United States Patent [19]

Bailey et al.

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[54] CEILING SYSTEM

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[21] Appl. No.: **43,130**

[30] **Foreign Application Priority Data**

June 4, 1969 Great Britain.....28,207/69

[52] **U.S. Cl.** .....**52/232**, 52/484, 52/489, 52/495, 287/189.36 A

[51] **Int. Cl.**.....**E04c 2/00**

[58] **Field of Search**.....52/484, 488, 489, 495, 665, 52/669, DIG. 5, 232; 287/189.36 A; 85/5; 24/73 P

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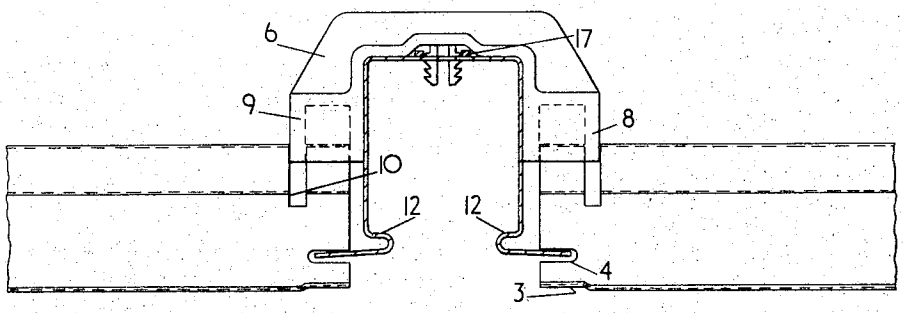
Primary Examiner—Henry C. Sutherland
Attorney—Craig & Antonelli

[57] **ABSTRACT**

In order to prevent buckling or excessive displacement or deflection of ceiling support members in a fire, a gap is left between ceiling support members but the ceiling support members are secured together and positively spaced apart by a spacing and supporting arrangement which includes fusible material so that in a fire, the fusible material will melt and allow the width of the gap to alter while at least one of the support members remains supported on the other. This prevents collapse of the ceiling and improves the fire resistance of the building.

17 Claims, 11 Drawing Figures



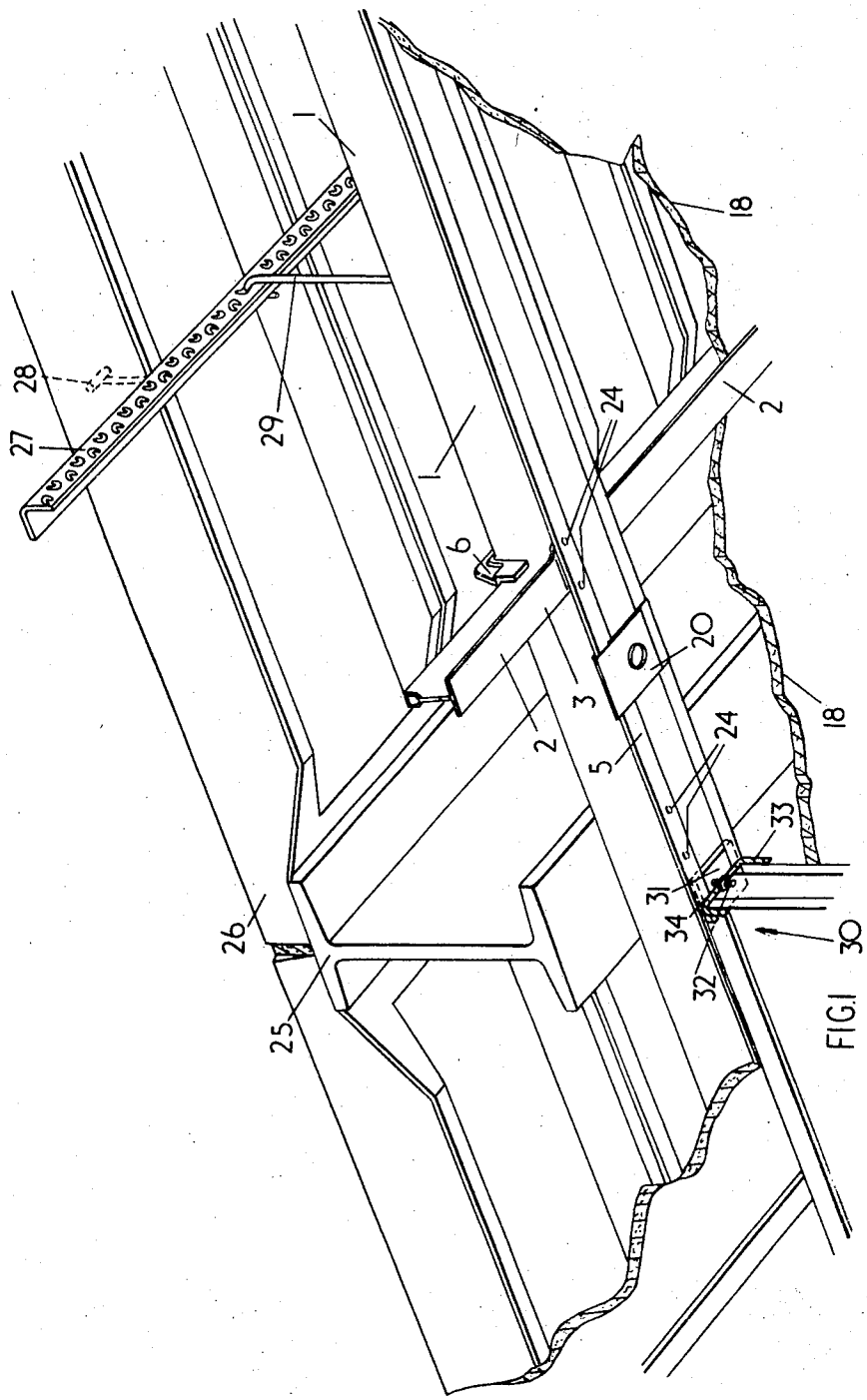


FIG. 1

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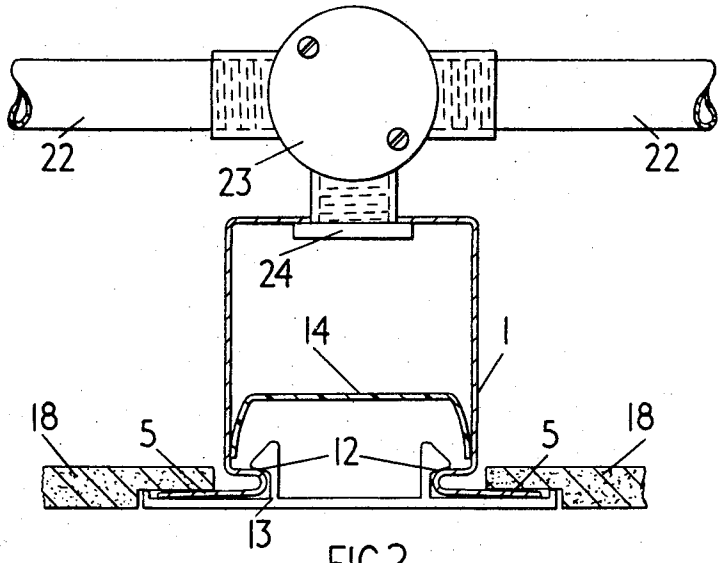

FIG.2

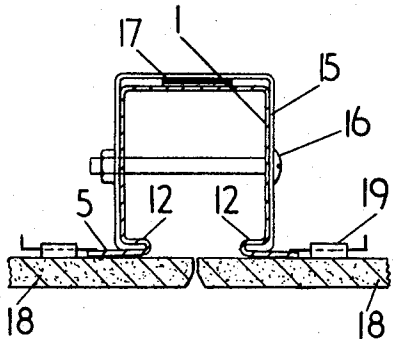

FIG.3

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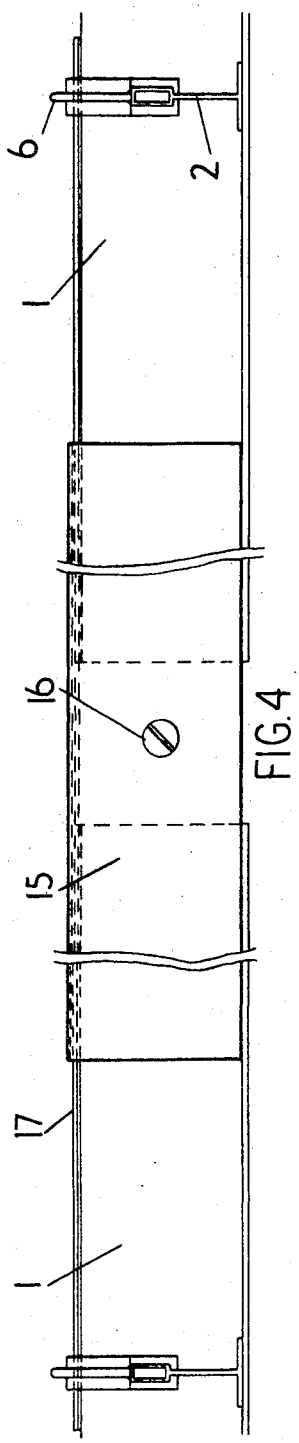

FIG.4

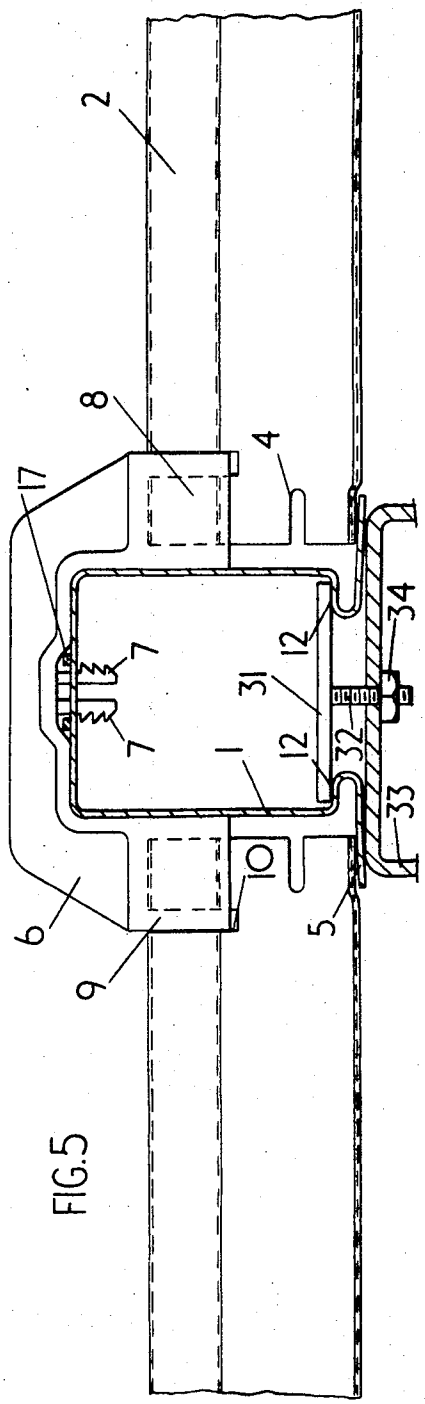

FIG.5

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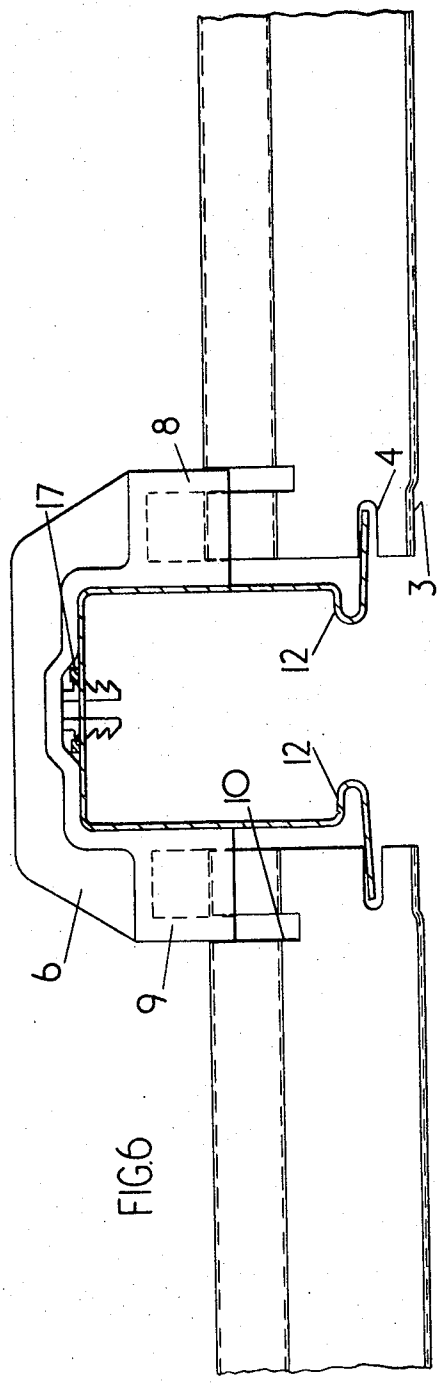

FIG.6

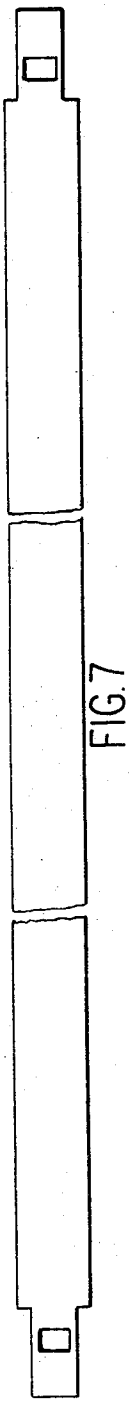

FIG.7

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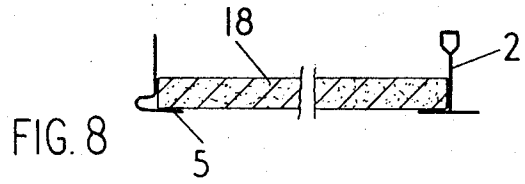

FIG. 8

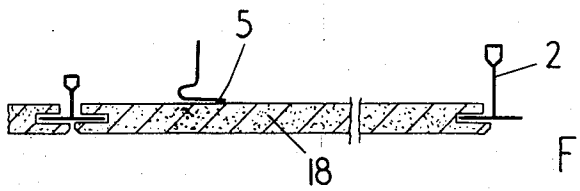

FIG.9

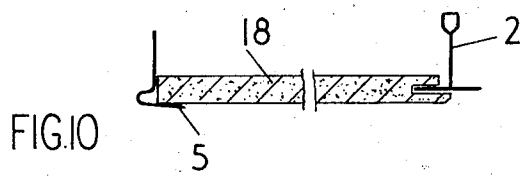

FIG.10

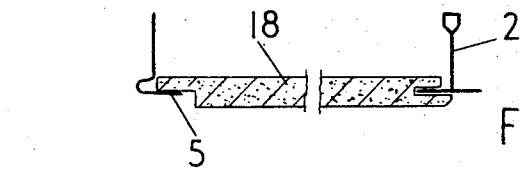

FIG.11

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CEILING SYSTEM

This invention relates to a ceiling system for a building and particularly, but not exclusively, to a suspended ceiling system, and can be applied to the system described in British Patent Specification No. 1,154,081 the description of which is incorporated herein by reference. Normally, ceiling systems, and suspended ceiling systems in particular, provide a ceiling which has either insulation qualities, decorative qualities, sound absorption qualities, fire protective qualities, or a combination of these properties, and is suspended from the floor above, or roof, using straps or hangers. The ceiling is usually supported on either T-section, bulb T-section, or I-section bearers, and uses either an exposed or secret method of fixing. The ceiling can be supported at a large number of points, and it is an object of the invention to arrange the ceiling so that both under normal conditions and in a fire, displacement or deflection of the ceiling support members can be within acceptable limits. In a fire, the ceiling should remain as flat and as dimensionally stable as possible in order that gaps should not occur, nor ceiling panels fall out.

According to the invention, a gap is left between the end of one ceiling support member and the adjacent part of another ceiling support member, the ceiling support members being secured together and positively spaced apart by a spacing and supporting arrangement which includes fusible material so that in a fire, the fusible material will melt and allow the width of said gap to alter whilst at least the first-mentioned ceiling support member remains supported on the other ceiling support member; the ceiling support members may remain mutually supported on each other.

According to the invention, a gap may be left between the adjacent ends of adjacent, aligned ceiling support members with the ceiling support members secured together and positively spaced apart by a spacing arrangement which includes fusible material so that in a fire, the fusible material will melt and allow the sections to move axially with respect to each other whilst remaining secured together as regards substantial relative movement in other directions. The spacing arrangement may include a longitudinal spacing member which spans said gap, the spacing member being secured to each ceiling support member as regards longitudinal movement, a fusible securing member (e.g. a peg-like member inserted through registering apertures in the spacing member and in the ceiling support member) being used to secure the spacing member to at least one of the channel sections. The spacing member can lie along the top of the ceiling support member, e.g. being a strip. In this case, the securing peg-like member may be a projection on the bridge-shaped securing device referred to hereafter.

The support members can be connected by sleeve members on the outside of the channel sections, the sleeve members having inwardly-projecting bottom lips which engage in the recesses provided under internal support surfaces of channel section support members. The sleeve members are a sliding fit within or over the channel sections until secured so that in a fire the tendency of the channel sections to buckle is reduced or prevented.

According to this invention, a ceiling system may have two parallel sets of members, a first set of

generally parallel main members and a second set of subsidiary members interconnecting (and preferably generally at right angles to) the first set of members, the sets of members being secured together by securing devices formed of or including fusible material so that in a fire, the fusible material will melt and allow the sets of members to move with respect to each other, the sets of members and securing devices being arranged such that the subsidiary members are slidably supported by the main members when the fusible material melts. One simple way of achieving this is to have the end portions of the subsidiary members resting on external support surfaces provided by projections on the main members. If the members are channel sections, they may have sidewalls having their lower portions curved inwards through approximately 90° and then downwards and outwards through approximately 180° to continue as outwardly-projecting lips.

The securing device may be just a clamp for clamping the relevant members together. One useful clamp-type securing device is a bridge-shaped (i.e. generally inverted U-shaped) member which spans the main member and holds the subsidiary member down. The bridge-shaped securing device may have a part for engaging in a detent on the end portion of the subsidiary member, conveniently on the top of the subsidiary member. The detent may be a transverse slot in the subsidiary member, for instance cut with a saw. The upright of the bridge may be of hollow section and open at the bottom so that the outer wall (the wall remote from the main member) can act as said part and enter the detent. The securing device is preferably snap-fitted into position. One possible snap-fitting is to have at least one resilient, ratchet-type projection on the securing device which engages in an aperture in the main member. If the main member is an inverted channel section and the securing device is bridge-shaped, the projection(s) may engage in an aperture in the top of the section.

The fusible material may be plastic, and in general, the fusible material preferably melts below 200° C.

The invention will be further described, by way of example, with reference to the accompanying drawing, of which:

FIG. 1 is a perspective view, partly in section and partly broken away, of a ceiling system in accordance with the invention;

FIG. 2 is a cross-section through a channel section in accordance with the invention, showing a closure panel, a bridge member and a pipe conduit;

FIG. 3 is a cross-section through a connection between two aligned channel sections;

FIG. 4 is a side view of two channel sections connected together;

FIG. 5 is a cross-section through a channel section showing how the interconnecting members are secured;

FIG. 6 is a similar cross-section to FIG. 5, showing a slightly different arrangement;

FIG. 7 is a top view of a spacing bar shown in FIGS. 3 to 6; and

FIGS. 8 to 11 illustrate four different ways of fixing the ceiling panels in position, each Figure showing two partial sections along two vertical planes at right angles to each other, one partial section being taken through

the channel section and the other partial section being taken through a T-bar.

The suspended ceiling system of FIG. 1 has metal, cold-rolled channel sections 1, which form a grid with subsidiary T-bars 2, extending at right angles to the sections 1. The ends of the T-bars 2 are notched or rebated at 3 (see FIGS. 6) and have cut-outs 4 (FIG. 5) so that the ends of the T-bars can either rest on lips 5 of the channel section 1 (FIG. 5) or can have the notches 4 resting on the slips 5 (FIG. 6). The arrangement of FIG. 5 is shown in FIG. 1. Protruberances (opposite the dimples 24) are formed on the lips 5 for locating the ends of the T-bars 2.

The building has a main beam 25 which supports a concrete floor unit 26. Either (a) chevron-slotted angle strips 27 are attached to the floor units 26 by means of hook bolts 28, and the channel sections 1 are suspended from the angle strips 27 by means of suspension rods 29 (as shown) or (b) the channel sections 1 are suspended direct from the floor units 26 (not shown). Apertures or deliniated apertures (scored or pressed rings in the surface of the metal which can easily be knocked out) are provided in the top of the channel sections 1 and are used to attach the suspension rods 29 direct to the channel sections 1.

As can be seen more clearly in FIGS. 4–6, the T-bars 2 are secured in position by bridge-shaped T-bar connectors 6 which are formed of a fusible material such as self-extinguishing nylon (nylon including a flame-retardant). The connector 6 spans the channel section 1 and two ratchet-type projections 7 (forming a peg-like member) have been inserted through a circular hole in the top of the channel section 1 and hold the connector 6 securely in position. As can be seen in FIGS. 5 and 6, the upright 8 of the connector 6 is of hollow section and its outer wall 9 engages in a cut-out 10 in the top of the end portion of the T-bar 2, securing the T-bar 2 against movement away from the channel section 1.

The cross-section of the channel section 1 can be seen in FIG. 2. The top has each edge portion curving downwards through approximately 90° to continue as a respective sidewall. The lower portion of the sidewall curves inwards through approximately 90° and then downwards and outwards through approximately 180° to continue as the outwardly-projecting lip 5. The inwardly-directed portions of the sidewalls provide internal support surfaces 12. As shown in FIG. 2, the internal support surfaces 12 may be used to support closure panel in the form of a snap-fitted plastic strip 13 (e.g. formed of stiff, polyvinyl chloride) for closing the channel section 1. Bridge members 14 may be provided at intervals along the channel section 1 for supporting services such as electrical wiring.

The section 1 shown in FIG. 2 is cold-rolled from a 200 mm wide steel strip.

The lengths of channel section 1 are joined together by sleeves 15 whose lower lips engage under the support surfaces 12. The sleeve 15 is clamped by a bolt 16 running across in a gap between the ends of the channel sections 1, the clamp being not so tight as to prevent longitudinal sliding movement of the channel sections 1 if a fire occurs. A spacing member in the form of a spacer bar 17 (see FIG. 7) lies along the top of the channel section 1. The spacer bar 17 locates the channel sections longitudinally; the projections 7 on the connectors 6 on either side of the connection pass down through respective registering holes in the end portions of the spacer bar and in the tops of the channel sections 1. Earth continuity is provided by spacer bar and by the sides and bottom lips of the sleeve 15.

Ceiling panels 18 are supported by the lips 5 of the channel sections 1 and by the bottom flanges of the T-bars 2. A choice of five different arrangements for the ceiling panel is provided, as follows:

i. The channel section lips 5 and the T-bar flanges are exposed (see FIG. 8).

ii. A full secret fix is provided, the panels 18 passing under the channel sections 1 but the flanges of the T-bars 2 engaging in side grooves in the ceiling panels 18, the T-bars 2 being lower than the channel sections as in FIG. 6 (see FIG. 9).

iii. A semi-secret fix is provided, the channel section lips 5 being exposed but the flanges of the T-bars 2 engaging in side grooves in the ceiling panels 18, the T-bars 2 being higher in relation to the channel section 1 than is shown in FIG. 5 (see FIG. 10).

iv. A recessed semi-secret fix is provided, the lower edges of the ceiling panels being rebated where they rest on the channel section lips 5 (see FIG. 11 and FIG. 2).

v. The ceiling panels 18 are not rebated but have sliding bolt-like catches on their upper surfaces for hooking over the channel section lips 5 and the flanges on the T-bars 2, the ceiling panels 18 providing a continuous ceiling beneath the channel sections 1 and the T-bars 2 (see FIG. 3).

In any of these arrangements, abutting edges of ceiling panels can be grooved and metal strips in the form of splines or even small T-bars can be inserted in the grooves to align the ceiling panels properly; if small T-bars are used, their end portions can be slightly joggled (displaced upwards) and rest on the flanges of the T-bars 2. The ceiling panels can be tiles of any suitable type, for instance mineral fiber board or asbestos board.

A light fitting clip 20 is shown in FIG. 1, clipped to the lips 5 of the channel section 1.

Pipe conduits 22 (see FIG. 2) extend between adjacent channel sections 1 and provide earth continuity and a conduit for services. An inspection Tee 23 is used for connection and a male bush 24 is screwed up through an aperture in the top of the channel section 1 and into the Tee.

FIG. 1 shows a partition 30, and FIG. 5 shows the mounting in more detail. A retaining bar 31 rests on the internal support surfaces 12, and carries a threaded spindle 32. A retaining channel 33 is clamped up against the lips 5 by a nut 34. The top of the partition is inserted up in the retaining channel 33.

It can be seen that the ceiling provides for sliding movement should a fire occur. Steel expands by about 40 mm for a 3.6 meter length and a temperature rise of 1000°C.

We claim:

1. A ceiling support system comprising: a set of substantially parallel main ceiling support members of inverted channel section configuration, a set of subsidiary ceiling support members interconnecting said main members, primary ceiling support means for holding said main and subsidiary members in a horizontal

plane, supporting guide means for guiding relative movement between the respective main and subsidiary members in said horizontal plane, said supporting guide means including means for slidably supporting the subsidiary members on the main members, and spacing means operatively connected to a respective main member and a respective subsidiary members for normally spacing said main and subsidiary members a predetermined distance from one another to form a gap between the end of the subsidiary member and the side of the main member, said spacing means being located in position on the main member by way of aperture means in the upwardly facing side of the main member and being interconnected with said subsidiary member by interengagement with top portions of said subsidiary member such that said spacing means can be attached from the top to respective subsidiary and main members after they are held in place in their final assembled positions by the primary ceiling support members, said spacing means being constructed of a relatively more fusible material than said support members and said supporting guide means such that melting of the fusible structure of the spacing means in the event of a fire will permit the ends of subsidiary members to move in a horizontal plane in the direction of the main members to thereby reduce the risks of buckling and collapse of the ceiling system.

2. A system according to claim 1, characterized in that the spacing means includes a bridge shaped member for each respective junction of main and subsidiary members, each of said bridge shaped members spanning a respective main member and holding at least one subsidiary member in position with respect to said main member.

3. A system according to claim 2, characterized in that gaps are formed between ends of the subsidiary members and edges of said main members at the respective junctions and between the ends of respective aligned main members at positions spaced from the respective junctions, said spacing means and said supporting means further including means for permitting relative movement of the aligned main members in a single axial direction while preventing substantial relative movement of the main members in directions other than said axial direction.

4. A system according to claim 2, characterized in that said bridge shaped member includes a part for engaging in a detent provided on an end portion of said at least one subsidiary member.

5. A system according to claim 4, characterized in that said bridge shaped member includes uprights of hollow section which are open in the downward direction, the part for engaging the detent being a wall of said hollow section disposed away from said main member.

6. A system according to claim 1, characterized in that means are provided for snap-fitting said spacing means into position on said ceiling support members, and in that at least one resilient ratchet-type projection is provided on said spacing means for engagement with the aperture means of said main ceiling support member.

7. A ceiling support system comprising a plurality of ceiling support members arranged for supporting ceiling panels, spacing means operatively connected to at least two adjacent support members for spacing said at least two adjacent support members a predetermined distance from one another to form a gap therebetween, and supporting guide means for guiding relative movement between the at least two adjacent support members in a horizontal plane, said spacing means including structure constructed of a relatively more fusible material than said support members and said supporting guide means, whereby the fusible structure of the spacing means will melt in the event of a fire permitting the adjacent support members to move in a horizontal plane relatively to one another thereby reducing the risks of buckling and collapse of the ceiling system, wherein at least one of said gaps is located between adjacent ends of adjacent aligned ceiling support members, wherein said spacing means and said supporting guide means include means for permitting relative movement of the aligned ceiling support members in a single axial direction while preventing substantial relative movement in directions other than said axial direction, and wherein said spacing means includes a longitudinal spacing members spanning said gap and a fusible securing member for securing the spacing member to at least one of said ceiling support members, said spacing member operatively engaging both of said adjacent ceiling support members to normally hold said ceiling support members in a fixed position with respect to one another.

8. A system according to claim 7, characterized in that said spacing member and one of said ceiling support members have registering apertures, and in that said fusible securing members includes a peg-like member inserted through said registering apertures.

9. A system according to claim 7, characterized in that said spacing member and said ceiling support member have registering apertures, said fusible securing member being bridge shaped for spanning the respective ceiling support member and including at least one resilient ratchet-type projection engaging in said registering apertures.

10. A ceiling support system comprising a plurality of ceiling support members arranged for supporting ceiling panels, spacing means operatively connected to at least two adjacent support members for spacing said at least two adjacent support members a predetermined distance from one another to form a gap therebetween, and supporting guide means for guiding relative movement between the at least two adjacent support members in a horizontal plane, said spacing means including structure constructed of a relatively more fusible material than said support members and said supporting guide means, whereby the fusible structure of the spacing means will melt in the event of a fire permitting the adjacent support members to move in a horizontal plane relatively to one another thereby reducing the risks of buckling and collapse of the ceiling system, wherein at least one of said gaps is located between adjacent ends of adjacent aligned ceiling support members, wherein said spacing means and said supporting guide means include means for permitting relative movement of the aligned ceiling support members in a single axial direction while preventing substantial relative movement in directions other than said axial direction, and wherein said adjacent aligned ceiling support members are constructed as channel sections

having internal support surfaces within and on each side thereof, said internal support surfaces having recesses thereunder, said supporting means including a sleeve member mounted on the outside of the channel sections and having inwardly projecting bottom lips engaging in said recesses.

11. A ceiling support system comprising at least one main ceiling support member extending longitudinally along a first axis, two subsidiary ceiling support members arranged at opposite sides of said main member and extending longitudinally along a second axis arranged at an angle with respect to the first axis, and a connecting means operatively connecting said main member to both of said subsidiary members at a position spaced from the ends of the main member, said connecting means including a connecting member having a downwardly open U-shaped configuration straddling the main member such that a connecting leg is disposed on each of two opposite sides of said main member, that portion of the U-shaped connecting member between the connecting legs being fastened to said main member by fastener means engaged in an aperture on said main member, each of said connecting legs being connected to an end of a respective subsidiary member by way of detent means positioned on said subsidiary member and said connecting leg such that the respective ends of the subsidiary members are held in a predetermined distance from vertically extending outer surfaces on said main member, whereby the subsidiary member can move along the second axis said predetermined distance upon disengagement of the connecting means prior to abuttingly engaging said main member.

12. A system according to claim 11, characterized in that said main member is constructed as a three sided box-shaped channel member with the open side facing downwardly, said channel member including outwardly extending lip portions for slidably supporting bottom end portions of said subsidiary members, and in that said first and second axes are substantially perpendicular to one another and are in a common horizontal plane.

13. A system according to claim 12, characterized in that said connecting member is constructed of material that is more fusible than the material of the ceiling support members, whereby during a fire the connecting member becomes inoperable and the subsidiary members are permitted to slide freely on the lip portions in the direction of the vertically extending outer surfaces of the main member.

14. A system according to claim 13, characterized in that said detent means include a cut-out recess portion in the respective subsidiary members and an outer wall portion of the respective connector legs.

15. A system according to claim 14, characterized in that said fastener means includes a peg-like member having two resilient ratchet type projections for engaging in an aperture at the top of the main member.

16. A fusible securing device for securing a first ceiling support building member of a three sided rectangular box-shaped configuration with the open side facing downwardly to two further ceiling support building members extending perpendicularly to and at opposite sides of said first member in such a manner as to permit the building members to move with respect to one another upon melting of the fusible device in a fire; said securing device being of a downwardly open U-shaped configuration for straddling said first member with securing legs of said device disposed at each of two opposite sides of said first member, said device further including at least one resilient ratchet-type projection extending downwardly from that portion of the device interconnecting the securing legs for snap-fitting engaging in a corresponding aperture at the top side of the first member, and each of said securing legs having detent parts for engaging with respective detents at the top portions of said further members for holding the further members a predetermined distance from vertically extending outer surfaces at the sides of the first member whereby said device can be inserted from above onto said building members and whereby said further members can move said predetermined distance upon melting of said securing device prior to abutting engagement with said first member.

17. A securing device according to claim 16, wherein said securing legs each include uprights of hollow section and open at the bottom, and wherein said detent part is an outer wall of said hollow section which is engageable in a detent on the end portion of the respective further member.

* * * * *