisfactory for most T-bar systems.

The fastening system permits the exposed faces of the panels to be decorated in any suitable way. For example, they may be spray coated, covered with a suitable vinyl film, or otherwise altered in appearance so long as the body portion of a fastener can be embedded in the panel.

Fastener elements can be inserted in the panels at the installation site or in the factory. Low density resilient and compressible panels containing fastener elements can be packaged and shipped without interference from the fasteners simply by stacking the panels back to back, thus permitting the exposed head portions of the fastener elements to penetrate into the back of the next adjacent panel. This can occur without adversely deforming the panel because the panel thickness is enough to easily receive the head portion of a fastener and the resiliency and compressibility of the material is enough to withstand such deformation. The fastener elements of one panel will engage the adjacent panel itself rather than engaging other fasteners in the adjacent panel if the fastener elements in one panel are staggered slightly with respect to the location of the fastener elements in the other panel.

It should now be apparent that this invention provides a novel, practical and highly effective means for supporting low density panels, of very large size, if desired, without sagging of the panels and without utilizing a visible support means. It further permits removal of a panel to provide access to the utility space above it.

What we claim is:

1. A fastening arrangement for attaching a low density compressible panel to a ceiling structure, comprising

(a) a fastener element,

(b) a portion of the fastener element being embedded in and secured to the interior of the panel, and another portion of the fastener element projecting outwardly from a major surface of the panel,

(c) means secured to the ceiling structure for holding the fastener element in place,

(d) at least a portion of said holding means being substantially parallel to the ceiling panel and containing a plurality of openings extending therethrough, and

(e) the projecting portion of the fastened element being comprised of resilient legs, each forming an acute angle with respect to the general plane in which the panel lies and extending through an opening in the holding means,

(f) the distance between the outer extremities of the legs, measured in the direction of the general plane in which the panel lies with the legs in their normal unstressed condition, being greater than the dimension of the opening through which the projecting portion extends as measured in the direction of the general plane in which the legs lie,

(g) the legs being sufficiently resilient so that a force directed against the legs in a direction at right angles to the general plane in which the panel lies will cause the legs to move relatively toward each other to reduce the distance between the outer extremities of

the legs to permit withdrawal of the projecting portion of the fastener element from the opening.

2. A fastening arrangement as recited in claim 1, wherein the embedded portion of the fastener element is helical in shape.

3. In a ceiling installation,

(a) a relatively low density compressible panel having an exposed face and a back face,

(b) a fastener element comprising a portion embedded in the panel and a portion projecting from the back face of the panel,

(c) the projecting portion of the fastener element being comprised of opposite legs resiliently biased away from each other,

(d) means secured to the ceiling structure holding the projecting portion of the fastener element in place,

(e) said means including a relatively flat plate portion containing an opening therein having a dimension narrower than the widest part of the projecting portion of the fastener element and through which opening the projecting portion can be forced against the bias of the resilient legs, and,

(f) means on the embedded portion of the fastener extending generally transversely of the projecting portion and engaging substantial portions of the

interior of the panel to resist the tendency of the embedded portion to be pulled out of the panel in response to the downward force exerted by the weight of the panel.

4. A ceiling installation as recited in claim 3, wherein the means on the embedded portion engaging substantial portions of the interior of the panel is a helical resilient element.

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U.S. Cl. X.R.

24—213; 52—489, 714