

A CEILING PANEL STRUCTURE FOR A CEILING-MOUNTED AIR-CONDITIONING APPARATUS OR THE LIKE

BACKGROUND OF THE INVENTION

Field of the Invention

- 5 The invention relates to an art for reducing smudging of a ceiling by a conditioning air blown out through an outlet of a ceiling-mounted air-conditioning apparatus (referred to hereinafter also as "ceiling-mounted air-conditioner") or the like.

Description of the Related Arts

- 10 An air-conditioning system essentially includes a pair of heat exchangers through which heating/cooling medium is circulated. The air is warmed or heated/cooled when passing through one of the heat exchanger while the medium having been cooled/heated upon warming/cooling the air in said one heat exchanger is heated/cooled at the other heat exchanger. In the air-conditioning system where
- 15 the pair of heat exchangers are made of separate units, the unit including said one heat exchanger is usually called "indoor unit" or "package type air-conditioner" while the other is called "outdoor unit". The ceiling-mounted air-conditioning apparatus where apparatus is mounted or installed or almost embedded in the ceiling corresponds to the indoor unit (see for example U.S. Patent No. 5,595,068).
- 20 More specifically, the ceiling-mounted air-conditioner has a room air-inlet at a central portion of a bottom thereof and a conditioning air-outlet at a peripheral portion of the bottom thereof, so that the air-conditioner sucks or introduces the room air from the room air-inlet at the central portion of the bottom portion thereof and, after having warmed or cooled the introduced room air by the heat
- 25 exchanger thereof, discharges or blows out the conditioning air from the air-outlet at the peripheral portion of the bottom portion.

The conditioning air is blown out in a direction generally along a ceiling surface so that the conditioning air can spread over a wide region in the room and, therefore, the air inherently tends to flow along the ceiling surface. Accordingly,

the conditioning air smudges an area of the ceiling surface near the air-outlet due to the contamination of the conditioning air itself or the contamination of the room air which is entangled in a rapid flow of air blown out through the air-outlet. When the air-conditioning apparatus has been used for a long period of time, the
5 smudged ceiling surface becomes too unsightly to be neglected.

It is proposed, for solving above-mentioned problems, to adjust an inclination of a wind direction plate, which is disposed near the air-outlet within an air discharge passage, in response to a degree of contamination of the room air and a selected air-conditioning state, i.e., cooling or warming, so as to change a direction of
10 conditioning airflow from the air-outlet (refer for example to Japanese Patent Application Publication (i.e., Laid-Open) No. 8-100942 (100942/96), or to change an air discharge direction and/or size of an opening near each of longitudinal ends of an air-outlet, where the discharged air tends to flow along the ceiling surface (refer for example to Japanese Patent Application Publication Nos. 7-324802
15 (324802/95), 8-313042 (313042/96) and 9-222237 (222237/97).

These proposals are directed to regulate or control the conditioning airflow directly at the air-outlet formed or defined as a part of an outer casing or frame of the air-conditioning apparatus, sizes or dimensions of which are practically limited. However, such direct control of the overall airflow at the air-outlet
20 where the flow speed or flow rate is high encounters various disadvantages, i.e., when the airflow is controlled not to be directed to the ceiling surface, there is a possibility that intended effects cannot be obtained because of the possibility that the conditioning air cannot be spread fully in the room, and also that the adjustment conditions should be changed when the flow rate changes.

25 Japanese Patent Application Publication No. 8-94160 (94160/96) discloses to have a step or projection, on a cover plate constituting an outer frame of the air-conditioning apparatus, which acts to deflect the conditioning air, having been blown out through the air-outlet of the air-conditioning apparatus, in a direction away from the ceiling surface. A Microfilm of Japanese Utility Model

Application No. 61-8595 (8595/86) corresponding to Japanese Utility Model Application Publication No. 62-120151 (120151/87) discloses to have a blow-out guide of "L"-shaped cross-section which provides similar function. However, there is a possibility that these arts also encounter the similar problems.

- 5 In addition, the above-mentioned prior arts directed to modification of a body of the air-conditioning apparatus cannot solve the problem of the contamination or smudging of the ceiling surface where the ceiling-mounted air-conditioning apparatus has been already mounted or installed.

10 Another attempt has been made domestically inside of Japan, i.e. the attempt described now in this paragraph is not a prior art except in a country where novelty- and/or obviousness-related provisions/provision define/defines that publicly accessible use of the structure even in the other country or countries may also constitute the prior art. In this attempt, a transparent plastic film or sheet having been bent in an obtuse angle was attached an area of the ceiling surface
15 where smudging is likely to be produced. However, when the flow rate of the blown-out air is low, there is a possibility that the air flows over the obtusely bent wall of the plastic film to smudge an area of the ceiling surface outside of the attached plastic film. On the other hand, when the flow rate of the blown-out air is high, an obtusely inclined and dependent deflection portion of "L"-shaped
20 cross-section is pressed by the airflow to be deformed away from the airflow.

In the meantime, It is also proposed to form a peripheral portion of an air-conditioning duct opened in the ceiling with an arcuately curved portion so as to reduce contamination or smudging of the ceiling surface (Japanese Utility Model Application Publication No. 7-12847 (12847/95)). However, this
25 proposal also involves similar problems as the above-mentioned proposed ceiling-mounted air-conditioning apparatuses. In addition, behavior of conditioning airflow having been blown out through the air-outlet in the air-conditioning duct is somewhat different from that of the air-conditioning apparatus having the air-inlet at the central portion and the air-outlet at the

peripheral portion, because the air-conditioning duct does not have the air-inlet in the opening but the whole opening serves as the air-outlet.

SUMMARY OF THE INVENION

5 The invention has been made in view of the foregoing, and one object of the invention is to provide a ceiling panel structure capable of being applied also to an existing, i.e., pre-installed, ceiling-mounted air-conditioning apparatus which has been already installed or mounted to the ceiling and of minimizing smudging or contamination of the ceiling surface around the air-conditioning apparatus.

10 Another object of the invention is to provide a ceiling panel structure facilitating mountability thereof even in a case where the ceiling surface is not flat but undulated.

15 Still another object of the invention is to provide a ceiling panel structure including a base member or structure and a cover member or structure, in which engagement/disengagement of the cover member or structure with/from the base member or structure can be facilitated, i.e., carried out easily.

20 According to the invention, the above-mentioned one object can be accomplished by a ceiling panel structure adapted to be mounted to a ceiling at a downstream of a conditioning air-outlet of a ceiling-mounted air-conditioning apparatus, having a room air-inlet at a central portion thereof and the air-outlet at a peripheral portion thereof, said ceiling panel structure being adapted to be mounted to the ceiling at an outside of the air-conditioning apparatus, and comprising a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the outlet of the air-conditioning apparatus, back to the room air-inlet.

25 Because the ceiling panel structure of the invention comprises , " a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the outlet of the air-conditioning apparatus, back to the room air-inlet", only by mounting the

ceiling panel structure to a predetermined position of the ceiling, the ceiling panel structure can deflect, by means of the deflection induction portion thereof, the airflow having been blown out through the air-outlet of the air-conditioning apparatus back to the room air-inlet, thereby enabling to minimize the conditioning airflow to blow against or impinge on the ceiling surface and to spread therealong and therefore enabling to minimize the ceiling surface to be smudged by fine solid and/or liquid particles contained in the conditioning air. In addition, because the deflection induction portion is substantially rigid against the airflow, the deflection induction portion can deflect the airflow, i.e., change the direction of airflow into predetermined directions even in a case where the air flows relatively rapidly. Further, the ceiling panel structure is situated in a spatial region, near the ceiling surface and more or less remote from the air-outlet of the air-conditioning apparatus, which is open to a room or indoor space, the airflow can spread more or less before impinging on the deflection induction portion and can be directed to spread downwards upon impinging on the deflection induction portion, so that the conditioning airflow can be deflected appropriately upon impinging on the deflection induction portion. Although the deflection induction portion is typically constituted by a deflection guide part having a concavely curved guide surface to deflect the airflow therealong, the detailed or concrete configuration or shape thereof may be of any form so long as the direction of airflow can be changed significantly. Meanwhile, it is typically preferred to reduce beforehand the flow rate and the wind pressure or dynamic pressure thereof to be described later so as to change significantly the direction of airflow by the deflection induction portion. Furthermore, because the ceiling panel structure is mounted to the ceiling, at the downstream of the air-outlet, around or outside the air-conditioning apparatus, the air-conditioning apparatus may have been already installed in the ceiling. When mounted around the air-conditioning apparatus having been already installed in the ceiling, the ceiling panel structure of the invention can not only prevent the further progress of the smudging of the ceiling but also serve for hiding the smudge of the ceiling by covering a part of the smudged ceiling.

The ceiling panel structure and/or element(s) thereof is mounted or attached to the "lower" face of the ceiling, which may be expressed hereinafter as being mounted "on" the ceiling surface or "on" the ceiling, although, strictly expressing, the ceiling panel structure or the like is mounted "beneath" the ceiling surface or ceiling.

Considering to facilitate the mounting work of the ceiling panel structure on the ceiling surface, the ceiling panel structure according to a preferred embodiment of the invention typically comprises at least one base member adapted to be mounted to a ceiling at the downstream of the air-conditioning apparatus and having an engaging portion at a side thereof opposite to a side faced to the ceiling; and at least one cover member engaged at an engaged portion thereof with the engaging portion of said at least one base member to be fixed thereto, said at least one cover member having the deflection induction portion.

In the ceiling panel structure of the preferred embodiment, because "the cover member has the deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the air-outlet of the air-conditioning apparatus, back to the room air-inlet", only by engaging the cover member with the base member, having been attached to the predetermined position of the ceiling, to be fixed thereto, the ceiling panel structure can deflect, by means of the deflection induction portion of the cover member, a part of the airflow having been blown out through the outlet of the air-conditioning apparatus back to the room air-inlet, thereby enabling to minimize the conditioning airflow to impinge on the ceiling surface and to minimize the airflow to spread along the ceiling surface. In addition, because the deflection induction portion of the cover member is substantially rigid against the airflow, the deflection induction portion can deflect the airflow, i.e., change the direction of airflow into predetermined directions even in a case where the air flows relatively rapidly. Further, the cover member is situated in the spatial region, near the ceiling surface and more or less remote from the air-outlet of the air-conditioning apparatus, which is opened to a room or indoor space, the airflow

tends to be deflected appropriately upon impinging on the deflection induction portion.

In addition, because the ceiling panel structure of the embodiment comprises "at least one base member to be mounted to the ceiling at the downstream of the air-conditioning apparatus and having an engaging portion at a side opposite to the ceiling, and at least one cover member engaged at an engaged portion thereof with the engaging portion of said at least one base member to be fixed thereto", the cover member can be easily fixed to the ceiling surface at the predetermined position.

- 10 More specifically, the ceiling panel structure having a configuration for adjusting the conditioning airflow has necessarily a considerable thickness. If such a thick ceiling panel structure is intended to be fixed directly to the ceiling surface without affecting an appearance thereof, it will become necessary to have a configuration for preventing heads of fastening screws or the like from being exposed, which would in turn make it difficult or hard to carry out the mounting work thereof to be done facing upward toward the ceiling surface from a lower position, or which would require plural persons or workmen to carry out even a simple mounting work. In contrast to these situations, in the above-mentioned embodiment of ceiling panel structure, because the engaged portion of the cover member can be essentially formed at a side faced to the base member to be engaged with the engaging portion thereof, the mounting work of the cover member can be carried out with ease even by the minimum number of person(s), e.g., by the single workman.

- 25 Further, because the base member is provided separately from the cover member in the ceiling panel structure of the embodiment, the base member can be configured to facilitate the mounting work thereof by screws etc. on the ceiling surface without consideration of appearance thereof, and to have the engaging portion for facilitating the engagement thereof with the cover member. As a result, the mounting work of the base member on the ceiling is facilitated and can

be performed even by the minimum person(s), e.g., by one person. Moreover, the engaging portion of the base member can be covered to be hidden by the cover member, the engaged portion of the cover member can be designed to have a configuration or structure as desired in view of ease of mounting and strength of engagement and fixation, and therefore the engagement/fixation of the cover member with/to the base member can be carried out easily. Accordingly, both mounting work of the base member to the ceiling surface and engagement/fixation of the cover member with/to the base member can be performed by the minimum person(s), e.g., by one person, which results in that the whole mounting work of the ceiling panel structure on the ceiling surface can be performed by the minimum number of person(s), e.g., by one person. Each of the cover and base members may be formed by a single or integral member or by combination of plural members or parts.

The ceiling-mounted air-conditioning apparatus may have any outer shape or any two dimensional shape, such as a rectangular (square or quadrilateral) or circular shape or other shape, in which a lower end of the apparatus extends or spreads along the ceiling surface in a state where almost all of the apparatus is embedded in the ceiling, so long as the apparatus has the room air-inlet at the central portion thereof and the conditioning air-outlet at the peripheral portion thereof. As a matter of course, although the air-conditioning apparatus has more or less three dimensional shape protruding downward from the ceiling surface, the three dimensional shape may be of any form so long as the apparatus has the room air-inlet at the exposed central bottom part thereof and the conditioning air-outlet at the exposed peripheral bottom part thereof.

The conditioning air-outlet may be provided at only a part of the peripheral portion or part of the apparatus or over substantially the whole periphery thereof, so long as the air-outlet is provided at the periphery and is configured or adapted to blow out the conditioning air more or less outwards. For example, in a case where the two dimensional shape or configuration of the air-conditioning apparatus on the ceiling surface, i.e., shape in plan view (strictly, bottom view), is

rectangular, the air-outlet may be formed along only one side of the four sides of the rectangle or along two parallel sides thereof or along all of the four sides thereof. The air-outlet may be formed at the corner.

- 5 The ceiling panel structure according to an embodiment of the invention typically comprises the cover member(s) each having the deflection induction portion to deflect the flow of the conditioning air blowing out of the associated one of the air-outlet(s). Therefore, in a case of one linearly extending air-outlet, the cover member(s) typically comprises a single linear cover member (as a matter of course, the single cover member may be formed by combination of plural parts).
- 10 However, if desired, the cover member(s) may further comprise, at the longitudinal end(s) of the linear cover member, a corner cover member(s) curved at the corner(s), or the cover member may be configured like a picture frame in the form of a rectangular or four-sided closed loop to surround all the periphery of the air-conditioning apparatus.
- 15 The base member has typically a two-dimensional shape or configuration similar to that of the cover member to be engaged by the cover member to be fixed thereto. Thus, when the cover member is a linear cover member, the base member is typically a linear base member, while the base member is typically a corner base member curved at the corner when the cover member is a corner
- 20 cover member curved at the corner. However, the base member may have a two dimensional shape different from that of the cover member, so long as the base member can engage the cover member to be fixed thereto. For example, when the cover member is a linear cover member, requirement in the base member(s) is to engage at least a part of the cover member near either longitudinal end thereof
- 25 to support it. Thus, both ends of the linear cover member may be supported by the associated corner base members situated at the associated corners.

Typically, the surface of the cover member has a configuration, for the purpose of adjusting the conditioning airflow, to deflect the airflow (i.e., to change the direction of airflow), to provide a resistance against the airflow (i.e., to serve as

flow-resistance against the airflow thereby reducing the wind pressure and flow rate of the air) and/or to guide the airflow (i.e., to regulate the direction of airflow without substantially preventing the flow of air, while changing or not changing the direction of the airflow). In a case where the cover member covers the base member substantially completely, only the surface of the cover member performs these functions. However, a part of the base member may be exposed at the ceiling surface without being covered by the cover member. Such being the case, surface configuration for the deflection, flow-resistance (reduction in flow rate) and/or flow-guide, to adjust the conditioning airflow may be partially provided by the base member. Even in the circumstances, the cover member serves not only for adjusting the conditioning airflow at the deflection induction portion thereof and for covering to hide a mounting structure portion of the base member to the ceiling surface, but also for covering to hide the engagement portions of the base member and cover member. The induction or guide portion having a flow-deflection function has more or less the flow-resistant function also.

Thus, in a typical ceiling panel structure according to an embodiment of the invention, said at least one base member comprises a linear base member capable of being mounted at one principal face thereof to a surface of the ceiling to extend along at least one linear side edge of the air-conditioning apparatus, the linear base member having an adjustable length and/or width, and said at least one cover member comprises a linear cover member engaged with the linear base member and having an adjustable length. In addition, the linear base member comprises, a conditioning airflow guide surface at one widthwise end portion of a principal face opposite to said one principal face generally parallel to said one principal face, said one widthwise end portion being closer, than another widthwise end, to the side edge of the air-conditioning apparatus where the air-outlet is provided; and the engaging portion at a position more remote, than the guide surface, in the widthwise direction from the side edge of the air-conditioning apparatus. Moreover, the linear cover member comprises the deflection induction portion for deflecting a part of the conditioning air, flowing

along the guide surface of the linear base member, back to the room air-inlet.

In addition, in one typical ceiling panel structure according to an embodiment of the invention, the linear base member further comprises a flow-resistant projection portion, at a widthwise outer end of the guide surface, engaged with a
5 widthwise inner end of the linear cover member and serving as a resistance against the airflow for reducing a flow rate of the conditioning air having spread along the guide surface.

Further, in one typical ceiling panel structure according to an embodiment of the invention, the cover member comprises a flow-resistant projection portion, at an
10 upstream of the deflection induction portion, which serves as a resistance against the airflow for reducing a flow rate of the conditioning air flowing along the surface of the cover member. There may be a plurality of such flow-resistant projections. Typically, the flow-resistant projection of the cover member is adapted to have a higher flow-resisting function than that of the base member.
15 However, the relationship therebetween may be reversed.

In any case, the appropriate reduction in the wind pressure or flow rate of the conditioning air before flowing into the deflection induction portion allows the airflow impinging on the deflection induction portion to tend to flow along the guide face of the deflection induction portion.

20 The ceiling panel structure is formed to have a shape and sizes according to an outer shape and dimensions (sizes) of the air-conditioning apparatus mounted in the ceiling surface. Therefore, the base and cover members constituting the ceiling panel structure are formed to be length-adjustable. The length adjustment is typically carried out by cutting by means of the saw or the like the
25 base and cover members, each having a constant shape in a cross-section perpendicular to the longitudinal direction thereof, at the mounting work or job site by the workman. Therefore, the base and cover members constituting the ceiling panel structure are typically made of plastic material and are produced by extrusion molding. The plastic material may be for example vinyl chloride resin.

However, other plastic material may be used to minimize the environmental pollution. The material of the members may, however, be others such as metal, wood or composite material of metal and plastics so long as the member can be cut with a saw etc. at the mounting job site by the workman.

- 5 The ceiling panel structure is mounted around the air-conditioning apparatus according to an unoccupied area therearound of the ceiling surface where the apparatus is mounted, typically in a manner to avoid obstacle(s), such as a power-supply line or electric wiring output and various sensors like a smoke sensor, which may happen to be in or on the ceiling surface near the outer
10 periphery of the air-conditioning apparatus. Therefore, in the ceiling panel structure, typically, the constituent base and cover members are also designed width-adjustable. In some case, a longitudinal side of the air-conditioning apparatus may be as long as 2 meters. Therefore, in order to facilitate the width-adjustment over about a length of 2 meters along the longitudinal direction
15 thereof, the ceiling panel structure has typically weakened parts extending in the longitudinal direction thereof to allow, if desired, a widthwise end part thereof to be removed by forming a cutting line therealong by means of a cutter knife or the like so that the width thereof can be adjusted. Typically, each of the weakened parts comprises the a groove, extending in the longitudinal direction. Such
20 grooves are formed in a rear face, i.e. a side faced to the ceiling, in view of appearance.

Therefore, in a typical ceiling panel structure according to an embodiment of the invention, said at least one base member comprises a linear base member capable of being mounted at one principal face thereof to a surface of the ceiling to extend
25 along at least one linear side edge of the air-conditioning apparatus, the linear base member having an adjustable length and/or width, and said at least one cover member comprises a linear cover member engaged with the linear base member and having an adjustable length.

In this case, it is possible to mount the linear base member avoiding the

obstacle(s) near the air-conditioning apparatus by adjusting the width of the base member. In addition, it is possible to adjust the lengths of the linear base and cover members at the mounting job site, according to the length of the air-outlet of the air-conditioning apparatus or a size of a side extending parallel with the
5 air-outlet of the apparatus, to mount or install the ceiling panel structure.

In a typical ceiling panel structure according to an embodiment of the invention, the base member includes a corner base member capable of being mounted at one principal face thereof to the ceiling surface adjacent to a longitudinal end of the linear base member at an outside of a corner portion of the air-conditioning
10 apparatus, and wherein the cover member includes a corner cover member engaged with the corner base member adjacent to a longitudinal end of the linear cover member.

In this case, for example, the ceiling panel structure may have, in plan view, a generally rectangular shape or the like to surround typically all the periphery of
15 the air-conditioning apparatus or to be situated at least around two sides thereof.

In a typical ceiling panel structure according to an embodiment of the invention, the base member includes a corner base member capable of being mounted to a surface of the ceiling at an outside of a corner portion of the air-conditioning apparatus, and wherein the cover member includes a linear cover member
20 engaged with the corner base member at either longitudinal end thereof and having an adjustable length and width; and a corner cover member engaged with the corner base member adjacent to the longitudinal end of the linear cover member. In this case, the base member is minimized while facilitating the mounting. However, in a case where the air-conditioning apparatus is of large
25 dimension or size and length(s) of the linear base member(s) is long, another or separate base member may be disposed at a rear side, of an intermediate position of the linear cover member, i.e. between the ceiling surface and the cover member, to support the linear cover member firmly.

A typical ceiling panel structure according to an embodiment of the invention is

adapted to be mounted to a ceiling at a downstream of a conditioning air-outlet of a ceiling-mounted air-conditioning apparatus, having a room air-inlet at a central portion thereof and the air-outlet at a peripheral portion thereof, said ceiling panel structure comprising linear panel structures and corner panel structures, wherein
5 each of the linear panel structures comprises a base member capable of being mounted to a surface of the ceiling at one principal face thereof to extend along an associated linear side edge of the air-conditioning apparatus, a length and width of the base member in an extending direction thereof being adjustable, the base member having an engaging portion at a principal face thereof opposite to said
10 one principal face, a cover member of an adjustable length and width adapted to be engaged with the engaging portion of the associated base member at an engaged portion thereof to be fixed thereto, the cover member having a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the outlet of the
15 air-conditioning apparatus, back to the room air-inlet, and each of the corner panel structure is adapted to be positioned between adjacent ends of the associated linear panel structures to be engaged with the adjacent ends.

So long as the smudge on the ceiling surface near the air-outlet of the ceiling-mounted air-conditioning apparatus having been already installed or
20 mounted can be covered to be hidden, at least a part or all of the base and/or cover members may be transparent or semi-transparent. However, in order to ensure to cover and hide the smudge on the ceiling surface near the air-outlet of the ceiling-mounted air-conditioning apparatus having been already installed, it is preferred that the base and cover members are typically made of substantially
25 opaque material, while at least a part of the members may be made of transparent or semi-transparent material in a case where the ceiling surface is not smudged yet or where the air-conditioning apparatus is mounted in the ceiling surface for the first time.

According to one aspect of the invention, the above-mentioned another object of
30 the invention can be attained by a ceiling panel structure adapted to be mounted to

a ceiling at a downstream of a conditioning air-outlet of a ceiling-mounted air-conditioning apparatus, having a room air-inlet at a central portion thereof and the air-outlet at a peripheral portion thereof, the ceiling panel structure including a deflection induction portion which is substantially rigid against an airflow to
5 deflect the conditioning air, having been blown out through the outlet of the air-conditioning apparatus, in a direction away from the ceiling, the ceiling panel structure comprising a base structure adapted to be mounted to a ceiling at an outside of the air-conditioning apparatus and having an engaging portion at a side opposite to a side faced to the ceiling, the base structure including a linear base
10 member adapted to be mounted to a surface of the ceiling at one principal face thereof to extend along a side edge of the air-conditioning apparatus; and a cover structure engaged at an engaged portion thereof with the engaging portion of the base structure to be fixed thereto, the cover structure including a linear cover member adapted to be engaged with the linear base member and having the
15 deflection induction portion; wherein the engaging portion of the linear base member comprises a pair of engaging recesses spaced from each other in a widthwise direction thereof and opened at opposite sides to be faced away from each other, one of the recesses having side walls, one of the side walls situated closer to the surface of the ceiling than another of the side walls having an
20 inclined face inclined to be closer to the surface of the ceiling as departing more remote from another of the recesses, and wherein the engaged portion of the linear cover member comprises a pair of engaged projections, to be engaged with the pair of engaging recesses of the linear base member, at regions spaced from each other in a widthwise direction of the linear cover member, the pair of the engaged
25 projections being situated at sides faced to each other and being capable of being displaced resiliently toward/from each other, one of the projections having a guide part movable along the inclined face of the side wall, closer to the surface of the ceiling, of said one recess.

Because the ceiling panel structure according to said one aspect of the invention is
30 adapted to be mounted or installed to the ceiling outside the air-conditioning

apparatus and includes "a deflection induction portion substantially rigid against the airflow for deflecting the airflow , having been blown out through the air-outlet of the air-conditioning apparatus, in a direction away from the ceiling (surface)", by mounting the ceiling panel structure at a predetermined position of the ceiling outside the apparatus, it is possible to deflect by the deflection induction portion the conditioning airflow, having been blown out through the air-outlet of the air-conditioning apparatus, in the direction away from the ceiling, to minimize the conditioning airflow out of the air-outlet to blow against or impinge on the ceiling and/or to spread along the ceiling surface, thereby minimizing the smudging of the ceiling surface by fine particles or the like such as solid or liquid particles contained in the conditioning airflow. In addition, because the deflection induction portion is substantially rigid against the airflow, the deflection induction portion can deflect the airflow (change the direction of the airflow) in a predetermined direction(s) even when the airflow is relatively strong or rapid. Further, because the ceiling panel structure is situated in a spatial region, near the ceiling surface and more or less remote from the air-outlet of the air-conditioning apparatus, which is opened to a room or indoor space, the airflow more or less spreads before impinging on the deflection induction portion and can be directed to spread downwards upon impinging on the deflection induction portion, so that the conditioning airflow having impinged on the deflection induction portion can be deflected appropriately.

Further, because the ceiling panel structure of the above-mentioned one aspect comprises "a base structure adapted to be mounted to a ceiling at an outside of the air-conditioning apparatus and having an engaging portion at a side opposite to the ceiling, the base structure including a linear base member adapted to be mounted on the ceiling surface at one principal face thereof to extend along a side edge of the air-conditioning apparatus; and a cover structure engaged at an engaged portion thereof with the engaging portion of the base structure to be fixed thereto, the cover structure including a linear cover member adapted to be engaged with the linear base member", the mounting or installation of the ceiling

panel structure can be carried out with ease by mounting the base structure on the ceiling surface with fixing means such as screws, by laying the cover structure on(beneath) the base structure to cover mounting part(s) of the fixing or mounting means, and by engaging the engaged portion of the cover structure with the engaging portion of the base structure. The base structure typically comprises the linear base member and a corner base member, while the cover structure typically comprises the linear cover member and a corner cover member. However, the base structure may be constituted by one linear base member and the cover structure may be constituted by one linear cover member.

- 10 Because the linear base member is provided separately from the linear cover member also in the ceiling panel structure of the embodiment according to said one aspect, the linear base member can be configured to facilitate the mounting work thereof by screws etc. on the ceiling surface without consideration of appearance a part thereof to be covered by the linear cover member, and to have
- 15 the engaging portion for facilitating the engagement thereof with the linear cover member. As a result, the mounting work of the linear base member on the ceiling is facilitated and can be performed even by the minimum person(s), e.g., by one person. Moreover, the engaging portion of the linear base member can be covered to be hidden substantially by the linear cover member, the engaging
- 20 portion of the linear base member and the engaged portion of the linear cover member can be designed to have configurations or structures as desired in view of easy and firm engagement and fixation/easy disengagement, and therefore the engagement and fixation/disengagement of the linear cover member with and to/from the linear base member can be carried out easily. Accordingly, both
- 25 mounting work of the linear base member to the ceiling surface and engagement/fixation of the linear cover member with/to the linear base member can be performed by the minimum person(s), e.g., by one person, which results in that the whole mounting work of the ceiling panel structure on the ceiling surface can be performed by the minimum number of person(s), e.g., by one person.
- 30 Each of the linear cover and base members may be formed by a single or integral

member or by combination of plural members or parts.

In addition, in the ceiling panel structure of said one aspect according to the invention, because "the linear cover member comprises the deflection induction portion which is substantially rigid against an air flow to deflect the conditioning
5 air, having been blown out through the outlet of the air-conditioning apparatus, in a direction away from the ceiling", the engaging portion of the linear base member and the engaged portion of the linear cover member can be arranged with ease within a region defined by a thickness and width, of the linear cover member, required for providing an airflow-adjustment structure such as the deflection
10 induction portion for adjusting the conditioning airflow, thereby enabling to provide the engaging portion and engaged portion in the form appropriate for the mounting work.

Herein, i.e., in the specification, as to the linear cover member, "adapted to be mounted on the ceiling surface at one principal face" typically means that the
15 member is mounted on the ceiling surface in a state said one principal face contacts directly with the ceiling surface. However, if desired, the linear base member may be mounted on the ceiling surface in a state where a projection (leg) or projections (legs) projecting from said one principal face toward the ceiling surface abuts against the ceiling surface. In addition, as to the linear base
20 member, "to extend along the side edge of the air-conditioning apparatus" means typically that the air-conditioning apparatus has a linear side edge and the linear base member extends parallel with the linear side edge of the apparatus. However, if desired, the linear base member may not be parallel. Further, in a case where the side edge of the air-conditioning apparatus is not linear, it is
25 sufficient that the linear base member extends in a direction generally identical or parallel with an average extending direction of the side edge. Moreover, as to the engaging portion of the linear base member, "a side opposite to a side faced to the ceiling" or "a side opposite to the ceiling" is intended to include a portion or part protruding in a desired direction from the side opposite to (the side faced to)
30 the ceiling, that is, the side is not limited to a face parallel to the ceiling surface

but includes a face not parallel with the ceiling surface.

Typically, the surface of the linear cover member has a configuration, for the purpose of adjusting the conditioning airflow, to deflect the airflow (i.e., to change the direction of airflow), to provide a resistance against the airflow (i.e., to serve as flow-resistance against the airflow thereby reducing the wind pressure and flow rate of the air) and/or to guide the airflow (i.e., to regulate the direction of airflow without substantially preventing the flow of air, while changing or not changing the direction of the airflow). In a case where the linear cover member covers the linear base member substantially completely, only the surface of the linear cover member performs these functions. However, a part of the linear base member may be exposed at the ceiling surface without being covered by the linear cover member. Such being the case, surface configuration for the deflection, flow-resistance (reduction in flow rate) and/or flow-guide, to adjust the conditioning airflow may be partially provided by the base member. Even in the circumstances, the linear cover member serves not only for adjusting the conditioning airflow at the deflection induction portion thereof and for covering to hide a mounting structure portion of the base member to the ceiling surface, but also for covering to hide the engagement portions of the linear base member and linear cover member. The induction or guide portion having a flow-deflection function has more or less the flow-resistant function also.

In addition, in the ceiling panel structure according to said one aspect of the invention, because "the engaging portion of the linear base member comprises a pair of engaging recesses spaced from each other in a widthwise direction thereof and opened at opposite sides to be faced away from each other, and the engaged portion of the linear cover member comprises a pair of engaged projections, to be engaged with the pair of engaging recesses of the linear base member, at regions spaced from each other in a widthwise direction of the linear cover member, the pair of the engaged projections being situated at sides faced to each other", the pair of engaging portions of the linear base member as well as the pair of engaged portions of the linear cover member to be engaged therewith can be covered

behind the linear cover member, and the engagement/disengagement of the engaged portions of the linear cover member with/from the engaging portions of the linear base member can be performed respectively by engaging/disengaging, with/from said one of the pair of engaging recesses, the associated one of the pair of engaged projections of the linear cover member, in a state where said another of the pair of engaging recesses of the linear base member engages the associated one of the engaged projections of the linear cover member. In addition, because the pair of the engaging recesses of the linear base member are opened to sides or senses of direction widthwise opposite to each other, both of side walls or wall portions defining each recess can extend along the longitudinal direction of the linear base member generally in parallel with the ceiling surface, the side walls can be deformed to be undulated in the longitudinal direction according to an undulation of the ceiling surface. Further, because the pair of engaged projections of the linear cover member protrude in widthwise opposite senses of direction to each other, each projecting rib defined by the engaged projection also extends along the longitudinal direction of the linear cover member generally in parallel with the ceiling surface, so that the ribs can be deformed with ease to be undulated relatively following to the undulation of the ceiling surface. Therefore, the undulation of the ceiling surface can be absorbed or compensated relatively with ease by the deformation, of the linear base and cover members, corresponding thereto. That is, even if the linear base member may be undulated to some extent according to the undulation of the ceiling surface upon mounting thereof on the ceiling, into another of the pair of engaging recesses of the linear base member at a side opposite to said one engaging recesses, the associated engaged projection of the linear cover member can be fit in by force. In this case, in order that the insertion, into said another engaging recess, of the corresponding engaged projection can be induced or guided, it is preferred that one of the side walls of said another engaging recess has a guide face for guiding the insertion of the corresponding engaged projection, that the engaged projection is tapered like a wedge, or that the engaging recess is opened to be wider as approaching closer to an open end thereof.

In this case, preferably, the linear cover member has, near said another engaged portion, a plate portion expanding generally in parallel with the ceiling surface, which facilitate the bending deformation of the linear cover member in the longitudinal direction according to the undulation of the ceiling surface. The
5 plate portion can serve as a guide face for the conditioning airflow.

In addition, in the ceiling panel structure of said one aspect, "one of the recesses having side walls, one of the side walls situated closer to the surface of the ceiling than another of the side walls having an inclined face inclined to be closer to the surface of the ceiling as departing more remote from another of the recesses, and
10 one of the engaged projections of the linear cover member corresponding to said one engaging recess having a guide part movable along the inclined face of the side wall, closer to the ceiling surface, of said one recess", even when the linear cover member is undulated in the longitudinal direction thereof according to the undulation of the ceiling surface in case of undulated ceiling surface, the
15 undulation can be absorbed or compensated by displacement of the guide part of the engaged projection of the linear cover member, in a direction approaching to or away from the ceiling surface, with respect to the inclined face of the side wall, of said one engaging recess of the linear base member, closer to the ceiling. Therefore, even when the ceiling surface is undulated, it is possible to avoid that
20 the engagement/disengagement of the linear cover member with/from the linear base member becomes too hard to performed smoothly.

The side wall, of the pair of side walls defining said one recess portion of the linear base member, situated more remote from the ceiling may be generally parallel with the ceiling surface, but is preferred to have an inclined face at a side,
25 opposite to the ceiling surface, which approaches to the ceiling as departing more remote from said another recess, so as to facilitate the engagement of the engaged portion of the linear cover member with the engaging portion of the linear base member.

Such being the case, only by pressing the linear cover member against the linear

base member while engaging, with said another engaging recess of the engaging portions of the linear base member, the corresponding engaged projection of the linear cover member, it is possible to move or displace the guide part of the engaged projection portion along the inclined face (opposite to the ceiling surface) of the side wall (situated more remote from the ceiling surface) of the engaging projection of the linear base member until the engaged projection is displaced over the end of the inclined face, and to engage the guide part thereof with the inclined face of said one side wall of the linear cover member. Thereafter, only by releasing the exertion of pressing force on the linear cover member as desired, the engagement of the linear cover member with the linear base member can be accomplished. In the explanation above, it is assumed that a side wall (of said one engaging recess portion) closer to the ceiling surface extends and terminates at a position more remote, from another engaging recess portion, than that of the side wall situated more remote from the ceiling surface.

Further, by pressing the linear cover member against the linear base member while the pair of engaged projections of the linear cover member are engaged with the corresponding pair of engaging recesses of the linear base member, it is possible to displace the guide part of one of the engaged projections along the inclined face of one of the engaging recesses in a sense of direction away from another of engaging recesses to increase a distance between the pair of engaging projections of the linear cover member. Thus, as desired, the engagement of the linear cover member with the linear base member can be released by utilizing a tool or the like.

Each of the pair of engaging recesses of the linear base member may extend intermittently in the form of a line over substantially the whole length along the extending direction of the linear base member. However, in order to release the engagement of the engaged projection with the engaging recess as if peeling off the engagement from one longitudinal end, it is preferred that at least said one engaging recess of the pair of recesses and therefore the side walls thereof extends continuously in the longitudinal direction of the linear base member, that is, the

recess is in the form of a groove extending along the longitudinal direction of the linear base member. Similar requirement or argument applies also to the corresponding engaged projection. For the disengagement or release of engagement, a distal end of an elongated tool such as screw driver may be utilized.

5 Instead, a tool, such as a thick walled spatula, shaped in the form of "L" to avoid interference with the ceiling surface may be used, where one of a pair of arms or legs of "L" serves as a handle and a wall part connecting the arms or legs are curved smoothly.

10 The linear cover member has typically a generally U-shaped cross-section, one engaged projection, of said one pair of the engaged projections, engaged with said one recess of the linear base member is formed at one of two legs of the "U", and the deflection induction portion is formed at another of the two legs. In this case, by pressing the bottom of "U" of the linear cover member while another recess of the linear base member engages the engaged projection of the linear cover
15 member, the engaged projection at the distal end of said one leg of "U" is displaced along the inclined face, of either side wall of said one engaging recess of the linear base member in a sense of direction away from the distal end of another leg of "U" to separate the distal ends of the two legs of "U". Thus, the "U-shaped" cross-sectional portion of the linear cover member facilitates the
20 deformation of the linear cover member for engagement/disengagement thereof with/from the linear base member. A certain magnitude or length is required in the legs of "U" for the deflection induction portion to perform the defection action. Therefore, the "U-shaped" cross-sectional portion ensures the height for the deflection induction portion on one hand and facilitates the
25 engagement/disengagement of the linear cover member on the other hand.

In the description above, said one recess is situated typically more remote from the air-outlet of the air-conditioning apparatus than another of the pair of recesses. However, when the downward protruding length from the ceiling surface may be relatively long, said one recess may be situated closer than another to the
30 air-outlet of the air-conditioning apparatus.

In a ceiling panel structure according to an embodiment of said one aspect of the invention, typically, the linear base member comprises a conditioning airflow guide face at a widthwise end portion, adjacent to the side edge of the air-conditioning apparatus where the air-outlet is provided, of a principal face
5 opposite to said one principal face generally parallel to said one principal face; and said another engaging portion at a position more remote in the widthwise direction than the guide face from the edge of the air-conditioning apparatus, and wherein the linear cover member comprises said another engaged portion, engaged with said another engaging portion of the linear base member, at a
10 widthwise inner end thereof, a part of said another engaged portion faced to the air-outlet of the air-conditioning apparatus serves as a flow-resistant projection acting as a resistance against the airflow for reducing a flow rate of the conditioning airflow having flown along the guide face of the linear base member.

Such being the case, a surface part of the engaged projection of the linear cover
15 member at an opposite side to a surface part for the engagement serves, as it is, as the flow-resistant projection portion. The linear cover member may also have, at a region downstream of the opposite surface of the engaged projection and upstream of the deflection induction portion, another flow-resistant projection, which serves as a resistance against the conditioning airflow flowing along the
20 surface of the cover member to reduce the wind pressure and flow rate thereof. In this case, typically, the downstream flow-resistant projection is designed to have a higher flow-resistance than the upstream flow-resistant projection. However, the relationship therebetween may be reversed. In any case, appropriate reduction in the flow rate of the conditioning air flowing into the
25 deflection induction portion facilitate the airflow impinging on or blowing against the deflection induction portion to be directed to flow along the guide face of the deflection induction portion.

The ceiling panel structure typically comprises the cover member(s) each having the deflection induction portion to deflect the flow of the conditioning air blowing
30 out of the associated one of the air-outlet(s). Therefore, in a case of one linearly

- extending air-outlet, the cover member(s) typically comprises a single linear cover member (as a matter of course, the single cover member may be formed by combination of plural parts). Such being the case, it is preferred that an end cap is fitted to cover an end thereof. More specifically, such being the case, the
- 5 ceiling panel structure preferably further comprises at least one end cap to cover at least one longitudinal end of each of the linear base structure (typically corresponds to the linear base member) and the linear cover structure (typically corresponds to the linear cover member) in a state where the engaging portion of the linear base member engages the engaged portion of the linear cover member.
- 10 However, if desired, the cover member(s) may further comprise, at the longitudinal end(s) of the linear cover member, a corner cover member(s) curved at the corner(s), or the cover member may be configured like a picture frame in the form of a rectangular or four-sided closed loop to surround all the periphery of the air-conditioning apparatus.
- 15 Therefore, in a typical ceiling panel structure according to an embodiment of said one aspect of the invention, the base structure comprises a linear base member capable of being mounted at one principal face thereof on the lower face of the ceiling to extend along at least one linear side edge of the air-conditioning apparatus and having adjustable length and width, and the cover structure
- 20 comprises a linear cover member engaged with the linear base member and having an adjustable length.

In a typical ceiling panel structure according to an embodiment of said one aspect of the invention, the base structure a corner base member capable of being mounted at one principal face thereof to the ceiling surface adjacent to a

25 longitudinal end of the linear base member at an outside of a corner portion of the air-conditioning apparatus, and wherein the cover structure includes a corner cover member engaged with the corner base member adjacent to a longitudinal end of the linear cover member.

The corner base member is adapted or configured typically to cover or is

laid on the ends of the linear base and cover members to be engaged therewith, whereupon "cover" or "laid on" refers to a state superposed in order on(beneath) the ceiling surface from lower side. However, the corner base member may have a side edge situated closer to the ceiling surface than at least one of adjacent ends of the linear base and cover members or as high as the linear base member.

In a ceiling panel structure according to an embodiment of one aspect of the invention, in a case where the corner base member covers the ends of the linear base and cover members, typically, the corner cover member comprises a part of the deflection induction portion which is substantially rigid against the airflow to deflect a part of the conditioning air, having been blown out through the air-outlet of the air-conditioning apparatus, in a direction away from the ceiling surface, and the corner cover member has a generally U-shaped cross-section, the corner cover member being engaged with an outwardly engaging portion of an outer side wall of the corner base member at an inwardly engaged portion of one of two leg parts of the "U", and contacting at an inner face of a bottom part of the "U" with an extending end of the deflection induction portion of the corner base member. Such being case, the corner base member typically comprises a flow-resistant projection, serving as a resistance to reduce the flow rate of the conditioning air flowing along the surface of the corner base member, upstream of the deflection induction portion. In this case, the disengagement of the corner cover member from the corner base member can be made relatively easily.

A ceiling panel structure according to a typical embodiment of said one aspect of the invention is adapted to be mounted to a ceiling at a downstream of a conditioning air-outlet of a ceiling-mounted air-conditioning apparatus, having a room air-inlet at a central portion thereof and the air-outlet at a peripheral portion thereof, the ceiling panel structure including a deflection induction portion which is substantially rigid against an airflow to deflect the conditioning air, having been blown out through the outlet of the air-conditioning apparatus, in a direction away from the ceiling, the ceiling panel structure comprising linear panel structures; and corner panel structures positioned between adjacent ends of the linear panel

structures and engaged thereto, each linear panel structure comprising a base member capable of being mounted to a surface of the ceiling at one principal face thereof to extend along an associated linear side edge of the air-conditioning apparatus and having an adjustable length and width in the extending direction, the base member having an engaging portion at a principal face opposite to said one principal face, and a cover member of an adjustable length and width adapted to be engaged with the engaging portion of the associated base member at an engaged portion thereof to be fixed thereto, the cover member having a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the air-outlet of the air-conditioning apparatus, in a direction away from the ceiling, wherein the engaging portion of the linear base member comprises a pair of engaging recesses spaced and faced away from each other in a widthwise direction of the linear base member, the pair of engaging recess portions extending in an extending direction of the linear base member, one of a pair of engaging recesses having side walls, one of the side walls closer to a surface of the ceiling than another of the side walls having an inclined face inclined to be closer to the ceiling surface as departing more remote from another of the pair of recesses, and wherein the engaged portion of the linear cover member comprising a pair of engaged projections, engaged with the pair of engaging recesses of the linear base member, spaced from and faced to each other in a widthwise direction of the linear cover member, one of the projections having a guide part movable along the inclined face of the side wall, closer to the ceiling surface, of said one recess.

Heretofore, description have been made on the basis that the ceiling panel structure is mounted on the ceiling at a downstream of the air-outlet of the ceiling-mounted air-conditioning apparatus having the room air-inlet at the central portion and the conditioning air-outlet at the peripheral portion. However, the features of the ceiling panel structure thus described, is also more or less effective in a case where the ceiling panel structure is mounted on the ceiling, instead of the outer periphery of the ceiling-mounted air-conditioning apparatus, at a

downstream of a conditioning air-outlet of a ceiling-mounted conditioning-air-discharge or blow-out apparatus, having only the conditioning air-outlet(s), i.e., conditioning-air discharge duct having no air-inlet and the whole aperture of the duct serves for the air-outlet. Therefore, the ceiling panel structure of the invention can be applied also even to the ceiling-mounted conditioning-air-discharge apparatus.

That is, the ceiling panel structure of the invention may be, for example,

(1) a ceiling panel structure adapted to be mounted to a ceiling at a downstream of a periphery of a conditioning air-outlet of a ceiling-mounted conditioning-air-discharge apparatus, having the air-outlet at a surface of the ceiling, said ceiling panel structure comprising: at least one base member adapted to be mounted to the ceiling at the downstream of the air-discharge apparatus and having an engaging portion at a side opposite to a side faced to the ceiling; and at least one cover member engaged at an engaged portion thereof with the engaging portion of said at least one base member to be fixed thereto, said at least one cover member having a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the outlet of the air-discharge apparatus, in a direction away from the ceiling,

(2) a ceiling panel structure adapted to be mounted to a ceiling at a downstream of a periphery of a conditioning air-outlet of a ceiling-mounted conditioning-air-discharge apparatus, having the air-outlet at a surface of the ceiling, said ceiling panel structure comprising linear panel structures and corner panel structures, wherein each of the linear panel structures comprises a base member capable of being mounted to a surface of the ceiling at one principal face thereof to extend along an associated linear side edge of the air-discharge apparatus, a length and width of the base member in an extending direction thereof being adjustable, the base member having an engaging portion at a principal face thereof opposite to said one principal face, a cover member of an

adjustable length and width adapted to be engaged with the engaging portion of the associated base member at an engaged portion thereof to be fixed thereto, the cover member having a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the outlet of the air-discharge apparatus, in a direction away from the ceiling, and each of the corner panel structure is adapted to be positioned between adjacent ends of the associated linear panel structures to be engaged with the adjacent ends,

(3) a ceiling panel structure adapted to be mounted to a ceiling at a downstream of a periphery of a conditioning air-outlet of a ceiling-mounted conditioning-air-discharge apparatus, having the air-outlet at a surface of the ceiling, the ceiling panel structure including a deflection induction portion which is substantially rigid against an airflow to deflect the conditioning air, having been blown out through the outlet of the conditioning-air-discharge apparatus, in a direction away from the ceiling, the ceiling panel structure comprising a base structure adapted to be mounted to a ceiling at an outside of the air-discharge apparatus and having an engaging portion at a side opposite to a side faced to the ceiling, the base structure including a linear base member adapted to be mounted to a surface of the ceiling at one principal face thereof to extend along a side edge of the air-discharge apparatus; and a cover structure engaged at an engaged portion thereof with the engaging portion of the base structure to be fixed thereto, the cover structure including a linear cover member adapted to be engaged with the linear base member and having the deflection induction portion; wherein the engaging portion of the linear base member comprises a pair of engaging recesses spaced from each other in a widthwise direction thereof and opened at opposite sides to be faced away from each other, one of the recesses having side walls, one of the side walls situated closer to the surface of the ceiling than another of the side walls having an inclined face inclined to be closer to the surface of the ceiling as departing more remote from another of the recesses, and wherein the engaged portion of the linear cover member comprises a pair of engaged

projections, to be engaged with the pair of engaging recesses of the linear base member, at regions spaced from each other in a widthwise direction of the linear cover member, the pair of the engaged projections being situated at sides faced to each other and being capable of being displaced resiliently toward/from each other, one of the projections having a guide part movable along the inclined face
5 of the side wall, closer to the surface of the ceiling, of said one recess, or

(4) a ceiling panel structure adapted to be mounted to a ceiling at a downstream of a periphery of a conditioning air-outlet of a ceiling-mounted conditioning-air-discharge apparatus, having the air-outlet at a surface of the
10 ceiling, the ceiling panel structure including a deflection induction portion which is substantially rigid against an airflow to deflect the conditioning air, having been blown out through the outlet of the conditioning air-discharge apparatus, in a direction away from the ceiling, the ceiling panel structure comprising linear panel structures; and corner panel structures positioned between adjacent ends of
15 the linear panel structures and engaged thereto, each linear panel structure comprising a base member capable of being mounted to a surface of the ceiling at one principal face thereof to extend along an associated linear side edge of the air-discharge apparatus and having an adjustable length and width in the extending direction, the base member having an engaging portion at a principal
20 face opposite to said one principal face, and a cover member of an adjustable length and width adapted to be engaged with the engaging portion of the associated base member at an engaged portion thereof to be fixed thereto, the cover member having a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out
25 through the air-outlet of the air-conditioning apparatus, in a direction away from the ceiling, wherein the engaging portion of the linear base member comprises a pair of engaging recesses spaced and faced away from each other in a widthwise direction of the linear base member, the pair of engaging recess portions extending in an extending direction of the linear base member, one of a pair of
30 engaging recesses having side walls, one of the side walls closer to a surface of

the ceiling than another of the side walls having an inclined face inclined to be closer to the ceiling surface as departing more remote from another of the pair of recesses, and wherein the engaged portion of the linear cover member comprising a pair of engaged projections, engaged with the pair of engaging recesses of the linear base member, spaced from and faced to each other in a widthwise direction of the linear cover member, one of the projections having a guide part movable along the inclined face of the side wall, closer to the ceiling surface, of said one recess.

BRIEF DESCRIPTION OF THE DRAWINGS

10 The foregoing and other objects as well as features of the invention will be made clearer from the description of preferred embodiments of the invention hereafter with reference to accompanying drawings in which,

Figs. 1A to 1F are explanatory views for illustrating that a ceiling panel structure is mounted according to a shape of a ceiling-mounted air-conditioning apparatus, in which Fig. 1A is an explanatory bottom view of an example of square-shaped air-conditioning apparatus mounted in the ceiling as viewed from a lower position, Fig. 1B is an explanatory bottom view of a ceiling panel structure, according to one preferred embodiment of the invention, for the air-conditioning apparatus of Fig. 1A, Fig. 1C is an explanatory view showing to adjust, according to a planner (bottom) shape of the ceiling-mounted air-conditioning apparatus, a shape or configuration of the ceiling panel structure, and Figs. 1D, 1E and 1F are explanatory bottom views of examples of various shapes or types of ceiling-mounted air-conditioning apparatus to which the ceiling panel structure is applied;

25 Fig. 1G is an explanatory bottom view of an anemometer type of air-discharge apparatus to which the ceiling panel structure is applied;

Fig. 2 is an explanatory bottom view, of the ceiling panel structure, where the shape and/or the size of thereof are/is changed according to presence of an obstacle on the ceiling;

Fig. 3 is an explanatory oblique view of a ceiling panel structure, as viewed from an obliquely lower position, according to one preferred embodiment of the invention;

5 Figs. 4A and 4B are illustrations of a ceiling panel structure according to one preferred embodiment of the invention, in which Fig. 4A is a partially broken explanatory bottom view thereof, and Fig. 4B is an explanatory side view of thereof as viewed in a direction of an arrow IVB in Fig. 4A;

10 Figs. 5A and 5B are illustrations of a linear panel structure for the ceiling panel structure of Fig. 4A, in which Fig. 5A is an explanatory bottom view, and Fig. 5B is an explanatory sectional view along a line VB-VB of Fig. 5A;

Figs. 6A and 6B are illustrations of a linear base member for the linear panel structure of Fig. 5A, in which Fig. 6A is an explanatory bottom view and Fig. 6B is an explanatory sectional view along a line VIB-VIB of Fig. 6A;

15 Figs. 7A and 7B are illustrations of a linear cover member for the linear panel structure of Fig. 5A, in which Fig. 7A is an explanatory bottom view, and Fig. 7B is an explanatory sectional view along a line VIIB-VIIB of Fig. 7A;

20 Figs. 8A and 8B are illustrations of a corner panel structure for the ceiling panel structure of Fig. 4A, in which Fig. 8A is an explanatory side view as viewed in a direction of an arrow VIIIA of Fig. 8B, and Fig. 8B is an explanatory bottom view;

25 Figs. 9A to 9D are illustrations of a corner base member for the corner panel structure of Fig. 8A, in which Fig. 9A is an explanatory side view, Fig. 9B is an explanatory sectional view along a line IXB-IXB of Fig. 9C, Fig. 9C is an explanatory bottom view as view in a direction of an allow IXC of Fig. 9A, and Fig. 9D is an explanatory sectional view along a line IXD-IXD of Fig. 9C;

Figs. 10A and 10B are illustrations of a corner cover member for the corner panel structure of Fig. 8A, in which Fig. 10A is an explanatory side view, and Fig. 10B

is an explanatory bottom view as viewed in a direction of an arrow XB of Fig. 10A;

Fig. 11 is an explanatory oblique view, as viewed from an obliquely lower position, for illustrating a mounting process of the corner cover member to
5 complete the ceiling panel structure of Fig. 4;

Fig. 12 is an explanatory bottom view illustrating a state where the corner cover member of Fig. 11 has been mounted;

Fig. 13 is a diagrammatic sectional view illustrating a state of flow of conditioning air adjusted by ceiling panel structure according to one preferred
10 embodiment of the invention;

Fig. 14 is a partially broken explanatory sectional view of a modified linear panel structure;

Figs. 15A to 15C are illustrations of a modification of the corner panel structure, in which Fig. 15A is an explanatory oblique view, of a corner base member
15 thereof serving also as a base for a linear cover member, as viewed from an obliquely lower position, Fig. 15B is an explanatory oblique view illustrating a mounting process of the linear cover member, and Fig. 15C is an explanatory oblique view illustrating a mounting process of the corner cover member;

Figs. 16A to 16B are illustrations of a modification of the corner base member, in
20 which Fig. 16A is an explanatory oblique view illustrating an intermediate state, for mounting the corner base member, as viewed from an obliquely lower position, and Fig. 16B is an oblique view of the corner base member after mounting or assembly of corner base member;

Figs. 17A to 17D are illustrations relating to a modified ceiling panel structure, in
25 which Fig. 17A is a bottom (plan) view illustrating a mounting process of a corner base member which serves also as a base of the linear cover member, Fig. 17B is a bottom view illustrating a state where two corner base members have been

assembled, Fig. 17C is a bottom view illustrating a state where two corner base members have been connected with each other through a linear cover member (a state where a linear cover member has been mounted between two corner base members) and, Fig. 17D is an explanatory bottom view illustrating a state just before completing of assembly of the ceiling panel structure;

Figs. 18A and 18B show a ceiling panel structure according to a preferred embodiment of said one aspect of the invention, in which Fig. 18A is a partially broken explanatory bottom view, and Fig. 18B is an explanatory side view in a direction of an arrow of XVIII B of Fig. 18A;

10 Figs. 19A and 19B show a linear panel structure for the ceiling panel structure of Fig. 18A, in which Fig. 19A is an explanatory bottom view, and Fig. 19B is an explanatory sectional view along a line XIXB-XIXB of Fig. 19A;

Fig. 20 is an oblique view of a linear base member for the linear panel structure of Fig. 19;

15 Figs. 21A to 21D are illustrations of the linear base member of Fig. 20A, in which Fig. 21A is an explanatory bottom view, Fig. 21B is an explanatory sectional view along a line XXIB-XXIB of Fig. 21A, Fig. 21C is an explanatory sectional view of a modification of an engaging recess situated at a widthwise outer end, and Fig. 21D is an explanatory sectional view of a modification of a part of an inclined
20 face;

Fig. 22 is an explanatory oblique view of a linear cover member for the linear panel structure of Fig. 19;

Figs. 23A to 23C are illustrations of the linear cover member of Fig. 22, in which Fig. 23A is an explanatory bottom view, Fig. 23B is an explanatory sectional view along a line XXIIIB-XXIIIB of Fig. 23A, and Fig. 23C is an explanatory sectional view of a modification of an engaged projection situated at a widthwise outer side;

Figs. 24A and 24B are illustrations of a corner panel structure for the ceiling panel structure of Fig. 18A, in which Fig. 24A is an explanatory side view as viewed in a direction of an arrow XXIVA of Fig. 24B, and Fig. 24B is an explanatory bottom view in a direction of an arrow XXIVB of Fig. 24A;

- 5 Figs. 25A and 25B are illustrations of, respectively, a corner base member and corner cover member for the corner panel structure of Fig. 24A, in which Fig. 25A is an explanatory oblique view of the corner base member, and Fig. 25B is an explanatory oblique view of the corner cover member;

- 10 Figs. 26A to 26C are illustrations of the corner base member of Fig. 25A, in which Fig. 26A is an explanatory side view as viewed in a direction of an arrow XXVIA of Fig. 26B, Fig. 26B is an explanatory bottom (surface) view as viewed in a direction of an arrow XXVIB of Fig. 26A, and Fig. 26C is an explanatory side view as viewed in a direction of an arrow XXVIC of Fig. 26B;

- 15 Fig. 27 is an explanatory view of an upper face (back) of the corner base member of Fig. 25A;

- 20 Figs. 28A to 28C are illustrations of the corner cover member for the corner panel structure of Fig. 24A, in which Fig. 28A is an explanatory side view as viewed in a direction of an arrow XXVIIIA of Fig. 28B, Fig. 28B is an explanatory bottom view as viewed in a direction of an arrow XXVIIIB of Fig. 28A, and Fig. 28C is an explanatory view of a modification of the engaged projection;

Figs 29 is an explanatory oblique view, as viewed from an obliquely lower position, for illustrating a mounting process of the corner cover member to complete the ceiling panel structure of Fig. 18A;

- 25 Fig. 30 is an explanatory bottom view illustrating a state where the corner cover member of Fig. 25B has been mounted;

Figs. 31A and 31B are illustrations of superposed states of the linear panel structure and the corner panel structure, in which Fig. 31A is an explanatory

sectional view of Fig. 30 along a line XXXIA-XXXIA (whereas the linear panel structure 311D is not shown), and Fig. 31B is an explanatory sectional view, of modification of Fig. 31A, illustrated similarly to Fig. 31A;

5 Fig. 32 is a diagrammatic sectional view illustrating a state of flow of conditioning air adjusted by ceiling panel structure of Fig. 18A according to the preferred embodiment of said one aspect of the invention; and

10 Figs. 33A to 33F are illustrations for an end cap structure to be fitted to either end of the linear panel structure to provide a linear panel structure apparatus in a case where the linear panel structure is used independently of the corner member, in which Fig. 33A is an explanatory plan (upper face) view, Fig. 33B is an explanatory front view, Fig. 33C is an explanatory bottom view, Fig. 33D is an explanatory right side view, Fig. 33E is an explanatory rear (back) view, and Fig. 33F is an explanatory left side view.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 Now, ceiling panel structures according to preferred embodiments of the invention are described in detail referring to accompanying drawings.

20 Fig. 1A shows a ceiling-mounted air-conditioning apparatus 200 mounted in a ceiling surface 201 as viewed from a lower face, i.e. bottom face thereof, Fig. 1B shows a ceiling panel structure 10 according to a preferred embodiment of the invention, and Fig. 1C shows a state where the ceiling panel structure of Fig. 1B is mounted around the air-conditioning apparatus of Fig. 1A.

The ceiling panel structure 10 comprises four linear panel structures 11, lengths of which are adjustable, and four corner panel structures 12, each connecting the adjacent linear panel structures 11,11 at respective adjacent ends thereof.

25 In a case where the air-conditioning apparatus is of a type 200a having a longitudinally or vertically (in the face of the drawing) elongated rectangular outer shape as shown in Fig. 1E, the ceiling panel structure 10 is assembled to

have a longitudinally or vertically (in the face of the drawing) elongated rectangular shape as shown by an imaginary line 10a in Fig. 1C. On the other hand, in a case where the air-conditioning apparatus is of a type 200b having a laterally or horizontally (in the face of the drawing) elongated rectangular outer shape as shown in Fig. 1F, the ceiling panel structure 10 is assembled to have a laterally or horizontally (in the face of the drawing) elongated rectangular shape as shown by an imaginary line 10b in Fig. 1C. Meanwhile, in a case where the air-conditioning apparatus is of a type 200c having a square shape as shown in Fig. 1D, the ceiling panel structure 10 is assembled to have the corresponding square shape as shown by solid lines in Fig. 1C, while a length of each side of the square may be increased or decreased as desired.

Each linear panel structure 11 of the ceiling panel structure 10 comprises, as shown in Figs. 5A-5B, 6A-6B, and 7A-7B, a linear base member 20 made of plastic material (Figs. 5A-5B and 6A-6B), and a linear cover member 40 made of plastic material and coupled to the linear base member 20 (Figs. 5A-5B and 7A-7B). In the description of this embodiment hereafter, concrete sizes of various portions or parts are shown, which are, however, only typical or one of desired examples and the invention is not limited to the sizes, shapes, or the similar order of sizes or similar shapes.

As shown in Figs. 6A and 6B, the linear base member 20 comprises a plate-like portion 21 having a width W1 of about 15 cm and a length L1 of about 200 cm. The plate portion 21 comprises a main plate portion 22, of about 3 mm in thickness D1, and a guide plate portion 26 of about 2 mm in thickness D2 and of about 9.5 cm in width W2. The guide plate portion 26 has a principal face 24 which is coplanar with one principal face 23 of the main plate portion 22, and extends integrally from one end 25 of the main plate portion 22.

The guide plate portion 26 has, in the principal face 24, grooves 27 extending over the whole length in the longitudinal direction thereof for example at regular widthwise intervals of 1 cm. The interval or spacing may be greater or smaller

than 1 cm, and may not be uniform or constant if desired. Therefore, a person or workman who mount the ceiling panel structure 10 can adjust by himself at the mounting job site the width W2 of the guide plate portion 26 and accordingly the width W1 of the base member 20 by producing, in and along a desired groove among the grooves 27, a deeper cutting groove by means of edges of a cutter knife or the like at the job site. A width, depth and cross-sectional shape are not limited so long as the guide plate portion 26 can be weakened for facilitating separation along the groove 27 within an extent in which there is not a possibility that the guide plate portion 26 may be separated or broken therealong during usual handling thereof. In this embodiment, a groove 27a similar to the groove 27 is formed in another principal face 28, i.e. the surface, of the plate portion 26, which facilitate separation, of an edge part which may be subjected to damages during transportation thereof etc., before use or application of the member 20 onto the ceiling 200. The groove 27a may be omitted.

The main plate portion 22 has, on another principal face or surface 29 of said one end 25, an engagement projection 30 in which one end 57 (Figs. 7A-7B) of the cover member 40 is fitted. The engagement projection 30 comprises a resistive face part 31 rising (depending) from the principal face 28 serving as the guide face of the guide plate portion 26 substantially in perpendicular thereto, and a deflection guide face part 32 of a semi-cylindrical shape (semi-circular shape in cross-section) connected continuously and smoothly with the resistive face portion 31. A recess 33 is formed in the projection 30 to receive therein an end 57 of the cover member 40 to be engaged therewith. An opening 33a of the recess 33 is narrowed for ensuring the engagement with the cover member 40.

The resistive face part 31 and deflection guide face part 32 may be of any other cross-sectional shape such as a part of ellipse, so long as the projection 30 in the form of a small protrusion can serve as a flow-resistant projection to act as a resistance against the conditioning airflow to decelerate the airflow. Similarly, a typical example of vertically downward length or height of the resistive face part 31 from the principal face 28 may be about 5 mm - about 1 cm. However, the

height may be greater than 1 cm or smaller than 5 mm so long as the projection 30 can serve as the flow-resistant projection.

At the other widthwise end 34 of the main plate portion 22, i.e. outer end 34 of the base member 20, the base member 20 has engaging projections 36,37 which protrudes from the principal face 28 to form a recess 35 therebetween extending in the longitudinal direction of the main plate portion 22 and serve as the engaging portion. The engaging projections 36,37 have, respectively, at inner faces of distal ends or lower ends thereof constituting respective parts of the inner face of the recess 35, engaging stops 36a,37a protruding within the recess 35 to allow an insertion (engagement) in a direction A1 while regulating an escape (disengagement) of in a direction A2. The main plate portion 22 has a projection 38, at a widthwise central region of the surface 29 thereof, projecting therefrom and extending in the longitudinal direction thereof, and an engagement recess 39, in the rear face 23, with which a projections 87,88 of a corner base member 70 to be described later are engaged. The projection 38 is produced upon formation of the recess 39, and may be omitted. As seen from Fig. 6B, a shape of the linear base member 20 in a cross-section perpendicular to the longitudinal direction thereof is all the same at any position along the length, which is also valid for the linear cover member 40 described later in detail.

Further, the main plate portion 22 has holes H for inserting therethrough screws for mounting. Although only one hole H is shown in Fig. 6A, the holes H may be formed at shorter intervals in the longitudinal direction of the main plate portion 22. The hole H may have a frust-conically slanted circumferential wall to receive therein a head of the screw as illustrated in a modified panel structure of Fig. 14, or may be formed in widthwise different positions of the main plate portion 22 unless engagement with the cover member 40 is not adversely affected.

As shown in Figs. 7A and 7B, the cover member 40 is made of an elongated plastic member of a width W3 which is about the same as the width of the main plate portion 22 of the base member 20, and of a length L3 which is about the

same as that (L1) of the base member 20, and comprises, as shown in Fig. 7B, a
 vertical end wall portion 41 extending vertically, a lower end guide portion 43
 extending generally horizontally from a lower end 42 of the end wall portion 41, a
 short vertical wall portion 45 extending vertically from an inner end 44 of the
 5 lower guide portion 43 approximately perpendicularly thereto, a deflection guide
 portion 47 extending convexly toward downstream from an upper end 46 of the
 vertical wall portion 45 and serving as the deflection induction portion, a
 semi-cylindrical flow-resistant projection 49 extending integrally from an
 upstream end 48 of the deflection guide portion 47 toward upstream and being
 10 convex toward downward and upstream directions, an upstream-side arcuately
 curved guide portion 51 extending integrally toward upstream from an upstream
 end 50 of the flow-resistant projection 49 and being slightly upwardly convex,
 and an upstream-side horizontal guide portion 53 extending substantially
 horizontally from an upstream end 52 of the upstream-side arcuate guide portion
 15 51. The deflection induction portion 47 comprises an upstream part 47a extending
 generally vertically to provide a flow-resistance, and a downstream part 47b, for
 providing the flow-resistance and changing the direction of the airflow to guide
 downwardly toward the center of the air-conditioning apparatus 200, the
 downstream part 47b being connected smoothly at an upper end 47c thereof with
 20 a lower end of the upstream part 47a and extending almost horizontally. The
 downstream part 47b is connected smoothly at a lower end thereof 46 with the
 vertical wall portion 45. A vertical height from the end 52 of the guide portion
 53 to the lower end of the horizontal wall portion 43 is, for example, about 4-5 cm.
 However, the height may be greater (e.g., 10 cm or greater) or smaller (e.g. about
 25 2-3 cm or smaller).

A rear face parts of regions near the downstream end 50 of the upstream-side
 arcuate guide portion 51 and near a downstream end 52 of an upstream-side
 horizontal guide portion 53, i.e., upper face parts 54 shown in Fig. 7B, form a
 coplanar plane to be closely contacted with the lower principal face 29 of the
 30 main plate portion 22 of the base member 20. Most of an upper face 55 of the

upstream-side horizontal guide portion 53 is connected with the upper face 54 through a small step 56. Therefore, a part, of the upstream-side horizontal guide portion 53, situated closer than the step 56 to the distal end can be bent easily in directions B1 and B2. An edge of the step 56 may be angled or arcuately curved.

5 The upstream-side horizontal guide portion 53 is thinned at the distal end part 57, and a shallow recess 59 is formed in a part of the surface or lower face between a main part 58 of the upstream-side horizontal guide portion 53 and the distal end part 57.

10 Therefore, the thinned distal end part 57 can be inserted by force into the recess 33 of the projection 30 of the linear base member 20 (Fig. 6B) while expanding a narrowed opening 33a of the recess 33 of the projection 30 by the thinned distal end part 57 in a state where the distal end part 57 situated more close to the distal end than the step 56 is being bent. After the insertion, the wall part 30a (Fig. 5B) around the opening 33a of the recess 33 fits in the recess 59 at the proximal
15 end of the distal end part 57 and can hold the horizontal guide portion 53 including the distal end part 57 in a slightly bent state. A semi-cylindrical wall portion 49 forming the flow-resistant projection also serves for the widthwise bending upon the insertion.

20 The upper face 54 has therein a wide recess 60, which is wider than the projection 38 on the surface 29 of the base member 20 and extends over the whole length in the longitudinal direction, to receive the projection 38 upon assembling or mounting the cover member 40 to the base member 20.

25 A horizontal reinforcing wall 61 is integrally formed between the downstream end 48 of the flow-resistant projection 49, i.e., the upstream end 48 of the downstream-side arcuate guide portion 47 and the vertical end wall portion 41. Engaged projections 62,63 serving as the engaged portion extends integrally and upwards from an upper face of the horizontal wall 61. The engaged projections 62,63, i.e., projections to be engaged, have at respectively distal ends thereof small engaged stop projections 64,65, i.e., projections to be engaged to be stopped,

protruding opposite directions from each other, i.e., protruding outwards relative to each other. Upper ends of the engaged stops 64,65 of the engaged projections 62,63 are situated slightly below the face 54.

5 The vertical end wall portion 41 protrudes more upward than the plane 54 just by the thickness D1 of the main plate portion 22 of the base member 20. When the cover member 40 is mounted on the base member 20, an end face 67 of an upper end 66 of the vertical wall portion 41 is substantially flush with the upper faces 23,24 of the base member 20. The vertical wall portion 41 is slightly thickened at the upper distal end 66 thereof so that an inner face 68 of the end 66 is pressed
10 against the end face 21a of the plate portion 21 of the base member 20.

Therefore, when the linear panel structure 11 is prepared and mounted, at first, the base member 20 is prepared to have a predetermined width W1x and a predetermined length L1 appropriated for the mounted site or position. The predetermined width is, herein, typically a width as wide as possible. The
15 possible widest width enables to minimize the conditioning air having been blown out through the air-conditioning apparatus 200 to flow along the ceiling surface 201.

However, as shown by imaginary lines 202 in Fig. 2, for example, there may be a pre-mounted obstacle 202, having been already mounted in the ceiling surface
20 201 such as a smoke sensor, an electric wiring connector and a downward illuminating light, at a region of the ceiling surface 202 relatively close to the site or area where the air-conditioning apparatus 200 is mounted. Such being the case, the width W1x of the base member 20 is adjusted to avoid the obstacle 202 or to fit to the width W3 between the obstacle 202 and the air-conditioning
25 apparatus 200. Typically, the width W1x is approximately the same as the width W3 (W1x being nearly equal to W3) but is smaller than W3 ($W1x < W3$). As a matter of fact, there is substantially no possibility that the obstacle 202 is mounted in the ceiling surface 201 without a substantial spacing therefrom to the air-conditioning apparatus 200 because of various requirements such as the

strength of the ceiling surface 201, the mounting structure and convenience of mounting work of each of various obstacles 202, and the function and conveniences of maintenance work of each of the obstacles 202. Therefore, a width W10 (Fig. 6A) between the outer end face 21a of the main plate portion 22 of the plate portion 21 of the base member 20 and outermost groove 27b of the grooves 27 in the guide plate portion 26 is preset to a possible minimum length considering the above-mentioned situations. Four obstacles 202 are shown in Fig. 2, which is, however, exceptional. Normally, there will be at most one or two regions where obstacles are found.

- 10 When the width W1 of the base member 20 is decreased, a cut-in groove is formed, in and along an appropriate one of the grooves 27 situated at a position providing the width W1 of not greater than a width W3 but as wide as possible, to be bent therealong for separation. When the widthwise inner edge of the guide plate portion 26 is inserted into between the ceiling surface 201 and the outer frame or smoothly planed board portion of the air-conditioning apparatus 200, the width W1 of the base member 20 is selected to be wider by the inserted length.

Meanwhile, considering use of the corner panel structure 12 to be described later in detail, the base member 20 and the cover member 40 are cut to a predetermined length by means of saw or the like. When the dimensions or sizes of the air-conditioning apparatus 200 are relatively standardized, plural kinds of members 20,40 of plural lengths may be prepared, and may be cut only when exceptional.

Upon mounting the linear panel structure 11, at first, the linear base member 20 is supported at a desired position to be attached to the ceiling 201 by means of the screws inserted in the screw holes H. The linear base member 20 is thin and light in weight, and can be temporarily fixed to the ceiling surface 201 only by at least two screws. Therefore, the linear base member 20 need not be supported or held by the a workman upon screwing operation of the third or further screw, which can be made easily by the workman even when the workman is forced to

have an unnatural posture toward the ceiling surface 201. In particular, in a case where the widthwise inner edge of the guide plate portion 26 of the linear base member 20 is inserted into between the ceiling surface 201 and the outer frame of the air-conditioning apparatus 200, the member 20 can be provisionally fixed
 5 even by the single screw.

Then, the thin walled distal end part 57 of the upstream-side horizontal guide portion 53 of the cover member 40 is inserted into the recess 33 of the projection 30 of the base member 20, and the engaged projections 62,63 of the cover member 40 are inserted, from the engaged stop parts 64,65 at the distal end
 10 thereof, into the engaging recess 35 of the base member 20, while the thin walled distal end part 57 is further inserted into depth of the recess 33. Upon the first insertion of the horizontal distal end part 57, the upstream-side horizontal guide plate portion 53 and the flow-resistant projection 49 are bent to be upwardly convexly. The downwardly convex curvature of the flow-resistant projection 49
 15 of the cover member 40 facilitates the bending deformation in the direction B1. These engagement and insertion are completed, when the distal end part 57 of the upstream-side horizontal guide portion 53 abuts to the bottom of the recess 33, the distal end of the wall portion 30a of the projection 30 is engaged in the recess 59 in the lower face of the distal end part 57 of the cover member 40, the upper faces
 20 54,54 at both sides of the upper end opening of the recess 60 abut against the principal face 29 of the main plate portion 22 of the base member 20, and the engaged stop projections 64,65 at the distal ends of the engaged projections 62,63 are fitted into the engaging recess 35 through the engaging projections 36a,37a at the lower end opening of the recess 35, and further when the inner face 68 of the
 25 upper end 66 of the vertical end wall portion 41 abuts against the end face 21a of the base member 20.

Each corner panel structure 12 of the ceiling panel structure 10 comprises, as shown in Figs. 8A-8B, 9A-9D and 10A-10B, a corner base member 70 (Figs. 8A-8B and 9A-9D) of plastic material and a corner cover member 90 (Figs. 8A-8B and 10A-10B) of plastic material coupled to the corner base member 70.
 30

The corner base member 70 comprises a generally square and horizontal top plate-like portion or top plate portion 57 to be closely contacted upon mounting at an outer principal face 71 thereof with the ceiling surface 201, and a vertical side wall portion 73 extending downwards from the horizontal top plate portion 72 in perpendicular thereto. The corner base member 70 is of a mirror symmetrical shape about a virtual plane which includes the diagonal line D of the top plate portion 72 and extends perpendicularly thereto. The vertical side plate portion 73 have linear or plate-like side wall portions 77,78 extending along two sides 75,76 at both sides of a arcuately curved corner 74 of the horizontal top plate portion 72, and an arcuate corner side wall part 79 along the arcuate corner 74 between the plate-like side wall portions 77,78. Ends 77c,78c of the side wall portions 77,78 protrude from associated sides or edges 80,81 of the horizontal plate portion 72.

The top horizontal plate portion 72 has, as shown Figs. 9A-9D, engaging wall portions 82,83 and 84,85 of a width W5 extending downwards from respective edges 80 and 81 and serving as the engaging portions. The wall portions 82,83 and 84,85 have, at respective outer sides thereof, projecting engaging stop parts, i.e., projections for stop, 82a,83a and 84a,85a. The plate portion 72 has also slits or grooves 82b,83b and 84b,85b for facilitating bending of the wall portions 82,83 and 84,85 while avoiding concentration of the stresses to the proximal ends thereof, and allowing the insertion of engaged portions (to be described later) of the cover member 90, and slits 82c,83c and 84c,85c connected to the slits 82b,83b and 84b,85b so that the wall portions 82,83 and 84,85 can be bent uniformly over the whole width. Reference numeral 86 denote an elongated hole for insertion of the screw.

In addition, the horizontal plate portion 72 has thin protrusion strip parts 87,88 of a width Wb protruding respectively from the edges 80,81. The protrusion strip parts 87,88 have a cross-sectional shape (a trapezoidal end face being shown in Fig. 9A) substantially identical with that of the recess 39 of the linear base member 20 to be inserted thereinto and engaged therewith to assist firm couplings

between the corner base member 70 and the associated linear base members 20 upon assembling the ceiling panel structure 10.

5 The horizontal plate portion 72 has grooves 89, similar to the grooves 27 of the linear base member 20 but in the form of a lattice, in a lower principal face (surface) 72a thereof near a corner portion where the edges 80,81 are crossed. A group of grooves 89a, extending vertically in Fig. 9C, among the grooves 89 serve as the weakened parts where a width or size or mounting position in the lateral or horizontal direction in Fig. 9C is adjusted, while a group of grooves 89b, extending horizontally in Fig. 9C, among the grooves 89 serve as the weakened parts where a width or size or mounting position in the vertical direction in Fig. 9C is adjusted.

15 The corner cover member 90 is engaged with and fixed to the corner base member 70 to provide a surface configuration or shape having flow-guide, flow-resistant and deflection functions similar to the linear cover member 40 with respect to the conditioning airflow.

20 In addition, the corner cover member 90 of this embodiment has an upper surface 91 of a configuration substantially the same as or complementary with that of the lower surface of the linear panel structure 11 in the side view or side section as in Fig. 10A so that the corner cover member 90 can be laid on the end portion of the linear panel structure 11 from the lower side to cover the end portion thereof. A wall 92 of the corner cover member 90 has typically substantially a uniform thickness of, for example, about 2-3 mm, and therefore a lower surface 93 of the wall has approximately the same configuration or shape as that of the surface of the linear panel structure 11 and has substantially the similar flow-resistant, deflection and guide functions.

25 The corner cover member 90 comprises a flat plate portion 94 having a flat surface part 91a superposed on the lower surface 72a of the top plate portion 72 of the corner base member 70, a downwardly convex upstream flow-resistant projection 95 having a concave surface part 91b superposed on the surface of the

flow-resistant projection 30 of the linear base member 20, an upstream arcuate guide portion 96 having an arcuate surface part 91c superposed closely on the surface of the upstream arcuate guide portion 51 of the linear cover member 40, a downwardly convex intermediate flow-resistant projection 97 having a concave surface part 91d superposed closely on the surface of the flow-resistant projection 49 of the linear cover member 40, a deflection induction portion 98 serving as the concave deflection induction portion and having convexly arcuate surface part 91e superposed closely on the surface of the deflection induction portion 47 of the linear cover member 40, a vertical wall portion 99 having a vertical face part 91f superposed closely on the vertical face of the vertical wall portion 45 of the linear cover member 40, and a lower end guide portion 100 having a horizontal face part 91g superposed closely on the lower horizontal surface of the horizontal lower end guide portion 43 of the linear cover member 40.

The corner cover member 90 has, similarly to the corner base member 70, a mirror-symmetrical shape about a virtual vertical plane passing through the virtual diagonal line D. Therefore, a flow-resistant, deflection-guide and flow-guide portion 101 including the wall portions 95,96,97,98,99,100, as seen from plan view of Fig. 10B, comprises two linear flow-resistant, deflection-guide and flow-guide portions 101b,101b along two sides extending in directions of 90 degrees relative to each other, each of the portions 101b being constituted by linear portions 95b,96b,97b,98b (not shown), 99b (not shown) and 100b, and an arcuate flow-resistant, deflection-guide and flow-guide portion 101c constituted by circular arc portions 95c,96c,97c,98c (not shown), 99c (not shown) and 100c extending over 90 degrees to connect smoothly the two linear portions 101b,101b at a corner portion. The arc may be a part of ellipse or the like instead of a part of the circle.

The corner cover member 90 includes four engaged projections 102,103 and 104,105 having respectively engaged stop parts 102a,103a and 104a,105a to be engaged and stopped by the engaging stop parts 82a,83a and 84a,85a of the engaging projections 82,83 and 84,85 of the corner base member 70. The

engaged stop parts 102a and 104a have respectively elongated opposite protrusions 102b and 104b for guiding positioning or registration of the corner cover member 90 upon the engagement. The engaged projections 102,103 extend from a position inwardly away from the edge 106 by a distance C in parallel with the linear flow-resistant guide part 101b over a region of a width W7 (=W5). similarly, the engaged projections 104,105 extend from a position inwardly away from the edge 107 by the distance C in parallel with another linear flow-resistant guide part 101b over a region of the width W7 (=W5). Parts 108,109 of the corner cover member 90 situated within the distance or width C respectively from the edges 106,107 is superposed on the surfaces near the adjacent longitudinal ends or edges of the linear panel structures 11 to hide the longitudinal edges thereof.

In addition, the corner cover member 90 has four engaged stop projections 112, 113 and 114,115 serving as the engaged portion at positions respectively inside of the edges 110 and 111 of the horizontal bottom wall portion 100 by a distance or width W8. In the illustrated embodiment, number of each of the projections 113,115 are two. The engaged stop projections 112-115 abut against inner faces 77b and 78b of the side walls 77 and 78, when surface parts 116 and 117 of the horizontal bottom wall portions 100 outside the projections 112,113 and 114,115 abut against lower end faces 77a and 78a of the side walls 77 and 78 of the corner base member 70, thereby positioning and fixes the corner cover member 90 to the corner base member 70 cooperatively with the above-mentioned engaged projections 102,103 and 104,105.

The corner cover member 90 has, in a rear face (upper face) 91a of the horizontal plate portion 94, grooves 118 in the form of a lattice similarly to the grooves 89 of the corner base member 70 and at the same intervals as that of the grooves 89. In the illustrated embodiment, a corner is cut out in the form of a square cut-out portion 119, defined by a vertically extending groove 118a and a laterally or horizontally extending groove 118b in Fig. 10B, in which the corner of the air-conditioning apparatus 200 can just fit.

Before mounting the corner cover member 90, each of the corner base members 70 is mounted between the adjacent linear base members 20 and the ceiling surface 201 in a state where the adjacent projections 87, 88 of the corner base member 70 fit in the recesses 39 of the adjacent linear base members 20 (actually and typically, the corner base member 70 is mounted on the ceiling surface 201 prior to the mounting of the linear base member 20 to the ceiling surface 201), and the linear cover members 40 are mounted to the linear base members 20 to form the linear panel structures 11. Upon mounting the corner cover member 90, as shown in Fig. 11, the corner cover member 90 is mounted to the corner base member 70 so that the edge portions 108,109 cover the adjacent ends 11e,11f of the linear panel structures 11,11, whereupon the corner cover member 90 is directed, to be fitted, from an inside of the corner to an outside thereof. Thus, the elongated inclined protrusions 102b,104b of the engaged projections 102,104 of the corner cover member 90 slide along the inclined lower end faces of the engaging stop projections 82a,84a of the engaging projections 82,84 of the corner base member 70 to be fitted in the outsides thereof. As a result, the stop engagements between the engaged stop parts 102a-105a of the engaged portions 102-105 of the corner cover member 90 and the associated engaging stops 82a-85a of the engaging projections 82-85 of the corner base member 70 have been established, and, at the same time, the surface parts 116,117 near ends of the horizontal wall portion 100 of the corner cover member 90 and the engaged stop projections 112-115 thereof abut respectively against the lower end faces 77a,78a of the side wall portions 77,78 of the corner base member 40 and the inner faces 77b,78b thereof thereby positioning and fixing the corner cover member 90 to the corner base member 70 to complete the mounting thereof.

Now, the overall mounting operation or work of the ceiling panel structure 10 thus constructed on the ceiling surface 10 is to be explained.

At first, the ceiling surface 201 is looked over whether or not the obstacle(s) is(are) present on the ceiling surface 201 around the air-conditioning apparatus 200.

We now assume a case where, as shown in Fig. 4A, there is an obstacle 202a at a position corresponding to the position G in Fig. 2. A width $W1x$ of a linear base member 20R constituting a linear panel structure 11R to be positioned along the right side in Fig. 4A (hereafter, reference character "R" is attached at the end of reference numerals to denote that the associated member or element is positioned on the right side) is adjusted depending on the distance $W3$ between the obstacle 202a and the adjacent side edge of the air-conditioning apparatus 200 so that the width $W1x$ is not greater than $W3$ (Figs. 4A-B). Upon the adjustment, the linear base member 20R is cut along an appropriately positioned groove among the multiple grooves 27 in the plate portion 26R thereof. The cutting operation is carried out with ease by cutting in and along the appropriate groove 27 by means of a cutter knife or the like, and by bending the member 20R along the cut-in line. In the illustrated embodiment, the obstacle 202a is situated at a position extremely close to the air-conditioning apparatus 200 as shown in Figs. 4A-B, and therefore the linear base member 20R is cut along the innermost groove 27b (Figs. 6A-B) so that the width thereof is minimized. We now assume that there is not any other obstacle on the ceiling surface 201 around the air-conditioning apparatus 200. Meanwhile, in a case where there is(are) other obstacle(s) on other side(s), width(s) of the linear panel structure(s) 11 to be mounted on the associated side(s) should be adjusted depending on the position(s) of the obstacle(s).

Then, the workman adjusts positions of the cut-outs in the inside corners of the corner panel structures 12RU, 12RD (situated respectively upper and lower positions on the right side in Fig. 4A, where subscripts "U" and "L" are respectively added to the end of the associated reference numerals or characters thereof) adjacent to ends of the linear panel structure 11R. A corner base member 70RU (not shown) of the right and upper corner panel structure 12RU is cut along the innermost groove 89a1 among the grooves 89a and along the outermost groove 89b2 among the grooves 89b in Fig. 9C. A corner cover member 90RU of the upper right corner panel structure 12RU is also cut along the innermost groove 118a1 among the grooves 118a and along the outermost groove

118b2 among the grooves 118b in Fig. 10B. On the other hand, a corner base member 70RD (not shown) of the right and lower corner panel structure 12RD is cut along the outermost groove 89a2 among the grooves 89a and along the innermost groove 89b1 among the grooves 89b in Fig. 9C. A corner cover member 90RD of the lower right corner panel structure 12RD is similarly cut along the outermost groove 118a2 among the grooves 118a and along the innermost groove 118b1 among the grooves 118b in Fig. 10B. Thus, the width of the corner panel structure 12 at the cut-out portion thereof becomes equal to the associated width of the adjacent linear panel structure 11, and the freshly formed cut-out portion just fits around the corresponding corner of the air-conditioning apparatus 200.

Then, the lengths of the linear panel structures 11U,11D,11L, 11R situated respectively on upper, lower, left and right sides of the air-conditioning apparatus 200 when viewed in Fig. 4A are adjusted or cut according to the lengths of the adjacent sides of the air-conditioning apparatus 200. Upon the cutting, the length of each linear panel structure 11 is selected to be shorter than that of the adjacent side of the air-conditioning apparatus 200 by a protrusion or superposition length of the corner base member 70 of the corner panel structure 12 toward or on adjacent to either associated end of the linear panel structure 11. Actually, the corner base members 70 are mounted in accordance with four corners of the air-conditioning apparatus 200 beforehand. And then, the linear base member 20 is positioned with respect to two adjacent corner members 70,70 so that one end thereof abuts against an associated end or edge of one of the two corner base members 70 and is marked at a longitudinal position thereof which corresponds to the position of an adjacent end of the adjacent other corner base member 70 so that the marked position should be the other end of the linear base member 20, thereby enabling to determine the length of the linear base member 20 and linear panel structure 11 without measuring the lengths thereof. The length-adjustment of the linear panel structure 11 is carried out for example by provisionally assembling the linear base and cover members 20,40 of each side

into the form of the linear panel structure 11 and then by cutting the assembly by means of saw or the like. As a matter of course, the linear base member 20 and the linear cover member 40 may be cut independently or separately if desired. The length-adjustment of the linear panel structure 11 may be carried out before
5 the adjustment of cut-in positions of the corner panel structures 12 or two kinds of adjustment may be carried out in mixed order.

Then, each of the four corner base members 70 is fixed to the ceiling surface 201 by means of screws or the like through the elongated screw holes 86,86 at a position where the cut-out portion thereof just matches or fits around the
10 associated corner of the air-conditioning apparatus 200. The screw holes 86 of the corner base member 70 are elongated, so that screwing positions can be selected, within the length of the elongated hole 86 for the appropriate screwing while avoiding inappropriate regions therefor of the ceiling surface 201, if any. In addition, because the holes 86,86 of each corner base member 70 are elongated
15 holes extending perpendicularly to each other, the direction of the corner base member 70 can be finely adjusted before tightly fastening the screws. As a matter of course, any other securing or fastening or fixing means can be used for fixing the corner base member 70 if desired.

Then, each of the four linear base members 20 is pressed against the ceiling
20 surface 201 so that either end of the linear base member 20 generally abuts the associated side or end face 80 or 81 of each of the adjacent corner base members 70,70 and so that a part of the recess 39 near either end thereof fits around the protrusion 87 or 88 of the adjacent corner base member 70, and therefore each linear base member 20 is provisionally fixed to the corner base member 70. The
25 linear base members can be then fixed to the ceiling surface 201 by the screws through the screw holes H.

The thin walled inner ends of the base members 70,20 may be inserted, if possible, into between the outer frame of the air-conditioning apparatus 200 and the ceiling surface 201. This is exemplified by an illustration shown by dotted lines in Fig.

12. When the thin inner ends J of the base members 70,20 are thus inserted between the outer frame of the air-conditioning apparatus 200 and the ceiling surface 201, the air-conditioning apparatus 200 may be pulled down slightly from the ceiling surface 201, if necessary, to provide a gap between the outer frame of the air-conditioning apparatus 200 and the ceiling surface 201 allowing the insertion of the inner ends J thereinto. As a matter of course, the width W1x of the linear base member 20 is adjusted to be wider by a length or width of insertion of the inner ends J (in other words, the width of the space where the linear base member 20 is placed can be smaller than the width W1x of the linear base member 20 by the insertion length or width). The groove 118 of the corner base member 70 to be cut therealong is also selected considering insertion lengths at both sides of the corner portion according to the estimated insertion width of the linear base member 20.

Then, four linear cover members 40 are engaged respectively with the associated linear base members 20 to be fixed thereto in the above-mentioned procedures or steps.

Lastly, four corner cover members 90 are engaged respectively with the associated corner base members 70 to be fixed thereto in such a manner that they cover the associated corner base members 70 and the adjacent ends of the linear cover members 40,40, thereby completing the mounting or assembling of the ceiling panel structure 10 in accordance with the position(s) of the obstacle(s) around the air-conditioning apparatus 200 as shown in Figs. 4A-B. An example of thus mounted state of the ceiling panel structure 10 is shown in an oblique view of Fig. 3 where the air-conditioning apparatus 200 is not shown.

As described above, the ceiling panel structure 10 can be mounted with ease only by adjusting, at the very site of mounting, the widths and lengths of the linear panel structures 11 and the widths of the corner panel structures 12 at the cut-out portions thereof according to the sizes of the air-conditioning apparatus 200 and the distribution of the obstacle(s) on or in the ceiling surface 201. The relatively

small size of corner base members 70 can be fixed with ease to the predetermined positions by means of screws or the like even by the single workman, because the associated corners of the air-conditioning apparatus 200 can be used as positioning guides for mounting the corner base members 70. The linear base members 20 can be also positioned and fixed, by screws etc., to the ceiling surface 201 with ease even by the single workman, because each of the linear base members 20 can be provisionally fixed substantially to the corner base members 70,70 at both ends thereof by the engagement of the recess 39 with the associated protrusion strips 87,88. If desired, a double-faced adhesive tape or the like may be put on the rear face of the linear base member 20 upon the provisional fixing of the linear base member 20 to ensure the provisional fixation thereof. In addition, the mounting of the linear cover members 40 can be also made with ease even by the single workman, because the mounting of the linear cover members 40 can be actually completed only by engaging them with the associated linear base members 20 to be fixed thereto. Furthermore, the mounting of the corner cover members 90 can be also made with ease even by the single workman, because the mounting of the corner cover members 90 can be completed only by engaging them with the associated corner base members 70 to be fixed thereto. In addition, above-mentioned width- and/or length-adjustment can be also made with ease even with the saw and cutter knife and even by the single workman.

Now, the function of the ceiling panel structure 10 upon the operation of the air-conditioning apparatus is described referring to Figs. 13 and 4A-B.

As shown in Figs. 4A-B, the air-conditioning apparatus 200 of generally rectangular (square) shape along the ceiling surface 201 has a room-air-inlet 210 at the center of the rectangle and conditioning-air-outlets 211 in the vicinity of four sides or four side edges thereof. Thus, as shown in Fig. 13, the air-conditioning apparatus 200 sucks or intakes the air in a room 207 in a direction K1 from the central room-air-inlet 210 by means of a motor-driven fan 212 disposed in a central conduit or passage 205, directs in a direction K2 toward

a generally tubular indoor heat exchanger 213 disposed between the central conduit 205 and an outer blow-out passage or conduit 206, heats or warms (in case heating-adjustment) or cools (in case of cooling-adjustment) the room air by means of heat medium flowing through heat transmission pipes of the heat exchanger 213 when the directed air passes through spaces between the heat transmission pipes and/or heat transmission fins of the heat exchanger 213, and thereafter blows out the air in a direction K3 generally in parallel with the ceiling surface 201 and slightly downwards through the conditioning air-outlet 211 after having adjusted directions of the airflow by means of desired shapes of smoothly planed board or circumferential or side wall 214 and a wind or airflow direction adjustment plate 215 at the conditioning air-outlet 211 at a downstream end of the blow-out passage 206. Filters are disposed, at positions such as an inlet of the airflow flowing into the heat exchanger 213 to pass therethrough, for removing contaminants (such as very fine particles) in the room air considerably.

The uppermost layer part of the conditioning airflow having been blown out through the conditioning air-outlet 211 in outward and slightly downward direction K3 flows generally parallel with the ceiling surface 201 along the guide plate portion 26 of the linear base member 20 of the linear panel structure 11 of the ceiling panel structure 10. The airflow then blows against the flow-resistant projection 30 of the linear base member 20, and the wind pressure thereof is reduced to decrease the flow rate thereof, while spreading generally over the surface of the projection 30. The airflow having flown over the flow-resistant projection 30 then flows along the guide portion 51, with the slightly downwardly curved guide surface, of the linear cover member 40 of the linear panel structure 11, and thereafter blows against the flow-resistant projection 49, so that the wind pressure thereof is significantly reduced to decrease the flow rate thereof. The conditioning airflow having flown over the flow-resistant projection 49 while spreading gradually due to the deceleration thereof is then significantly deflected by the deflection guide wall portion 47, which is curved to project abruptly downwards, i.e., bend downwards significantly, into the form of airflow S1, the

flow direction of which has been changed relative to that of the original airflow out of air-outlet 211 by an angle of 90 degree or greater. A part of the airflow may flow further over the lower end portion 43, which is however directed substantially inclined downwards.

- 5 The changes in the flow rate and flow direction of the conditioning airflow thus described are mainly typical phenomena applicable to the airflow near the surface of the linear panel structure 11. The airflow which flows along regions more remote from the surface of the linear panel structure 11 is less affected directly by the changes of the surface configuration of the linear panel structure 11.
- 10 However, the above-described changes in the conditioning air flow near the panel structure 11 more or less affect the airflow of lower regions or layers to reduce the flow rate, to spread and to be deflected or directed downwards in the form of the airflow S2.

- 15 On the other hand, the room air is always drawn or suck in the direction K1 from the air-inlet 210 at the central portion of the air-conditioning apparatus 200. Therefore, a part of the conditioning airflow having been deflected downwards provides a circulation flow as shown by S3 in Fig. 13. This circulation flow S3 significantly reduces, as so-called short-cut or short-circuit, the air-conditioning efficiency of the air-conditioning apparatus 200 if it becomes excessive.
- 20 However, it will be acceptable that only a part of the conditioning air is mixed as the circulated flow S3 into the intake flow S4 of the room air.

- 25 Meanwhile, the formation of thus described circulation airflow S3 serves or helps, together with the above-mentioned deflected airflow S1,S2, that most of the conditioning airflow may spread as shown by the airflow S5 in Fig. 13 over the room in the desired manner.

As a result, it can be minimized that the airflow having flown over the lowermost end 43 of the linear cover member 40 of the linear panel structure 11 flows along the ceiling surface 201a in contact therewith at the outside of the panel structure 11. Therefore, it can be minimized that the ceiling surface 201 is smudged or

contaminated by fine solid and/or liquid particles contained in the conditioning airflow.

5 The role or function of the linear panel structure 11 thus described applies similarly to the corner panel structure 12 because the corner panel structure 12 has substantially similar cross-sectional shape or external shape or contour as that of the linear panel structure 11. Particularly, in the illustrated embodiment where the air-outlets 211 are provided along four sides, if it is hypothetically assumed that the corner panel structures 12 are not provided and that there are gaps between the linear panel structures 11,11 instead of the corner panel structures 12, 10 there would be possibilities that a part of the conditioning air having spread over due to the resistance of the linear panel structures 11 would flow from ends of the linear panel structures 11 into the hypothetical gaps where the corner panel structure 12 are assumed to be omitted, and that such airflow into the gaps may tend to grow or to be accelerated once such airflow has been established. In the 15 ceiling panel structure 10 in the form of closed quadrilateral loop, however, such hypothetical airflow into the gaps is eliminated by the corner panel structures 12 and the flow of the conditioning air toward the ceiling surface 201 can be minimized as a whole.

20 However, in a case where the air-outlet is provided, for example, along two parallel sides or only along one side of the quadrilateral air-conditioning apparatus, the linear panel structure may be mounted only along the side(s) adjacent and opposed to the air-outlet(s), preferably over a range longer enough than that of the air-outlet. If desired, however, the corner panel structure(s) may be further provided on one or both end(s) of the linear panel structure for such 25 air-conditioning apparatus. Further, closed quadrilateral ceiling panel structure may be employed to eliminate the above-mentioned gaps regardless of the number of air-outlets, if desired.

The structural or constructional features and/or the configurational features or shape features of the linear and corner panel structures thus described can be

changed or modified into various forms in a case where the length and/or width of thereof can be adjusted with ease at the mounting job site and especially in a case where the conditioning airflow towards the ceiling surface 201 can be substantially eliminated. Some of the examples of the modifications of the
 5 above-mentioned embodiment will now be described briefly.

In Fig. 14, a modified linear panel structure 11m is shown. In this modification, reference character "m" is added to the end of the reference numerals. The linear panel structure 11m comprises the single engaged projection 62m with a roughened surface instead of the two engaged projections 62,63. In addition,
 10 inner surfaces of the engaging projections 36m,37m are roughened instead of the two engaging projections 36,37 having the engaging stop protrusions 36a,37a. Thus, way of engagement/fixation of the base member with/to the cover member can be appropriately modified as desired. In addition, the linear cover member 40m has semi-cylindrical deflection induction portion 45m instead of the vertical
 15 wall portion 45. Thus, faces for providing the flow-resistance, deflection (direction-change) and/or guide function(s) defined by the surface shape or configuration of the cover member 40 rigid against the conditioning airflow can be also modified as desired.

Figs. 15A-C show an embodiment where the linear panel is formed only by the
 20 linear cover member 40n having a projection 30n and plate portion 26n as well, and where the linear cover member 40n is engaged with and fixed to, at either end, a corner base member 70n. In this illustrated embodiment, the linear cover member 40n comprises engaged projections extending substantially over the whole length thereof to be engaged with and fixed to engaging projections
 25 82n,83n,84n,85n of the corner base member 70n (in this embodiment or modification, reference character "n" is added to the end of each reference numeral). In this embodiment, the engagement of the engaging projections 82n-85n of with the engaged portions of the linear cover member 40n is selected to be firm or strong enough to support the relatively long linear cover member
 30 40n only at both ends thereof. Thus, instead of having separately linear panel

structures and corner panel structures each having individual base and cover members, the base member of one (i.e., corner or linear) panel structure may be commonly used for mounting cover member of the other (i.e., linear or corner respectively) panel structure. This embodiment may be further modified as shown in Figs. 16A-B where reference character "p" is added to the end of each reference numeral. In the modification of Figs. 16A and 16B, the corner base member 70p is constituted by combination of plural members 70p1, 70p2, 70p3 instead of the single integral member. The corner cover member and the linear cover member may be similarly configured.

10 Figs. 17A-D show a further modification, where a corner base member 70q serving for engagement and fixation of both of the corner cover member and the linear cover member are constituted by two parts 70q1, 70q2 to be engaged with each other along the diagonal line, and are displaced in the longitudinal direction of the linear cover member 40q along an end thereof to be fitted thereto for
15 fixation thereto (reference character "q" is added to the end of each reference numeral).

The ceiling panel structure 310 according to a preferred embodiment of said one aspect of the invention will now be described in detail referring to Figs. 18A-B to Fig. 32. In this embodiment, reference numeral "3" is added to the beginning of
20 the reference numerals or characters of the members, elements or portions of the first described embodiment generally although some exceptions excepted.

The ceiling panel structure 310 of Figs. 18A-B comprises linear panel structures 311, each of which comprises, as shown in Figs. 19A-B to 23A-C, a linear base member 320 of plastic material (Figs. 19A-B to 21A-B) and a linear cover member 340 (Figs. 19A-B, 22 and 23A-B) of plastic material coupled to the linear
25 base member 320. In the description of this embodiment hereafter, concrete sizes of various portions or parts are shown, which are, however, only a typical or one desired examples and the invention is not limited by any means to the sizes, shapes, or the same order of sizes or similar shapes, as described in the first

mentioned embodiment.

The linear base member 320 comprises, as shown in Figs. 20 and 21A-B, a plate portion 321 of a width W1 of about 20 cm and a length L1 of about 200 cm at its maximum. The plate portion 321 includes a main plate portion 322 of a thickness D1 of about 3 mm (Fig. 21B), and a guide plate portion 326 of a thickness D2 of about 2 mm (more specifically 2.2-2.3 mm or thicker) and of a width W2 of about 10 cm having a principal face 324 substantially co-planar with one principal face 323 (face opposed to the ceiling surface 201, i.e., rear face) of the main plate portion 322 and extending integrally from one end 325 of the main plate portion 322. At least one of the main and guide plate portions 322,326 may be formed so that the thickness of a part thereof becomes thinner as approaching closer to an widthwise inner end (right-hand side end in Figs. 21A,21B), or both of the main and guide plate portions 322,326 may have the same thickness.

The guide plate portion 326 has, in the principal face 324, grooves 327 extending over a whole length in the longitudinal direction thereof, for example, at regular intervals of 1 cm. The interval may be greater or smaller than 1 cm, and may not be uniform or constant if desired. Therefore, a workman of mounting work can adjust by himself at the mounting job site the width W2 of the guide plate portion 326 and accordingly the width W1 of the base member 320 by producing a cut-in groove in and along a desired groove 327 among the grooves 327 by means of edges of a cutter knife or the like at the mounting job site. A width, depth and cross-sectional shape are not limited so long as the guide plate portion 326 can be weakened for facilitating separation along the groove 327 within an extent in which there is not a possibility that the guide plate portion 326 may be separated or broken during usual handling thereof. In this embodiment, a groove 327a similar to the groove 327 is formed in another principal face 328, i.e. the surface, of the plate portion 326, which facilitate separation, of an edge part which may be subjected to damages during transportation etc., before use or application of the member 320 onto the ceiling 200. The groove 327a may be omitted.

In addition, the guide plate portion 326 has, in the side of the ceiling, i.e., rear face 324 thereof, recesses 327c extending over the whole length thereof in regular intervals in the widthwise direction, each recess 327c having about the same depth as that of the grooves 327 and a width wider than that of the grooves 327.

5 The recess 327c is used for engagement with an end cap 450 (refer to Figs. 33A-F) described later. The guide plate portion 326 has, on a surface 328 thereof, small projections 327d extending over the whole length in regular intervals in the widthwise direction thereof, each projection 328 having a height of the order of 0.1mm. The projections 327d mainly for design purpose also
10 serve for a resistance against the airflow to some extent. However, the projections 327d may be omitted.

The guide plate portion 326 may have in the surface 328 near the groove 327a a projected rib or projection 327e exaggeratedly shown by imaginary lines in Figs. 20 and 21A-B. The projection 327e is taller (e.g., 2 mm high and 1 mm wide)
15 than the above-mentioned projections 327d, and serves for the standard positioning of the linear panel structure 311, when the standard width of the structure 311 is mounted on the ceiling surface 201. More specifically, in a case where the linear base member 320 is used, as it is or as cut along the groove 327a, in a state of standard width (substantially maximum width), a part of the guide
20 plate portion 326 situated closer to the distal end than the projection 327e, i.e., distal end portion 326a between the groove 327a and the projection 327e, is inserted into a region between the outer frame or smoothly planed board part of the air-conditioning apparatus 200 and the ceiling surface 201 to abut the projection 327e against an outer edge of the smoothly planed board part of the
25 air-conditioning apparatus 200 for the positioning of the linear base member 320, thereby enabling the positioning of the linear panel structure 311. However, the positioning projection 327e shown by the imaginary lines may be omitted. In addition, instead of inserting the distal end portion 326a or the like into between the outer frame or smoothly planed board part of the air-conditioning apparatus
30 200 and the ceiling surface 201, it may be simply abutted, as shown in Fig. 30,

against the outer side face of the outer frame or smoothly planed board part of the air-conditioning apparatus 200.

The main plate portion 322 has at said one end 325 on another principal face or surface 329 a projection 330 defining a engaging recess 331 serving as the engagement portion in which a hooked engaged portion 337 (Figs. 22 and 23A-B) serving as an engaged portion at one end of the cover member 340 is fitted. As the engaging recess 331 is associated with the projection 330, the projection 330 is also called hereafter as the "engaging projection". Further, herein, i.e., in this specification, one of members establishing the engagement relationship is called as "engaging portion" while another of the members is accordingly called as "engaged portion", and therefore, we may call both members as the engaging portion and the engaged portion without distinguishing "engaging portion" and "engaged portion" from each other. This way of naming also applies to engaging relationship of elements other than the engaging elements 331,357 in question.

The projection 330 has an arcuate protrusion wall portion 332 protruding from the principal faces 328,329 to define the recess 331 opened to widthwise inward co-operatively with the principal face 328 serving as the guide face of the guide plate portion. The engaging recess 331 and arcuate protrusion wall portion 332 of the projection 330 extend continuously over a whole length of the linear base member 320. However, the arcuate protrusion wall portions 332 may be formed by plural parts each having a desired length in the longitudinal direction and being aligned at regular intervals to define as a whole the engaging recess 331 which extends almost continuously over the whole length of the linear base member 320.

The main plate portion 322 has, at another end 333 thereof or at a widthwise outer end 333 of the linear base member 320, an engaging projection 335 protruding from the principal face 328 to define an engaging recess 334 opened to a widthwise outer end and to the ceiling surface 201. Each of the engaging recess 334 and engaging projection 334 also extend over the whole length of the linear base member 320 in the longitudinal direction thereof. Herein, widthwise "outside (or outward)" and "inside (or inward)" as to the linear panel structure 311

or linear base member 320 means respectively a side more remote from (or a sense of direction away from) the air-conditioning apparatus 200 and a side nearer to (or a sense of direction approaching to) the air-conditioning apparatus 200 when the element such as the linear panel structure 311, linear base member 320 or linear cover member 340 is disposed in a predetermined orientation relative to the air-conditioning apparatus. The projection 335 comprises, when viewed in a cross-sectional view as shown in Figs. 19B and 21B, a proximal inclined portion or inclined guide portion 336 protruding from the principal face 328 to be situated widthwise inward as departing more remote from the main plate portion 322, a semicircular arcuate portion 336a curved downwardly convex from a linear extended end of the proximal inclined portion 336 to define a recess 334 together with the proximal inclined portion 336, and a distal inclined portion 337 extending slant and generally parallel with the proximal inclined portion 336 from the arcuate end of the semicircular arcuate portion 336a. An inner face 336b of the proximal inclined portion 336 or ceiling-side wall portion 336 inclined to be closer to the ceiling surface 201 as departing more remote from the widthwise inner recess 331, serves as a guide face for engagement or disengagement in directions F2, F1 respectively upon the engagement with or disengagement from an engaged portion of the cover member 340 to be described later. A widthwise outer end portion or distal end portion 337a of the distal inclined portion 337 is situated widthwise more inside than a widthwise outer end 333 of the main plate portion 322 corresponding to the end of the proximal inclined portion 336, and the outer surface 337b (a surface opposite to a side faced or opposed to the ceiling surface 201) of the distal inclined portion 337 is slanted to be closer to the ceiling surface 201 as departing more remote from the recess 331, thereby serving as a guide face in the direction F1 upon engagement of the cover member 340.

The main plate portion 322 has, on a widthwise central part of the surface 329, a projection 338 extending in the longitudinal direction thereof and a recess 339 in the rear face 323. As seen from Fig. 21B, a shape of the base member 320 in a cross-section perpendicular to the longitudinal direction thereof is all the same at

any position in the longitudinal direction. This is also the case with respect to the below-described linear cover member 340.

5 The main plate portion 322 has further screw holes H for allowing a stem or shaft of mounting screw etc. to pass therethrough. Each hole H is elongated to enable to select the screwing position on the ceiling surface 201. The hole H may have a slanted peripheral recess to receive therein a head of the screw or may be formed in widthwise different part of the main plate portion 322 unless the engagement with the linear cover member 340 is prevented. The main plate portion 322 of the linear base member 320 is covered from the downward by the
10 linear cover member 340 to be described later so that a surface thereof is hidden. Therefore, the heads of the screws mounted in the main plate portion 322 are hidden by the linear cover member 340.

The cover member 340 is, as shown in Figs. 22 and 23A-B, made of an elongated plastic member having a width W3, which is about the same as that of the main
15 plate portion 322 of the base member 320, and a length L3 which is substantially the same ($L3=L1$) as the length L1 of the base member 320. Herein, i.e., in the specification, unless mentioned otherwise, "up" and "down" is respectively referred to as being a side closer or approaching to and a side more remote or departing from the ceiling surface in a condition or state where the ceiling panel
20 structure 310 or element(s) thereof is mounted to the ceiling surface 201. As shown in Fig. 23B, the cover member 340 comprises a vertical inclined end wall portion 341 extending generally vertically while being slightly slanted to be situated widthwise outwards as approaching to the ceiling surface (upwards); a lower end guide portion 343 extending generally horizontally from a lower end
25 342 of the end wall portion or side wall portion 341, a short vertical wall portion 345 extending vertically from an inner end 344 of the lower end guide portion 343 substantially perpendicularly thereto, a deflection guide portion 347 extending from an upper end 346 of the vertical wall portion 345 to be downwardly convex and serving as the deflection induction portion, a downwardly and upstream
30 convex semi-cylindrical flow-resistant projection portion 349 extending upstream

from an upstream end 348 of the deflection induction portion 347 and integrally therewith to provide a resistance against flow of the conditioning air to decelerate it, a slightly upwardly convex upstream arcuate guide portion 351 extending upstream from an upstream end 350 of the flow-resistant projection portion 350 and being integral therewith, an upstream horizontal guide portion 353 extending substantially horizontally from an upstream end 352 of the upstream arcuate guide portion 351, and a hooked end portion 357 formed substantially continuously with an upstream (widthwise inner) end of the horizontal guide portion 353 and serving as the engaged portion to be engaged with the widthwise inner engaging recess 331 of the base member 320.

The hooked end portion 357 comprises an inclined wall portion 357b, a generally vertical inclined wall portion 357c and a generally horizontal and tapered small projection 357d having a wedge-like cross-sectional shape to be fitted in the widthwise inwardly opened engaging recess 331 of the engaging portion 330 of the base member 320. In other words, arcuately projecting wall portion 332 of the engaging projection 330 of the base member 320 fits in a recess 358 defined by wall portions 357a-357d of the hooked end portion. In an assembled state as shown in Fig. 19B, the hooked end portion 357 serves as a flow-resistant small projection 359 defined by the wall portions 357c and 357b. The cross-section of the surfaces of the wall portions 357c and 357b may be of any other shape such as a part of ellipse, so long as the small projection 359 acts as the flow-resistant projection serving as a flow-resistant against the flow of conditioning air to decelerate it. Similarly, although the typical example of the downward length or height of the small projection 359 is about 5 mm - about 1 cm, the height may be greater than about 1 cm or smaller than about 5 mm so long as the small projection 359 serves as the flow-resistant projection.

The cover member 340 has legs 355,356 for abutting against the lower principal face 329 of the main plate portion 322 of the base member 320, on the rear face or upper face 354 in Fig. 23B, at regions near the downstream end 350 of the upstream arcuate guide portion 351 and near the downstream end 352 of the

upstream horizontal guide portion 353. In the illustrated embodiment, the leg 355 comprises two leg parts 355a, 355b, and a recess between the legs 355, 356 receives the projection 338 of the base member 320. The leg 355 may be omitted.

- 5 The deflection induction portion 347 comprises an upstream part 347a extending generally vertically for providing a flow-resistance and changing significantly the direction of the airflow, and a downstream part 347b connected smoothly at an upper end 347c thereof with a lower end of the upstream part 347a and extending along directions approaching the horizontal direction for providing the
- 10 flow-resistance and changing the direction of the airflow to guide the airflow downwards and toward the center of the air-conditioning apparatus 200. The downstream part 347b is connected smoothly at the downstream end 346 thereof with the vertical wall portion 345. A vertical height from the end 350 of the guide portion 351 to the lower end of the horizontal wall portion 343 is, for
- 15 example, about 4-5 cm. However, the height may be much greater (e.g., 10 cm or greater) or much smaller (e.g., about 2-3 cm).

As seen from Figs. 22 and 23B, the linear cover member 340 comprises, at a widthwise outer region thereof, a portion 340u of a generally "U"-shaped cross-section. That is, the U-shaped portion 340u is constituted by the horizontal

- 20 guide portion 343 forming the bottom part of "U", downstream vertically inclined end wall portion 341 forming one of the two legs of "U", and the short vertical wall portion 345, deflection induction portion 347 and the semi-cylindrical flow-resistant projection portion 349 cooperatively forming as a whole another of the two legs of "U". The U-shaped configuration or structure having a cavity
- 25 340s between the two legs 341 and 345, 347, 349, i.e., leg 341 and leg 345, 347, 349, enables the distance of upper ends of the two legs to be increased/decreased within an elastic limit of the material therefor, and the distal end 341a of the outer leg 341 can be elastically or resiliently displaced with respect to the upper end of the inner leg 345, 347, 349 to be departed therefrom or to approach thereto in the
- 30 directions B1, B2.

The vertical inclined wall portion 341 at the widthwise outer end of the cover member 340 comprises, at the upper end (ceiling-side end) 341a thereof, a projection 361 projecting widthwise inward. The projection 361 serves as an engaged portion 363 to be engaged with the engaging recess 334 of the base member 320. Herein, a recess 362 defined by the projection 361 and wall portion 341 of the cover member 340 may be regarded as the engaged portion 363 to be engaged with the projection 337 of the base member 320 or both of the recess 362 and the projection 361 may be regarded as the engaged portion 363.

A lower face or inner face of the projection 361 is inclined to be situated lower as going widthwise inward in the embodiment illustrated in Fig. 23B. Instead, the projection 361 may have a lower face projecting widthwise inward generally horizontally and as shown in an enlarged form of the projection and denoted by reference characters 361a in Fig. 23C, or an upwardly inclined lower face (engaged face) extending to be higher (more upwards) as going widthwise inward, as shown by an imaginary line 361b in Fig 23C, so that the disengagement can be facilitated. In addition, the projection 361 may be shorter so long as the engagement of the cover member 340 can be ensured. Thus, the length may be, for example, as short as about 1 mm or shorter.

Upon the mounting, the horizontal wall portion 343 of the cover member 340 is pressed upward V2 in a state where the hooked engaged portion 357 situated at the widthwise inner side of the linear cover member 340 and having the wedge-shaped engaged projection 357d is engaged with the engaging recess 331 of the widthwise inner engaging portion 330 of the linear base member 320, and where the upper end 341a of the vertical inclined wall portion 341 situated at the widthwise outer side of the cover member 340, i.e., the upper face of the projection 361, abuts against the inclined face 337b of the inclined wall 337 of the engaging portion 335 of the base member 340 serving as the guide part, thereby deforming as a whole elastically or resiliently the U-shaped portion 340u constituted by the wall portions 341,343,345,347,349 so that the wall portion 341 can be moved or expanded in the direction B1 to displace or move the guide part

or slide-contact part 341a at the upper end of the widthwise outer and almost vertically inclined wall portion 341 of the cover member 340 in the direction F1 along the inclined face 337b of the inclined wall portion 337 of the engaging portion 335 of the base member 320. When the inwardly directed projection 361 is widthwise outward beyond the distal end 337a of the inclined wall portion 337, the projection 361 then abuts against the upper inclined wall 336 of the base member 320, whereupon the upwardly pressing force on the cover member 340 is weakened or removed to enable the wall portion 341 of the U-shaped portion 341u of the cover member 340 to restore to the original shape or widthwise original position due to the elasticity or resiliency of the wall portions 341,343,345,347,349 of the U-shaped portion. Therefore, the cover member 340 is engaged with the engaging portion 335 of the base member 320 in such a manner that the projection 361 of the engaged portion 363 thereof fits into the engaging recess 334 of the base member 320 and that the recess 362 fits around or receive therein the projection 337 of the base member 320. This engagement action or operation may be carried out all over the length of the linear base and cover members 320,340 substantially simultaneously or may be proceeded sequentially or gradually from one longitudinal ends thereof to the other longitudinal ends.

On the other hand, upon disengagement or removal, operations reverse to the mounting or engaging operations are carried out. That is, the wall portion 343 etc. are pressed upward in the direction V2 to deform elastically or resiliently as a whole in the B1 direction the U-shaped portion 340u constituted by the wall portions 341,343,345,347,349 so that the wall portion 341 of the U-shaped portion 341u of the cover member 340 is expanded or displaced in the direction B1, thereby releasing the engagement of the engaged portion 363 with the engaging portion 335, and then the wall portion 341 of the cover member 340 is pulled down in the direction V1. Thus, the engagement of the engaged portion 363 of the cover member 340 with the engaging portion 335 of the base member 320 is completely released. Then, the engagement of the engaged portion 357 of

the cover member 340 with the engaging portion 330 of the base member 320 is released.

In a case where relatively large force or pressure is required for expanding the U-shaped portion 340u of the linear cover member 340 in the direction B1, the wall portion 343 etc. are pressed upwards in the vicinity of one longitudinal end of the linear cover member 340 to expand the end 341a in the direction B1 or F1 along the inclined face 336b of the upper inclined wall portion 336 and, while keeping the expanded condition thereof, a distal end of an elongated rod-like part such as a screw driver or an other appropriate tool having a strip-like or thin and elongated plate part is inserted into a gap between the distal end 337a of the lower inclined wall portion 337 of the engaging portion 335 and thus expanded engaged projection 361 of the engaged portion 363 and is then moved along the longitudinal direction of the linear base and cover members 320,340 toward the other longitudinal ends thereof, so that the engagement between the engagement portions 335,363 can be completely released as if the portions 335,363 are peeled off from each other. When the projection 361 is configured as shown in Fig. 23C, the engagement can be released easily. The lower wall portion 337 of the engaging recess 334 of the engaging portion 335 of the base member 320 may have an inner face extending generally horizontally or slanted downwards widthwise outwardly as shown in Fig. 21C to facilitate the release of the engagement while ensuring secure engagement.

Further, as shown in an enlarged view in Fig. 21D, the base member 320 may have a step 336c at the inclined face 336b of the inclined wall portion 336 so that the distal end projection 361 of the wall portion 341 may be engaged once with the step 336c along the whole region in the longitudinal direction when the wall portion 341 of the U-shaped portion 340u of the cover member 340 is expanded in the direction F1 or B1, and so that the engaged portion 363 of the cover member 340 can be, thereafter, completely disengaged from the engaging portion 335 of the base member 320 by drawing or pulling down the end wall 341 of the cover member 340. In Fig. 21D, an imaginary line 337a denotes a widthwise position

of the distal end 337a of the short inclined wall portion 337 which will be situated outside of the lower end of a region shown in the enlarged view of Fig. 21D.

In each of the illustrated embodiments, the short and long inclined wall portions 337,336 of the base member 320 guide the engaged portion 363 of the cover member 340 upon the engagement, while the long inclined wall portion 336 of the
5 base member 320 guides the engaged portion 363 of the cover member 340 upon the release of the engagement, thereby enabling to engage/disengage of the cover member 340 with/from the base member 320 easier, even in a case where only one workman has to carry out the engagement/disengagement while keeping an
10 unnatural posture facing upward to the ceiling surface 201.

Thus, the downstream (widthwise outer) engaged portion 363 of the cover member 340 is engaged with the downstream (widthwise outer) engaging portion 335 of the base member 320 while the wedge-shaped engaged projection 357d of the upstream (widthwise inner) engaged portion 357 of the cover member 340 is
15 kept to be engaged with the engaging recess 331 of the upstream (widthwise inner) engaging portion 330 of the base member 320.

Now, the corner panel structure 312 of the ceiling panel structure 310 is to be described with reference to Figs. 24A-28C. As shown in these drawings, the corner panel structure 312 comprises a corner base member 370 (refer to Figs.
20 24A-27) of plastic material, and a corner cover member 390 (refer to Figs. 24A-B,25B and 28A-C) of plastic material coupled to the corner base member 370.

In the corner panel structure 312 shown in Figs. 24A-28C, the corner base member 370 are configured or adapted to be laid on the adjacent longitudinal ends
25 of the linear panel structures 311 to be engaged therewith (refer to Figs. 29-31A). The corner base member 370 itself has a surface configuration or contours providing flow-guide, flow-resistance and deflection (change of direction of flow) functions similar to the whole linear panel structure 311.

More specifically, the corner base member 370 of generally square shape in a plan view includes an upper surface 371 having two side edges 382a,382b extending at right angle relative to each other and being configured to be complementary in shape with that of the lower surface of the linear panel structure 311 (refer to Figs. 31A-B and 26A-C) so that the corner base member 370 can be put, from the lower side, on the longitudinal ends 311a,311a (refer to Figs. 19A,29 and 30) of the linear panel structure 311 to cover the longitudinal ends 311a,311a. As seen from Fig. 26A, a wall 372 of the corner base member 370 has typically substantially a uniform or constant thickness of, for example, about 2-3 mm except a part thereof. Therefore, a lower surface 373 of the wall 372 is configured generally similarly to the surface of the linear panel structure 311 and has substantially the same flow-guide, flow-resistance and deflection functions with respect to the conditioning airflow.

The corner base member 370 comprises a corner base body portion 380 and a corner base outer frame portion 384 integral with corner base body portion 380. The corner base body portion 380 comprises a plate-like member of typically generally uniform thickness and of square shape in a plan view, in which one corner part 381a of the square is curved in the form of circular arc.

The corner base body portion 380 is configured mirror-symmetrical about a virtual plane including a diagonal line D, passing through both of the arcuately curved corner 381a and an opposite corner 381b cut out in the form of small square, and extending in perpendicular to a plane (plane of Fig. 26B) of the body portion 380. Sides or edges 382a,382b including the corner 381b are superposed on the adjacent edges or ends 311a,311a of the adjacent linear panel structures 311, while sides or edges 382c,382d including the curved corner 381a are connected integrally with the corner base outer frame portion 384.

The corner base body portion 380 comprises a plate portion 374 having a plane surface part 374u superposed on the lower face 328 of the guide plate portion 326 of the linear base member 320 of the linear panel structure 311, a downwardly

convex upstream flow-resistant projection portion 375 having a concave surface part 375u complementary in shape with the surface of the flow-resistant projection portion 359 of the linear cover member 340 of the linear panel structure 311 to be exactly superposed thereon, an upstream arcuately curved guide portion 376 having an arcuate surface part 376u complementary in shape with the surfaces of the plate portion 353 and upstream arcuate guide portion 351 of the linear cover member 340 to be exactly superposed thereon, a downwardly convex flow-resistant projection portion 377 of circular arc cross-sectional shape having a concave surface part 377u complementary in shape with the surface of the flow-resistant projection portion 349 of the linear cover member 340 to be exactly superposed thereon, and an upstream deflection induction portion 378 serving as a part of the concave deflection induction portion having a convexly arcuate surface part 378u complementary in shape with the deflection induction portion 347 of the linear cover member 340 to be exactly superposed thereon. Each portion 375,376,377,378 has, in a plan view (strictly, bottom view) of Fig. 26B linearly extending parts 375a,376a,377a,378a and 375b,376b,377b,378b, and a circular arc part 375c,376c,377c,378c connecting the linearly extending parts smoothly with each other.

In addition, the corner base body portion 380 has legs 383 in the form of a rib extending from a rear face (upper face) thereof to support the plane of the body portion 380 in parallel with the ceiling surface 201. In an embodiment illustrated in Fig. 27, the legs 383 comprises three leg parts 383p,383q,383r. Each leg part 383p,383q,383r extends, in the plane of Fig. 27, in a pattern of "L", while leg parts 383p,383q are arcuately curved around regions crossing the virtual diagonal line D. Number of leg parts constituting legs 383 may be much more or much less than three, and may be intermittently distributed instead of being continuously extended.

A plate portion 374 providing most upstream guide face of the corner base member 380 is generally square, and has, at a side corresponding to the circular arcuate corner part 381a of the body portion 380, a similar circular arcuate corner

part 374r (of smaller radius) and a cut-out part 374c defined by cut-out lines 374a,374b at a corner corresponding to the cut-out corner 381b of the body portion 380. In addition, the plate portion 374 has a square leg part 383s protruding from the side of the upper face 374u at the cut-out part 374c. The square leg part 383s is connected integrally at two side edges thereof with the cut-out edges 374a,374b of the plate portion 374, and defines, cooperatively with the other leg parts 383p,383q,383r, a leg face or abutting plane of the corner base member 380 with respect to the ceiling surface 201.

Further, the plate portion 374 has, in the upper face 374u thereof, grooves 374g at regular intervals, serving as the weakened parts for facilitating cutting thereof for size-adjustment, similarly to the grooves 327 of the guide plate portion 326 of the linear base member 320 of the linear panel structure 311, and a rib-like projection 374p, on the lower face thereof 374d, similar to the projection 327d of the guide plate portion 326 of the linear base member 320.

The corner base member 370 includes a support wall 378s, extending continuously from the end of the upstream deflection induction portion 378 and having an extended end (lower end) 378t for supporting the corner cover member 390, at a region except for the regions near the edges 382a,382b superposed on the edge 311a of the linear panel structure 311. A cut-out portion 378f is defined by an end 378w of the support wall 378s and the lower end 378u of the upstream guide portion 378 of the deflection induction portion. The cut-out portion 378f allows the downstream part 347b of the deflection induction portion 347 and the vertical guide portion 345 of the linear panel structure 311 to be projected therethrough slightly downwardly at the ends 311a thereof (Fig. 31A), when the corner base member 370 is superposed on the linear panel structure 311.

The corner base outer frame portion 384 comprises, when view in a plane parallel with an extending plane of the corner base body portion 380 (e.g., Fig. 26B), an outer frame body portion 385 extending generally in the form of "L" along the two right-angled side edges 382c,382d, of the body portion 380, connected to

each other at the arcuate corner 381a. More specifically, the outer frame body portion 385 comprises a linear part 385b, 385a extending parallel with the sides 382a, 382b, and an arcuate part 385c between the two linear parts 385a, 385b. The parts 385a, 385b and 385c of the outer frame body portion 385 are integrally

5 connected at respective lower ends thereof with linear parts 378sa, 378sb and an arcuate part 378sc of the vertically extending wall 378s of the corner base body portion 380 through the corresponding linear parts 386a, 386b and arcuate part 386c of a horizontal connection portion 386. End faces 386at and 386bt (not shown) of the horizontal connection portion 386 is also cut out to be substantially

10 flush with the end face 378w. The outer frame body portion 385 is inclined to spread out slightly from the lower end thereof toward the upper end to be situated more remote from the air-conditioning apparatus 200 as approaching to the ceiling surface 201 similarly to the vertical inclined wall portion 341 of the linear cover member 340 of the linear panel structure 311, and has a wide leg part 387 at

15 the upper end thereof. The leg part 387 adapted to abut against the ceiling wall 201 at the upper end has also linear parts 387a, 387b and an arcuate part 387c therebetween to be configured, in its plan view, in the form of "L". Reference characters 384h, 384g, 384s denote respectively a screw hole for mounting the corner base member 370, a recess for allowing a tool such as a screw driver to be

20 inserted therein for mounting/removing the screw through the screw hole 384h, and a partially cylindrical wall part defining therein the recess 384g. It is preferred that each screw hole is configured in the form of elongated hole or elongated-circular hole 384hi as shown by an imaginary line for one of the holes in Figs. 26B and 27 to enhance a degree of freedom for selecting the mounting

25 position of the ceiling panel structure 310 on the ceiling surface 201 without considering positioning thereof relative to support frames at the back of, i.e. behind, the ceiling. Such being the case, associated screw-mounting tool insertion recess 384gi and recess-defining wall portion 384si are also shaped, as a matter of course, into an elongated-circular form as shown by the imaginary lines.

30 The leg part 387 of the corner base outer frame portion 384 extends to a region to

flush with the edges 382a,382b of the corner base body portion 380 so that free ends 387ae,387be of the linear parts 387a,387b defining both sides or legs of "L" are engaged respectively with adjacent edges 333 of the linear base members 320 of the linear panel structures 311. Meanwhile, as shown in Fig. 31B, the free
5 ends 387ae and 387be (not shown) of the leg part 387 may be cut to be flush approximately with the end face 386at and 386bt (not shown). In addition, the body portion 385 of the corner base outer frame 384 has thin walled protrusions 385at,385bt protruding from the free ends 385ae,385be of the linear part 385a,385b so that they may be slightly inserted into recesses between wall
10 portions 341,347 defining the two leg parts of the U-shaped portion 340u of the linear cover member 340 of the linear panel structure 311. However, there may be a possibility that the thin wall protrusions 385at,385bt may prevent or affect adversely the ease of mounting the corner base member 370 and, therefore, there are not a few configurational cases where the protrusions 385at,385bt should be
15 omitted. Thus, in a case where the protrusions 385at,385bt are formed, the lengths thereof should be minimized or the corner thereof should be preferably cut obliquely to enable the mounting/detaching of the corner base member 370 with ease, in comparison with the projections 385at,385bt exaggeratedly largely shown in the illustrated embodiment. In this connection, Fig. 31A shows an example in
20 which the thin wall protrusion 385at is formed while Fig. 31B shows an example in which the protrusion 385at is omitted. The corner base outer frame portion 384 further comprises, at an outer face of the body portion 385 thereof, an engaging recess 389 (Fig. 25A) with which the corner cover member 390 is engaged. In an embodiment illustrated in Fig. 26C, the engaged recesses 389a
25 and 389b (not shown) at both ends are configured in the form of recess in free ends of the outer frame body part 385, while each of intermediate cut-out 389c and 389d (not shown) is configured in the form of an aperture. However, for facilitating the mounting/detachment of the corner cover member 390, each cut-out part 389c,389d may be in the form of a shallow groove where one of the
30 two cut-out parts or grooves may be omitted. The arrangement thereof can be determined according to the number thereof. Further, each of the engaging

recesses 389a and 389b (not shown) at both ends may be configured in the form of an aperture enclosed completely by a circumferential wall thereof instead of the cut-out part opened at least one side thereof.

The corner cover member 390 comprises, as shown in Figs. 28A-B, 25A-B and 24A-B, a corner cover body portion 391 having as a whole generally L-shaped configuration and U-shaped cross-section, whereas one of two legs of "U" is much shorter than the other of the two legs. The body portion 391 comprises a generally L-shaped long outer wall portion 392, a generally L-shaped end wall portion 393 extending from one (lower) end of the outer wall portion 392 almost in perpendicular thereto (at a slightly obtuse angle), and a generally L-shaped short inner wall portion 394 extending from one (inner) end of the end wall portion 393 generally in perpendicular thereto. More specifically, as shown in Figs. 28A-B, the outer, end and inner wall portions 392, 393, 394 have respectively two linear wall parts 392a, 393a, 394a and 392b, 393b, 394b and circular arcuate wall parts 392c, 393c, 394c connecting the associated two linear wall parts 392a, 393a, 394a and 392b, 393b, 394b at regions therebetween. The outer wall portion 392 has, at an inner edge of the upper end thereof, an engaged projection portion 395 to be engaged with the cut-out portion 389 of the corner base member 370. In the illustrated embodiment, the projection portion 395 comprises the substantially the same shape of projections 395a, 395b protruding at an acute angle relative to the outer wall portion 392 and substantially the same shape of projections 395c, 395d protruding at approximately right angle relative thereto to be engaged respectively with the cut-out parts 389a, 389b (not shown), 389c and 389d. One of the projections 395c, 395d may be omitted for facilitating detachment of the corner cover member 390, if desired. In addition, the inner projections 395c, 395d may be configured in the form of an arcuate projection 395f projecting at an obtuse angle relative to the outer wall part 392 as shown in Fig. 28C to facilitate release of the engagement.

The corner cover body portion 391 has, on an inner face of the end face 393 thereof, a thin side wall 396 extending in the form of "L" and being spaced by a

generally constant distance from the inner wall portion 394. Reference characters 396r denotes a rib supporting the side wall 396. The side wall 396 terminates before reaching to regions where the corner cover body portion 391 covers the adjacent linear panel structures 311. The inner side wall 396 may be
 5 omitted. The end wall of the corner cover body portion 391 abuts against the lower end 378t of the extended wall part 378s of the corner base member 370 when the corner cover member 390 is put on the corner base member 370.

The L-shaped inner wall portion 394 of the corner cover body portion 391 comprises a band-like edge 394u bent outward (toward inside of "U") at upper
 10 parts of thereof. The band-like edge 394u faces through a narrow gap to the wall part 378s extended from the lower end of the arcuate deflection wall portion 378 of the corner base member 370, when the corner cover member 390 is put on the corner base member 370, and serves as a lower part of the deflection induction portion. The L-shaped band-like edge part 394u comprises, at both of the
 15 longitudinal ends thereof, protrusion walls 394ut,394ut. The protrusion walls 394ut,394ut of the inner wall portion 394 are engaged with the downstream part 347b of the deflection induction portion 347 of the adjacent ends 311a of the linear panel structures 311 exposed through the cut-out part 378f of the corner base member 370, when the corner cover member 390 is put on the corner base
 20 member 370 under a state where the corner base member 370 has been already put on the adjacent ends 311a of the linear panel structures 311. However, the protrusion wall 394ut may be omitted. The embodiment with the wall 394ut is shown in Fig. 31A, while the embodiment without the wall 394ut is shown in Fig. 31B.

25 The corner panel structure 312 is mounted in such a manner as to be laid on the adjacent linear panel structures 311,311 after the linear panel structures 311,311 of predetermined lengths and predetermined widths have been mounted at predetermined positions. More specifically, at first, the corner base member 370 is attached so that the edges thereof 382a,382b are superposed on the adjacent
 30 ends 311a,311a of the linear panel structures 311,311 extending perpendicularly to

each other. Thus superposed length of each of the edges 382a,382b of the corner base member 370 on each adjacent end 311a,311a of the linear panel structure 311,311 is selected not to be greater than a length or distance LE (Fig. 27) from each of the cut-out end 378w at the cut-out 378f and the end of the leg 383 to each
5 associated edge 382a,382b. In other words, what is required is to have at least minimum superposition that should not be greater than LE. The length LE corresponds to the maximum tolerance (strictly, a half thereof) for the length of the linear panel structure 311. When the corner base member 370 is superposed on the linear panel structure 311 from the lower side, the corner base member 370
10 contacts, at the wall portions 374,375,376,377,378 thereof against the respective complementary configured wall portions 326,357,353,349,347a of the linear panel structure 311 and at the leg 383 thereof against the ceiling surface 201, and is engaged at the leg 387 of the outer frame portion 384 thereof with the end 333 of the linear panel structure 311 (refer to Figs. 31A-B). In a case where the thin wall
15 protrusions 385at,385bt are provided, for example, the corner cover member 370 is inclined in such a manner that the diagonally outer corner 381a is closer to the ceiling surface 201 than the diagonally inner corner 381b, and the legs 387,387 of the outer frame portion 384 are engaged with the adjacent ends 311a,311a of the linear panel structures 311,311 while inserting the thin wall protrusions
20 385at,385bt from the diagonally outer side, and then the diagonally inner corner 381b is displaced closer to the ceiling surface 201 to complete the above-mentioned superposition. Then, as described above, the corner cover member 390 is superposed on the corner base member 370 so that the engaged projections 395 of the corner cover member 390 can be engaged with the
25 engaging recesses 389 of the corner base member 370.

Now, the mounting of the thus constructed ceiling panel structure 310 on the ceiling surface is to be described.

At first, it is looked over whether obstacle(s) is(are) present on the ceiling 201 around the air-conditioning apparatus 200. For example, suppose that an
30 obstacle 202a is present, at the position G of Fig. 2, as shown in Fig. 18A. The

width of the linear base member 320 is adjusted in the same manner as described with respect to the linear base member 20 if required. In this example, we assume, as shown in Figs. 18A-B, that the obstacle 202a is situated remote enough and, therefore, that the linear base member 320R is cut along the
5 widthwise outermost groove 327a (Fig. 20 etc.) to have the standard maximum width thereof or can be used or applied to without being cut. We further assume herein that there is not any other obstacle 202 on the ceiling surface 201 around the air-conditioning apparatus 200. If the other obstacle 202 is present, the width of the linear base member 320 of the linear panel structure 311 to be
10 mounted at the associated position is adjusted utilizing the grooves 327 depending on the position of the obstacle 202.

Then the lengths of the linear panel structure 311R,311L,311U and 311D are adjusted. More specifically, the linear panel structures 311R,311L,311U,311D are respectively cut to be equal to the lengths of the side edges, of the
15 air-conditioning apparatus 200, along which they are disposed. In a case where a part of the linear panel structure 331 (e.g., 311U or 311D) is inserted into between the ceiling surface 201 and the side wall or smoothly planed board of the air-conditioning apparatus 200, the corner panel structure 312 (e.g., 312RU or 312RD) is shifted in the vertical direction in Fig. 18A along the ceiling surface
20 201. Therefore, the length of the linear panel structure 311 (e.g., 311R) is appropriately adjusted according to the inserted length of the widthwise inner end of the adjacent linear panel structure 311 (e.g., 311U or 311D). Similarly, sizes of the other linear panel structures 311 and corner panel structures 312 are adjusted. In this example, however, we assume that all the linear and corner
25 panel structures 311,312 are of the standard width and that the widthwise inner end is not inserted into between the air-conditioning apparatus 200 and the ceiling surface 201, and therefore it is not necessary to cut any of them along the groove.

Then, four linear panel structures 311 are mounted at their predetermined positions according to the widths and lengths thereof on the ceiling 201 and then
30 the corner panel structures 312 are mounted at their predetermined corners to be

superposed on the edges or ends 311a of the linear panel structure 311. Upon the mounting of each linear panel structure 311, the associated linear base member 320 is provisionally fixed on the ceiling 201 by means of a few (e.g., about 2-3) screws through the elongated holes, and then the linear cover member 340 is
5 attached to the linear base member 320 so that a pair of the engaged portions thereof are engaged with a pair of the engaging portions of the linear base member 320 as described before. Further, the corner base member 370 of the corner panel structure 312 is put on the edges of the adjacent linear panel structures 311 among the four linear panel structures 311R,311L,311D,311U and
10 is provisionally fixed to the ceiling surface 201 by means of fixing means such as screws. Thus, four corner base members 370 are provisionally fixed and the overall or whole arrangement thus assembled is checked from the floor.

For example, in a case where the longitudinal position of the linear panel structure 311 is not appropriate, corner base members 312 put on the inappropriately
15 positioned linear panel structure 311 in question and provisionally fixed to the ceiling surface 201 is detached and then the linear cover member 340 of the linear panel structure 311 in question is disengaged from the linear base member 320 thereof, whereupon the U-shaped portion 340u of the linear cover member 340 is pressed toward the ceiling surface 201 to expand the leg portion 341 of the "U" to
20 displace the engaged projection 361 thereof along the inclined face 336b to be disengaged as described before. Meanwhile, because each of the linear cover and base members 340,320 is configured to be produced by extrusion molding, i.e., in the constant or uniform cross-sectional shape, the linear cover member 340 may be disengaged from the linear base member 320 by drawing or pushing the
25 member 340 in the longitudinal direction thereof relative to the member 320. Then, the screws are loosened to allow the linear base member 320 to be displaced or shifted to a new provisional fixing position, and thereafter the linear cover member 340 and corner base member 370 are superposed again to be provisionally fixed. If desired, in a condition where the corner base member 370
30 is disengaged or where some of the corner base members 370 are provisionally

fixed, the linear panel structure 311 as provisionally fixed by the screws through the elongated holes may be hit with a hammer or the like to adjust the longitudinal position of thereof. Thus, when the width, length and mounting position of each linear panel structure 311 are finally determined, the linear cover members 340
5 are disengaged again, and each linear base member 320 is fixed to the ceiling surface 201 at the predetermined number of positions by means of the screws or the like. Further, the linear cover members 340 are engaged with the associated linear base members 320 to be fixed thereto, thereby completing the mounting of the four linear panel structures 311. Then, the corner base members 370 having
10 been adjusted to predetermined sizes if necessary are superposed on the associated adjacent ends of the linear panel structures 311,311 and fixed to the ceiling surface 201. Finally, the corner cover members 390 are put on the four corner base members 370 to complete the corner panel structures 312, thereby completing the assembly of the ceiling panel structure 310. The ceiling panel
15 structure 310 thus mounted also looks as shown in Fig. 3 when viewed in an oblique view.

In the meantime, the ceiling surface 201 on which the ceiling panel structure 310 is to be mounted as described above is, however, not completely planar, i.e., not an ideal plane, but is more or less undulated or irregular in comparison with the
20 planar plane. In a case where the air-conditioning apparatus 200 is relatively large in size and has a length of, for example, about 2 meters, the undulation or irregularity of the ceiling surface 201 may become not negligible. In the ceiling panel structure 310 according to a preferred embodiment of said one aspect of the invention, however, because most of the parts of the linear base member 320 is
25 constituted by plate-like portions, also because the length or height of the projection or protrusion portions of the plate-like portions of the linear base member 320 in perpendicular thereto have relatively short while the width thereof is relatively narrow, and because the projection or protrusion portions extend over the whole length of the linear base member 320, the linear base member 320 can
30 be relatively flexible in the directions Q1,Q2 in Fig. 20. Therefore, even in a

case where the ceiling surface 201 is undulated in the longitudinal direction of the linear base member 320, the linear base member 320 can be mounted on the ceiling surface 201 while being deformed along or according to the undulation of the ceiling surface 201.

5 Then, when the linear cover member 340 is engaged with and fixed to the linear base member 320 having been undulated along the longitudinal direction thereof, the engaged projection 357d of the linear cover member 340 having the inwardly tapered wedge-like distal end is fitted by force into the inwardly widely opened engaging recess 331 of the linear base member 320 along the plane 328 of the
10 guide plate portion 326 thereof, whereupon fitting of the tapered engaged projection 357 into the widely opened engaging recess 331 is ensured even when the linear base member 320 is undulated to some extent, by pushing or drawing the engaged projection 357d along the plane of the guide plate portion 326 of the linear base member 320. Meanwhile, because both of the engaged projection
15 357d of the linear cover member 340 and the projecting wall part 332 of the engaging recess 331 of the linear base member 320 extend continuously along the longitudinal direction of the members 340,320, even assuming that there should be part(s) where the fitting or insertion cannot be easily performed, according to the progress of the engagement (i.e., increase in the insertion depth of the
20 projection into the associated recess) at regions continuously adjacent the not-easily-inserted part(s), the not-easily-inserted part(s) of the engaged portion 357 of the linear cover member 340 can be deformed to be undulated in the direction(s) Q1,Q2 gradually (refer to Fig. 22), thereby the fitting or inserting at the not-easily-inserted part(s) can be started to proceed. Herein, it should be
25 noted that the some extent of flexion or bending of the linear cover member 340 can be generated because the length of projection of the engaged portion 357 of the linear cover member 340 from the generally plate-like portions 353,351 thereof in a direction perpendicular thereto is relatively short, although the engaged portion 357 is in general not easily flexed or bent to be undulated in the
30 longitudinal direction in comparison with the simple plate. When the engaging

recess 331 is opened to be wider widthwise inwardly, the engaged projection 357d need not be wedge-like or not tapered. When the engaged projection 357d is tapered or of wedge-like shape, the engaging recess may be opened to have a constant width in the widthwise direction.

- 5 After completing the engagement of the engaged projection 357d with the engaging recess 331, the widthwise outer engaged projection 361 of the linear cover member 340 is engaged with the widthwise outer engaging recess 334 of the linear base member 320. As for this engagement, because there is actually an allowance or tolerance, in the vertical position of the projection 361 relative to
10 the engaged recess 334, by a height corresponding to the length of the upper inclined face 336b, some degree of undulation can be absorbed or compensated by variation in the vertical position of the projection 361. In addition, deviation of the widthwise position of the engaged projection 361 associated with the displacement or deviation in the vertical position can be absorbed or compensated
15 by flexure or bending of the U-shaped portion 340 of the linear cover member 340 in the direction B1 or B2.

Thus, even in the case where the ceiling surface 201 is undulated, the engagement of the linear cover member 340 with the linear base member 320 is ensured so that the linear cover and base members 340,320 can be assembled into the linear
20 panel structure 311. Meanwhile, undulation of the ceiling surface 201 can be substantially negligible within a narrow region defined by the sizes of the corner panel structure 312.

The function of the ceiling panel structure 310 upon operation of the air-conditioning apparatus 200 is illustrated in Fig. 32 which is substantially the
25 same as Fig. 13 for the ceiling panel structure 10 and, therefore detailed description is omitted to avoid repetition. The description of the function of the ceiling panel structure 10 can be applied to the description for the ceiling panel structure 310 of Fig. 32, only if elements of the ceiling panel structure 10 in Fig. 13 such as the guide plate portion 26, the flow-resistant projections 30,49, the

guide portion 51, the deflection guide wall portion 47 and the lower end 43 of the linear panel structure 11 as well as the corner panel structure 12 are substituted respectively by corresponding elements of the ceiling panel structure 310 such the guide plate portion 326, the flow-resistant projections 359,349, the guide portion
5 351, the deflection guide wall portion 347 and the lower end 343 of the linear panel structure 311 as well as the corner panel structure 312.

As described before, in a case where the air-outlet is provided, for example, along two parallel sides or only along one side of the quadrilateral air-conditioning apparatus as in the one-way or unidirectional flow type or two-way or
10 two-direction flow type of ceiling-mounted air-conditioning apparatus, the linear panel structure may be mounted only along the side(s) adjacent and opposed to the air-outlet(s), preferably over a range longer enough than that of the air-outlet(s).

In this connection, when the linear panel structure 311 is mounted without the corner panel structure(s) 312, an end cap 450 as shown in Figs. 33A-F is fitted on
15 and around either end of the linear panel structure 311. The end cap shown in Figs. 33A-F is configured to be fitted on one end (right end when viewed toward downstream of the airflow) of the linear panel structure 311 and the end cap for another (left) end thereof should be, as a matter of course, configured mirror
20 symmetrical with respect to the end cap 450 shown in Figs. 33A-F, the detailed description of which is omitted herein.

The end cap 450 comprises an end wall portion 470 and projecting portions, projecting from an inner face thereof, such as projecting wall portions and projection portions, and is configured to be fitted on and around the end portions
25 311a (Fig. 19A) of the linear panel structure 311. More specifically, lower wall portions 451,452,453,454 of the end cap 450 are configured substantially same respectively as the associated wall portions 374,375a,376a,377a of the corner base member 320 of the corner panel structure 312. Lower wall portions 455,456,457,458,459 have inner faces respectively configured to be

complementary with the outer faces of the associated wall portions 347,345,343,341,333 of the linear panel structure 311. Between the wall portions 458,459 is formed a concave wall portion 458a, an inwardly convex inner face of which contacts a concave face defined by an inclined face near the distal end 341 of the linear cover member 340 of the linear panel structure 311 and by the inclined face 336b of the linear base member 320 (refer for example to Fig. 19B as to the shape or configuration of the linear panel structure 311). Grooves 451g are formed, at regular intervals in an inner face of the wall portion 451, for allowing to adjust a widthwise length thereof according to the width-adjustment of the linear panel structure 311. An upper projections 460 are engaged with the recess 327c in the upper face of the linear panel structure 311. Each projection 460 has an width smaller than that of the recess 327c and is relatively long and is tapered toward the distal end, so that the end cap 450 can cover the end of the linear panel structure 311 even in a case where the end is cut along a direction which deviates to some extent from the direction perpendicular to the longitudinal direction. In addition, even in a case where lengths of the linear base member 320 and linear cover member 340 of the linear panel structure are different to some extent from each other, the difference can be covered by the wall portions 451-459 of the end cap 450. Although the end cap 450 has three upper projections 460 in the illustrated embodiment, the number thereof may be much greater or smaller. The end cap 450 further comprises, on the end wall 470, a cylindrical projection 461 to be fitted in a recess defined by the partially cylindrical wall portion 349 among recesses of the U-shaped portion 340u of the linear cover member 340 of the linear panel structure 311, a tubular projection 462 of a generally quadrilateral cross-section to be fitted in the lower recess defined by parts of the wall portions 345,343,341 near lower ends thereof, and a tubular projection 463 of a generally triangular cross-section to fit in a triangle space or cavity portion defined by the wall portion 336 and the main plate portion 322 of the linear base member 320.

The end cap 450 and another end cap of mirror symmetrical thereto are fitted on

and around the respective ends the linear panel structure 311, after the linear panel structure 311 has been mounted on the ceiling surface at the predetermined position and after the end caps have been adjusted in size to be adapted to the width of the linear panel structure 311, thereby completing to form the linear panel structure apparatus. The lower wall portion 451 of the end cap 450 is cut out at a distal end 451a thereof and, therefore, a narrow part of the end wall portion 470 situated more upstream than the distal end 451a can be inserted into between the ceiling surface 201 and the outer frame such as smoothly planed board of the air-conditioning apparatus 200. In a case where the projection 327e (imaginary line in Fig. 20) is formed on the surface 328 of the linear base member 320 of the linear panel structure 311, the cut-out end 451a abuts against the downstream face of the projection 327e. If desired for regulating or suppressing airflow flowing over the end cap 450 in the longitudinal direction of the linear panel structure 311, the wall portions 451-456 may be curved, similarly to the corner base member 370, to be situated more upstream as approaching closer to the end wall portion 470.

The description of the preferred embodiments heretofore have been made based on an assumption that the ceiling panel structure 310, i.e., structure 311 and/or 312, is mounted or installed on the ceiling surface 201 at the downstream of the air-outlet 211 of the ceiling mounted air-conditioning apparatus having the room air-inlet 210 at the central portion thereof and the conditioning air-outlet at the peripheral portion thereof. However, the features of the ceiling panel structure 310, i.e., structure 311 and/or 312, is also all effective, except for a part of the conditioning air is return to the air-inlet 210, even in a case where the structure is mounted or installed on or embedded in the ceiling surface 201 at the downstream of the conditioning air-outlet 211 of an conditioning air discharge or blowout apparatus having only the air-outlet 211, i.e., having no air-inlet at the ceiling surface 201, instead of the ceiling-mounted air-conditioning apparatus 200. Therefore, the ceiling panel structures, such as those illustrated in the drawings hereinbefore, according to the embodiments of the invention can be applied also

to the ceiling-mounted or embedded type of conditioning air discharge apparatus, such as the air-conditioning duct, having an air-outlet with an aperture at the ceiling surface, in which the whole region of the aperture serves as the air-outlet or air discharge aperture but not as the air-inlet, so as to minimize or eliminate the smudging or contamination of the ceiling surface 201 around the apparatus. A typical conditioning air discharge apparatus includes, for example, one having plural coaxial and circular or annular discharge apertures between adjacent hollow frust-conical discharge passage-defining walls known as "anemometer" as shown in Fig. 1G. For the apparatus having a circular outer circumference, a further guide plate may be added to cover a ceiling surface between the circular conditioning-air-discharge apparatus and the inner edge of the quadrilateral or square ceiling panel structure, if desired.



CLAIMS

1. A ceiling panel structure adapted to be mounted to a ceiling at a downstream of a conditioning air-outlet of a ceiling-mounted air-conditioning apparatus, having a room air-inlet at a central portion thereof and the air-outlet at
5 a peripheral portion thereof, said ceiling panel structure being adapted to be mounted to the ceiling at an outside of the air-conditioning apparatus, and comprising a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the outlet of the air-conditioning apparatus, back to the room air-inlet.
- 10 2. A ceiling panel structure according to claim 1, comprising:

at least one base member adapted to be mounted to a ceiling at the downstream of the air-conditioning apparatus and having an engaging portion at a side opposite to a side faced to the ceiling; and

at least one cover member engaged at an engaged portion thereof with the
15 engaging portion of said at least one base member to be fixed thereto, said at least one cover member having the deflection induction portion.
3. A ceiling panel structure according to claim 2, wherein

said at least one base member comprises a linear base member capable of being mounted at one principal face thereof to a surface of the ceiling to extend along at
20 least one linear side edge of the air-conditioning apparatus, the linear base member having an adjustable length and/or width, and

said at least one cover member comprises a linear cover member engaged with the linear base member and having an adjustable length.
4. A ceiling panel structure according to claim 3, wherein the linear base
25 member comprises,



a conditioning airflow guide surface at one widthwise end portion of a principal face opposite to said one principal face generally parallel to said one principal face, said one widthwise end portion being closer, than another widthwise end, to the side edge of the air-conditioning apparatus where the air-outlet is provided;
5 and

the engaging portion at a position more remote, than the guide surface, in the widthwise direction from the side edge of the air-conditioning apparatus, and
wherein

the linear cover member comprises the deflection induction portion for deflecting
10 a part of the conditioning air, flowing along the guide surface of the linear base member, back to the room air-inlet.

5. A ceiling panel structure according to claim 4, wherein the linear base member further comprises a flow-resistant projection portion, at a widthwise outer end of the guide surface, engaged with a widthwise inner end of the linear
15 cover member and serving as a resistance against the airflow for reducing a flow rate of the conditioning air having spread along the guide surface.

6. A ceiling panel structure according to claim 3, wherein the base member includes a corner base member capable of being mounted at one principal face thereof to the ceiling surface adjacent to a longitudinal end of the linear base
20 member at an outside of a corner portion of the air-conditioning apparatus, and wherein the cover member includes a corner cover member engaged with the corner base member adjacent to a longitudinal end of the linear cover member.

7. A ceiling panel structure according to claim 2, wherein the base member includes a corner base member capable of being mounted to a surface of the
25 ceiling at an outside of a corner portion of the air-conditioning apparatus, and

wherein the cover member includes a linear cover member engaged with the corner base member at either longitudinal end thereof and having an adjustable



length and width; and a corner cover member engaged with the corner base member adjacent to the longitudinal end of the linear cover member.

8. A ceiling panel structure according to claim 2, wherein the cover member comprises a flow-resistant projection portion, at an upstream of the deflection
5 induction portion, which serves as a resistance against the airflow for reducing a flow rate of the conditioning air flowing along the surface of the cover member.

9. A ceiling panel structure according to claim 2, wherein each of the base and cover members is made of plastic material.

10 A ceiling panel structure according to claim 2, wherein each of the base
10 and cover members are made of substantially opaque material.

11. A ceiling panel structure adapted to be mounted to a ceiling at a downstream of a conditioning air-outlet of a ceiling-mounted air-conditioning apparatus, having a room air-inlet at a central portion thereof and the air-outlet at a peripheral portion thereof, said ceiling panel structure comprising linear panel
15 structures and corner panel structures, wherein

each of the linear panel structures comprises

a base member capable of being mounted to a surface of the ceiling at one principal face thereof to extend along an associated linear side edge of the air-conditioning apparatus, a length and width of the base member in an extending
20 direction thereof being adjustable, the base member having an engaging portion at a principal face thereof opposite to said one principal face,

a cover member of an adjustable length and width adapted to be engaged with the engaging portion of the associated base member at an engaged portion thereof to be fixed thereto, the cover member having a deflection induction portion which is
25 substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the outlet of the air-conditioning apparatus, back to the room air-inlet, and



each of the corner panel structure is adapted to be positioned between adjacent ends of the associated linear panel structures to be engaged with the adjacent ends.

12. A ceiling panel structure adapted to be mounted to a ceiling at a downstream of a conditioning air-outlet of a ceiling-mounted air-conditioning apparatus, having a room air-inlet at a central portion thereof and the air-outlet at a peripheral portion thereof, the ceiling panel structure including a deflection induction portion which is substantially rigid against an airflow to deflect the conditioning air, having been blown out through the outlet of the air-conditioning apparatus, in a direction away from the ceiling, the ceiling panel structure comprising

a base structure adapted to be mounted to a ceiling at an outside of the air-conditioning apparatus and having an engaging portion at a side opposite to a side faced to the ceiling, the base structure including a linear base member adapted to be mounted to a surface of the ceiling at one principal face thereof to extend along a side edge of the air-conditioning apparatus; and

a cover structure engaged at an engaged portion thereof with the engaging portion of the base structure to be fixed thereto, the cover structure including a linear cover member adapted to be engaged with the linear base member and having the deflection induction portion;

wherein the engaging portion of the linear base member comprises a pair of engaging recesses spaced from each other in a widthwise direction thereof and opened at opposite sides to be faced away from each other, one of the recesses having side walls, one of the side walls situated closer to the surface of the ceiling than another of the side walls having an inclined face inclined to be closer to the surface of the ceiling as departing more remote from another of the recesses, and

wherein the engaged portion of the linear cover member comprises a pair of engaged projections, to be engaged with the pair of engaging recesses of the linear



base member, at regions spaced from each other in a widthwise direction of the linear cover member, the pair of the engaged projections being situated at sides faced to each other and being capable of being displaced resiliently toward/from each other, one of the projections having a guide part movable along the inclined
5 face of the side wall, closer to the surface of the ceiling, of said one recess.

13. A ceiling panel structure according to claim 12, wherein the linear cover member has a generally U-shaped cross-section, one engaged projection, of said one pair of the engaged projections, engaged with said one recess of the linear base member is formed at one of two legs of the "U", and the deflection induction
10 portion is formed at another of the two legs.

14. A ceiling panel structure according to claim 13, wherein said another side wall situated more remote from the ceiling surface than said one side wall having an inclined face, at a side opposite to a side faced to the ceiling surface, inclined to be closer to the ceiling surface as departing more remote from said another
15 recess.

15. A ceiling panel structure according to claim 12, wherein each of said one pair of recesses of the linear base member extend continuously along an extending direction thereof over a substantially whole length thereof.

16. A ceiling panel structure according to claim 12, wherein said one recess of
20 said one pair of recesses is more remote than said another recess from the air-outlet of the air-conditioning apparatus.

17. A ceiling panel structure according to claim 16, wherein the linear base member comprises a conditioning airflow guide face at a widthwise end portion, adjacent to the side edge of the air-conditioning apparatus where the air-outlet is provided, of a principal face opposite to said one principal face generally parallel
25 to said one principal face; and said another engaging portion at a position more remote in the widthwise direction than the guide face from the edge of the air-conditioning apparatus, and



wherein the linear cover member comprises said another engaged portion, engaged with said another engaging portion of the linear base member, at a widthwise inner end thereof, a part of said another engaged portion faced to the air-outlet of the air-conditioning apparatus serves as a flow-resistant projection
5 acting as a resistance against the airflow for reducing a flow rate of the conditioning airflow having flown along the guide face of the linear base member.

18. A ceiling panel structure according to claim 17, wherein the linear cover member comprises a plate portion, extending generally parallel with the ceiling surface, adjacent to said another engaged portion thereof.

10 19. A ceiling panel structure according to claim 12, wherein the linear base member and the linear cover member are configured to be formed by extrusion molding of plastic material.

20. A ceiling panel structure according to claim 12, wherein the linear base member of the linear panel structure has an adjustable length and/or width and the
15 linear cover member of the linear panel structure has an adjustable length.

21. A ceiling panel structure according to claim 12, wherein the base structure comprises a corner base member capable of being mounted to the ceiling surface at one principal face thereof adjacent to a longitudinal end of the linear base member to be positioned at an outside of a corner portion of the air-conditioning
20 apparatus, and wherein the cover structure comprises a corner cover member engaged with the corner base member adjacent to the longitudinal end of the linear cover member.

22. A ceiling panel structure according to claim 21, wherein the corner base member is adapted, for the engagement, to be positioned over associated ends of
25 the linear base and cover members.

23. A ceiling panel structure according to claim 21, wherein the corner cover member comprises a part of the deflection induction portion which is substantially



rigid against the airflow to deflect a part of the conditioning air, having been blown out through the air-outlet of the air-conditioning apparatus, in a direction away from the ceiling surface, and

5 wherein the corner cover member has a generally U-shaped cross-section, the corner cover member being engaged with an outwardly engaging portion of an outer side wall of the corner base member at an inwardly engaged portion of one of two leg parts of the "U", and contacting at an inner face of a bottom part of the "U" with an extending end of the deflection induction portion of the corner base member.

10 24. A ceiling panel structure according to claim 23, wherein the corner base member comprises a deflection induction portion serving as a flow-resistant projection acting as a resistance against the airflow for reducing a flow rate of the conditioning airflow having flown along the surface of the corner base member.

15 25. A ceiling panel structure according to claim 12, further comprising an end cap to fitted over at least one of longitudinal ends of linear base and cover structures in a state where the engaging portion of the linear base member and the engaged portion of the linear cover member are engaged with each other.

26. A ceiling panel structure according to claim 12, wherein the linear base member and the linear cover member are made of substantially opaque material.

20 27. A ceiling panel structure adapted to be mounted to a ceiling at a downstream of a conditioning air-outlet of a ceiling-mounted air-conditioning apparatus, having a room air-inlet at a central portion thereof and the air-outlet at a peripheral portion thereof, the ceiling panel structure including a deflection induction portion which is substantially rigid against an airflow to deflect the
25 conditioning air, having been blown out through the outlet of the air-conditioning apparatus, in a direction away from the ceiling, the ceiling panel structure comprising



linear panel structures; and

corner panel structures positioned between adjacent ends of the linear panel structures and engaged thereto,

each linear panel structure comprising

- 5 a base member capable of being mounted to a surface of the ceiling at one principal face thereof to extend along an associated linear side edge of the air-conditioning apparatus and having an adjustable length and width in the extending direction, the base member having an engaging portion at a principal face opposite to said one principal face, and
- 10 a cover member of an adjustable length and width adapted to be engaged with the engaging portion of the associated base member at an engaged portion thereof to be fixed thereto, the cover member having a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the air-outlet of the air-conditioning apparatus, in
- 15 a direction away from the ceiling,

wherein the engaging portion of the linear base member comprises a pair of engaging recesses spaced and faced away from each other in a widthwise direction of the linear base member, the pair of engaging recess portions extending in an extending direction of the linear base member, one of a pair of

- 20 engaging recesses having side walls, one of the side walls closer to a surface of the ceiling than another of the side walls having an inclined face inclined to be closer to the ceiling surface as departing more remote from another of the pair of recesses, and

wherein the engaged portion of the linear cover member comprising a pair of

- 25 engaged projections, engaged with the pair of engaging recesses of the linear base member, spaced from and faced to each other in a widthwise direction of the linear cover member, one of the projections having a guide part movable along



the inclined face of the side wall, closer to the ceiling surface, of said one recess.

28. A ceiling panel structure adapted to be mounted to a ceiling at a downstream of a periphery of a conditioning air-outlet of a ceiling-mounted conditioning-air-discharge apparatus, having the air-outlet at a surface of the ceiling, said ceiling panel structure comprising:

at least one base member adapted to be mounted to the ceiling at the downstream of the air-discharge apparatus and having an engaging portion at a side opposite to a side faced to the ceiling; and

at least one cover member engaged at an engaged portion thereof with the engaging portion of said at least one base member to be fixed thereto, said at least one cover member having a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the outlet of the air-discharge apparatus, in a direction away from the ceiling.

29. A ceiling panel structure adapted to be mounted to a ceiling at a downstream of a periphery of a conditioning air-outlet of a ceiling-mounted conditioning-air-discharge apparatus, having the air-outlet at a surface of the ceiling, said ceiling panel structure comprising linear panel structures and corner panel structures, wherein

each of the linear panel structures comprises

a base member capable of being mounted to a surface of the ceiling at one principal face thereof to extend along an associated linear side edge of the air-discharge apparatus, a length and width of the base member in an extending direction thereof being adjustable, the base member having an engaging portion at a principal face thereof opposite to said one principal face,

a cover member of an adjustable length and width adapted to be engaged with the engaging portion of the associated base member at an engaged portion thereof to



be fixed thereto, the cover member having a deflection induction portion which is substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the outlet of the air-discharge apparatus, in a direction away from the ceiling, and

- 5 each of the corner panel structure is adapted to be positioned between adjacent ends of the associated linear panel structures to be engaged with the adjacent ends.

30. A ceiling panel structure adapted to be mounted to a ceiling at a downstream of a periphery of a conditioning air-outlet of a ceiling-mounted
10 conditioning-air-discharge apparatus, having the air-outlet at a surface of the ceiling, the ceiling panel structure including a deflection induction portion which is substantially rigid against an airflow to deflect the conditioning air, having been blown out through the outlet of the conditioning-air-discharge apparatus, in a direction away from the ceiling, the ceiling panel structure comprising

- 15 a base structure adapted to be mounted to a ceiling at an outside of the air-discharge apparatus and having an engaging portion at a side opposite to a side faced to the ceiling, the base structure including a linear base member adapted to be mounted to a surface of the ceiling at one principal face thereof to extend along a side edge of the air-discharge apparatus; and

- 20 a cover structure engaged at an engaged portion thereof with the engaging portion of the base structure to be fixed thereto, the cover structure including a linear cover member adapted to be engaged with the linear base member and having the deflection induction portion;

- 25 wherein the engaging portion of the linear base member comprises a pair of engaging recesses spaced from each other in a widthwise direction thereof and opened at opposite sides to be faced away from each other, one of the recesses having side walls, one of the side walls situated closer to the surface of the ceiling than another of the side walls having an inclined face inclined to be closer to the



surface of the ceiling as departing more remote from another of the recesses, and

wherein the engaged portion of the linear cover member comprises a pair of engaged projections, to be engaged with the pair of engaging recesses of the linear base member, at regions spaced from each other in a widthwise direction of the linear cover member, the pair of the engaged projections being situated at sides
5 faced to each other and being capable of being displaced resiliently toward/from each other, one of the projections having a guide part movable along the inclined face of the side wall, closer to the surface of the ceiling, of said one recess.

31. A ceiling panel structure adapted to be mounted to a ceiling at a
10 downstream of a periphery of a conditioning air-outlet of a ceiling-mounted conditioning-air-discharge apparatus, having the air-outlet at a surface of the ceiling, the ceiling panel structure including a deflection induction portion which is substantially rigid against an airflow to deflect the conditioning air, having been blown out through the outlet of the conditioning air-discharge apparatus, in a
15 direction away from the ceiling, the ceiling panel structure comprising

linear panel structures; and

corner panel structures positioned between adjacent ends of the linear panel structures and engaged thereto,

each linear panel structure comprising

20 a base member capable of being mounted to a surface of the ceiling at one principal face thereof to extend along an associated linear side edge of the air-discharge apparatus and having an adjustable length and width in the extending direction, the base member having an engaging portion at a principal face opposite to said one principal face, and

25 a cover member of an adjustable length and width adapted to be engaged with the engaging portion of the associated base member at an engaged portion thereof to be fixed thereto, the cover member having a deflection induction portion which is



substantially rigid against an airflow to deflect a part of the conditioning air, having been blown out through the air-outlet of the air-conditioning apparatus, in a direction away from the ceiling,

5 wherein the engaging portion of the linear base member comprises a pair of engaging recesses spaced and faced away from each other in a widthwise direction of the linear base member, the pair of engaging recess portions extending in an extending direction of the linear base member, one of a pair of engaging recesses having side walls, one of the side walls closer to a surface of the ceiling than another of the side walls having an inclined face inclined to be
10 closer to the ceiling surface as departing more remote from another of the pair of recesses, and

wherein the engaged portion of the linear cover member comprising a pair of engaged projections, engaged with the pair of engaging recesses of the linear base member, spaced from and faced to each other in a widthwise direction of the
15 linear cover member, one of the projections having a guide part movable along the inclined face of the side wall, closer to the ceiling surface, of said one recess.