

СТАНОВИЩЕ

ОТНОСНО: проучване за новост на

“Терморегулиращи прозоречни пана за екраниране на външни електромагнитни полета” с вх.№ ПрИ-190/11.12.2019

Проучването е направено въз основа на представените патентни претенции, представеното описание и приложената към него фигура. Патентните претенции 1-7 се отнасят до терморегулиращи прозоречни пана за екраниране на външни електромагнитни полета.

Съгласно патентните претенции 1 - 7:

Терморегулиращите прозоречни пана за екраниране на външни електромагнитни полета съдържат електропроводими наномрежи, закрепени към прозорци. Наномрежите са прозрачни и се поддържат от галванично свързани с тях електропроводими рамки, монтирани към външната страна на прозорците. Двата диагонални края на мрежите са свързани през автоматизиран компютърен управляващ блок към електрически източник, при което сигнален вход на управляващия блок е свързан със сигнален извод на комбиниран датчик за температура и влажност на вътрешния въздух. Тази връзка може да бъде безжична. Рамките са лесно демонтируеми и са с магнитно прилепване към прозорците. Наномрежите са съставени от некородиращи метални и текстилни влакна. Електрическият източник е многократно зареждаем акумулатор от фотоволтаични панели. Активното електрическо съпротивление на наномрежите е от 25 до 35 пъти по-ниско от това на поддържащите ги електропроводими рамки. Наномрежите са с правоъгълна форма и са монтирани на правоъгълни поддържащи ги електропроводими рамки.

В резултат на извършеното проучване бяха намерени следните документи, които са отразени в доклада от проучването, отнасящи се до терморегулиращи прозоречни пана за екраниране на външни електромагнитни полета:

- В документ BG111816 А е разкрит многофункционален прозорец с допълнително пано, включващ прозоречна рамка, като от вътрешната страна на прозореца е подвижно монтирана рамка на допълнителното пано с входящи отвори за въздух и изходящи отвори за въздух, като в него е монтиран електронагревател и излъчвател на ултравиолетови лъчи, които се управляват от централен програмируем

Дирекция „Експертиза и закрила на изобретенията и промишлените дизайни“

блок за управление. В горната най-външна страна на прозоречната рамка е монтиран хоризонтален вал с подвижен сенник, върху който е фиксиран фотоволтаичен панел, електрически свързан, през контролер и електрически акумулатор, към вход на токоизточник за електрозахранване на електронагревателя и излъчвателя на ултравиолетови лъчи.

- В документ CN104951009 A е разкрит прозорец за електромагнитно екраниране на компютър. Той е оформен от композитни материали и съдържа сребърни нанопроводници, смесени с никел-борни частици силициев двуокис в акрилна среда.

- В документ KR20120086606 A е разкрит прозорец за екраниране на електромагнитни вълни и предотвратяване на кондензация на росата посредством въглероден нанотрубен филм. Прозорецът е съставен от две стъклени плочи, разположени на разстояние една от друга, като отстрани те са запечатани. Филмът, нанесен върху плочите предпазва от електромагнитните вълни и предотвратява конденса на росата чрез топлина, генерирана по време на процеса на екранирането.

- В документ CN204031723 U е разкрит прозорец, върху който е залепен прозрачен филм за екраниране на електромагнитни полета. Този филм е съставен от сребърни нанопроводници.

Анализът на обектите на проучването и извесните решения показва следното:

Новост

В нито един от намерените при проучването документи не са разкрити терморегулиращите прозоречни пана за екраниране на външни електромагнитни полета, които да включват всички признаци на обекта на проучването, разкрит в патентните претенции от 1 до 7.

Следователно, терморегулиращите прозоречни пана за екраниране на външни електромагнитни полета, обект на проучването, **отговарят на изискванията за новост, съгласно чл. 8 от Закона за патентите и регистрацията на полезните модели (ЗПРПМ).**

14.01.2020 г.

Държавен експерт:
(инж. С. Демирева)



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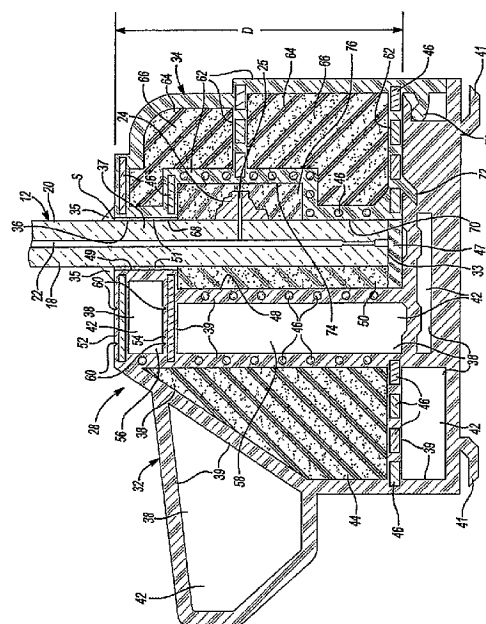
(54) 【発明の名称】 真空断熱ガラスユニット用の窓枠システム

【要約】 (修正有)

【課題】 改良された窓組立体を提供する。

【解決手段】 窓組立体は真空断熱ガラスユニット12及び枠組立体を含んでもよい。真空断熱ガラスユニットは、大気圧よりも低い圧力の、第1ガラス基板18と第2ガラス基板20との間の空間を定める第1ガラス基板18及び第2ガラス基板20を含んでもよい。前記第1ガラス基板18及び前記第2ガラス基板20のうちの一方は、この基板から外側に延びる真空口24を含んでもよい。真空口24は前記空間と連通する通路25を定めてもよい。枠組立体は、前記ガラスユニット12を支持し、基礎部材32とグレーシング部材34とを含んでもよい。基礎部材32及びグレーシング部材34は前記ガラスユニット12の端部が収容されたスロット36を定めるように協働する。グレーシング部材34は真空口24を収容する空洞を含んでもよい。基礎部材32及び前記グレーシング部材34は、複数のポケット38を定めてもよい。

【選択図】 図2



【特許請求の範囲】

【請求項 1】

窓組立体であって、

大気圧よりも低い圧力の、第 1 ガラス基板と第 2 ガラス基板との間の空間を定める第 1 ガラス基板及び第 2 ガラス基板を含む真空断熱ガラスユニットであって、前記第 1 ガラス基板及び前記第 2 ガラス基板のうちの一方は、この基板から外側に延びる真空口を含み、前記真空口は前記空間と連通する通路を定める、真空断熱ガラスユニットと、

前記ガラスユニットを支持し、基礎部材とグレーシング部材とを含む枠組立体と、を含み、前記基礎部材及びグレーシング部材は前記ガラスユニットの端部が収容されたスロットを定めるように協働し、前記基礎部材又は前記グレーシング部材のうちの 1 つは真空口を収容する空洞を含み、前記グレーシング部材及び前記基礎部材は前記枠組立体を通る熱伝導率を減少させる複数のポケットを定める、窓組立体。

【請求項 2】

前記グレーシング部材が、前記基礎部材とスナップ係合するタブを含む、請求項 1 に記載の窓組立体。

【請求項 3】

前記基礎部材が、組み込まれた補強部材を含む、請求項 1 に記載の窓組立体。

【請求項 4】

前記基礎部材が、前記ガラスユニットが歪んだ状態にあるときに、前記ガラスユニットの一部を収容する前記スロットに隣接する凹部を含む、請求項 1 に記載の窓組立体。

【請求項 5】

前記凹部が、前記ガラスユニットの歪みに伴うエネルギーを吸収するために、その内部に収容された断熱障壁を含む、請求項 4 に記載の窓組立体。

【請求項 6】

前記グレーシング部材が、構造的に前記ガラスユニットを支持する、請求項 1 に記載の窓組立体。

【請求項 7】

前記真空口を収容する空洞が、断熱材料で充填される、請求項 1 に記載の窓組立体。

【請求項 8】

前記ポケットの少なくとも 1 つが空気で充填される、請求項 1 に記載の窓組立体。

【請求項 9】

前記ポケットの少なくとも 1 つが発泡体で充填される、請求項 1 に記載の窓組立体。

【請求項 10】

前記基礎部材及び前記グレーシング部材の少なくとも 1 つが、その熱伝導率を減少させる組み込まれた添加剤を有するビニールを含む、請求項 1 に記載の窓組立体。

【請求項 11】

前記ガラスユニットの端部が、1.25 インチ以上のバイト深さまで前記スロットに挿入される、請求項 1 に記載の窓組立体。

【請求項 12】

前記グレーシング部材が、前記ガラスユニットの負荷の少なくとも一部を支える、請求項 1 に記載の窓組立体。

【請求項 13】

前記グレーシング部材及び前記基礎部材が、前記ガラスユニットの負荷を支えるように協働する、請求項 12 に記載の窓組立体。

【請求項 14】

窓組立体であって、

大気圧よりも低い圧力の、第 1 ガラス基板と第 2 ガラス基板との間の空間を定める第 1 ガラス基板及び第 2 ガラス基板を含む真空断熱ガラスユニットと、

前記ガラスユニットを支持し、基礎部材とグレーシング部材とを含む枠組立体と、を含み、

前記基礎部材及びグレーシング部材は前記ガラスユニットの端部が収容されたスロットを定めるように協働し、前記基礎部材又は前記グレーシング部材のうちの１つは前記ガラスユニットが歪んだ状態にあるときに、前記ガラスユニットの一部を収容する前記スロットに隣接する凹部を含む、窓組立体。

【請求項 15】

前記第 1 ガラス基板及び前記第 2 ガラス基板のうちの一方は、この基板から外側に延びる真空口を含み、前記真空口は前記空間と連通する通路を定め、前記基礎部材又は前記グレーシング部材の 1 つは、前記真空口を収容する空洞を含む、請求項 14 に記載の窓組立体。

【請求項 16】

前記真空口を収容する空洞が、断熱材料で充填される、請求項 15 に記載の窓組立体。

【請求項 17】

前記グレーシング部材及び前記基礎部材が、前記枠組立体を通る熱伝導率を減少させる複数のポケットを定める、請求項 14 に記載の窓組立体。

【請求項 18】

前記ポケットの少なくとも 1 つが空気で充填される、請求項 17 に記載の窓組立体。

【請求項 19】

前記ポケットの少なくとも 1 つが発泡体で充填される、請求項 17 に記載の窓組立体。

【請求項 20】

前記基礎部材及び前記グレーシング部材の少なくとも一方が、その熱伝導率を減少させる組み込まれた添加剤を有するビニールを含む、請求項 19 に記載の窓組立体。

【請求項 21】

前記グレーシング部材が、前記基礎部材とスナップ係合するタブを含む、請求項 14 に記載の窓組立体。

【請求項 22】

前記基礎部材が、組み込まれた補強部材を含む、請求項 14 に記載の窓組立体。

【請求項 23】

前記凹部が、前記ガラスユニットの歪みに伴うエネルギーを吸収するために、その内部に収容された断熱障壁を含む、請求項 14 に記載の窓組立体。

【請求項 24】

前記グレーシング部材が、構造的に前記ガラスユニットを支持する、請求項 14 に記載の窓組立体。

【請求項 25】

前記ガラスユニットの端部が、1.25 インチ以上のバイト深さまで前記スロットに挿入される、請求項 14 に記載の窓組立体。

【請求項 26】

前記グレーシング部材が、前記ガラスユニットの負荷の少なくとも一部を支える、請求項 14 に記載の窓組立体。

【請求項 27】

前記グレーシング部材及び前記基礎部材が、前記ガラスユニットの負荷を支えるように協働する、請求項 26 に記載の窓組立体。

【発明の詳細な説明】

【技術分野】

【0001】

本発明は、窓枠システムに関し、より詳細には、真空断熱ガラスユニット用の窓枠システムに関する。

【背景技術】

【0002】

本セクションは、本開示に関連する背景情報を提供し、必ずしも先行技術ではない。

【0003】

ガラス技術の進歩によって、例えば、建物又は住宅の窓の断熱値が増えている。このような進歩によってガラスユニットを通過する伝熱量が減少している。しかし、このような高性能ガラスユニットは、従来の窓枠及び／又はグレーシングの技術に新たな問題を生じさせる。窓組立体が全体として高水準の性能を発揮するためには、これらの高性能ガラスユニットが高性能窓枠システムに設置されることを必要とする。高性能ガラスユニットが高性能窓枠システムに設置されると、概して、窓組立体のR値（熱抵抗）が大幅に増加し、建物又は住宅のエネルギー効率が大幅に向上するという相乗効果が得られる。

【発明の概要】

【課題を解決するための手段】

【0004】

本セクションは、本開示の概要を提供するものであり、その全範囲又はその全ての特徴の包括的な開示ではない。

【0005】

窓組立体は、真空断熱ガラスユニットと枠組立体とを含んでもよい。真空断熱ガラスユニットは、大気圧よりも低い圧力の、第1ガラス基板と第2ガラス基板との間の空間を定める第1ガラス基板及び第2ガラス基板を含んでもよい。第1ガラス基板及び第2ガラス基板のうちの一方は、この基板から外側に延びる真空口を含んでもよい。真空口は空間と連通する通路を定めてもよい。枠組立体は、ガラスユニットを支持し、基礎部材とグレーシング部材とを含んでもよい。基礎部材及びグレーシング部材は、ガラスユニットの端部が収容されたスロットを定めるように協働する。基礎部材又はグレーシング部材のうちの1つは、真空口を収容する空洞を含んでもよい。グレーシング部材及び基礎部材は、枠組立体を通る熱伝導率を減少又は妨害する複数のポケットを定めてもよい。

【0006】

いくつかの実施形態では、グレーシング部材が、基礎部材とスナップ係合するタブを含む。

【0007】

いくつかの実施形態では、基礎部材が、組み込まれた補強部材を含む。

【0008】

いくつかの実施形態では、基礎部材及びグレーシング部材の少なくとも1つが、その熱伝導率を減少させる組み込まれた添加剤を含む。

【0009】

いくつかの実施形態では、基礎部材が、ガラスユニットが歪んだ状態にあるときに、ガラスユニットの一部を収容するスロットに隣接する凹部を含む。

【0010】

いくつかの実施形態では、凹部が、ガラスユニットの歪みに伴うエネルギーを吸収するために、その内部に収容された断熱障壁を含む。

【0011】

いくつかの実施形態では、グレーシング部材が、構造的にガラスユニットを支持する。

【0012】

いくつかの実施形態では、グレーシング部材が、ガラスユニットの負荷の少なくとも一部を支える。

【0013】

いくつかの実施形態では、グレーシング部材及び基礎部材が、ガラスユニットの負荷を支えるように協働する。

【0014】

いくつかの実施形態では、真空口を収容する空洞が断熱材料で充填される。

【0015】

いくつかの実施形態では、ポケットの少なくとも1つが空気で充填される。

【0016】

いくつかの実施形態では、ポケットの少なくとも1つが発泡体で充填される。

【 0 0 1 7 】

いくつかの実施形態では、ガラスユニットの端部が、少なくとも 1 . 2 5 インチのバイト深さ (b i t e d e p t h) までスロットに挿入される。

【 0 0 1 8 】

別の形態では、本開示は、真空断熱ガラスユニットと枠組立体とを含む窓組立体を提供する。ガラスユニットは、大気圧よりも低い圧力の、第 1 ガラス基板と第 2 ガラス基板との間の空間を定める第 1 ガラス基板及び第 2 ガラス基板を含んでもよい。枠組立体は、ガラスユニットを支持し、基礎部材とグレーシング部材とを含んでもよい。基礎部材及びグレーシング部材は、ガラスユニットの端部が収容されたスロットを定めるように協働してもよい。基礎部材又はグレーシング部材の 1 つは、ガラスユニットが歪んだ状態にあるときに、ガラスユニットの一部を収容するスロットに隣接する凹部を含んでもよい。

【 0 0 1 9 】

いくつかの実施形態では、第 1 ガラス基板及び第 2 ガラス基板のうちの一方が、この基板から外側に延びる真空口を含んでもよく、真空口は空間に連通する通路を定め、基礎部材又はグレーシング部材の 1 つが、真空口を収容する空洞を含む。

【 0 0 2 0 】

いくつかの実施形態では、真空口を収容する空洞が断熱材料で充填される。

【 0 0 2 1 】

いくつかの実施形態では、グレーシング部材及び基礎部材が、枠組立体を通る熱伝導率を減少させる複数のポケットを定める。

【 0 0 2 2 】

いくつかの実施形態では、ポケットの少なくとも 1 つが空気で充填される。

【 0 0 2 3 】

いくつかの実施形態では、ポケットの少なくとも 1 つが発泡体で充填される。

【 0 0 2 4 】

いくつかの実施形態では、グレーシング部材が、基礎部材とスナップ係合するタブを含む。

【 0 0 2 5 】

いくつかの実施形態では、基礎部材が、組み込まれた補強部材を含む。

【 0 0 2 6 】

いくつかの実施形態では、基礎部材及びグレーシング部材の少なくとも 1 つが、その熱伝導率を減少させる組み込まれた添加剤を含む。

【 0 0 2 7 】

いくつかの実施形態では、凹部が、ガラスユニットの歪みに伴うエネルギーを吸収するために、その内部に収容された断熱障壁を含む。

【 0 0 2 8 】

いくつかの実施形態では、グレーシング部材が、構造的にガラスユニットを支持する。

【 0 0 2 9 】

いくつかの実施形態では、ガラスユニットの端部が、1 . 2 5 インチ以上のバイト深さまでスロットに挿入される。

【 0 0 3 0 】

いくつかの実施形態では、グレーシング部材が、ガラスユニットの負荷の少なくとも一部を支える。

【 0 0 3 1 】

いくつかの実施形態では、グレーシング部材及び基礎部材が、ガラスユニットの負荷を支えるように協働する。

【 0 0 3 2 】

さらなる適用領域は、本明細書で提供される説明から明らかになるであろう。この要約における説明及び特定の実施例は、説明のみを目的としており、本開示の範囲を限定するものではない。

【図面の簡単な説明】

【0033】

本明細書に記載された図面は、選択された実施形態の説明のみを目的とし、すべての可能な実施形態ではなく、本開示の範囲を限定することを意図するものではない。

【0034】

【図1】本開示の原理による窓組立体の概略図である。

【図2】図1の窓組立体の窓枠システムに設置されたガラスユニットの断面図である。

【図3】歪んだ状態の図2のガラスユニット及び窓枠システムの断面図である。

【図4】本開示の原理によるガラスユニット及びカブラ（coupler）の斜視図である。

【図5】枠組立体に設置されたガラスユニット及びカブラの斜視図である。

【0035】

対応する参照番号は、図面のいくつかの図を通して対応する部分を示す。

【発明を実施するための形態】

【0036】

ここで、例示的な実施形態を添付の図面を参照してより完全に説明する。例示的な実施形態は、本開示が徹底したものであり、かつその範囲を当業者に十分に伝えるように提供される。本開示の実施形態の完全な理解を提供するために、特定の構成要素、装置、及び方法の例などの、多くの具体的な詳細が記載されている。特定の詳細を採用する必要はなく、例示的な実施形態は多くの異なる形態で実施してもよく、いずれも本開示の範囲を限定すると解釈すべきでないことが、当業者に明らかであろう。いくつかの例示的な実施形態では、周知の工程、周知の装置構造、及び周知の技術は詳細に記載されていない。

【0037】

本明細書で使用する用語は、特定の例示的な実施形態のみを説明するためのものであり、限定することを意図するものではない。本明細書で使用するように、単数形「a」、「an」及び「the」は、文脈で他に明記されない限り、複数形も含むことを意図することがある。「comprises」、「comprising」、「including」、及び「having」の用語は、包括的であり、従って、述べられている特徴、整数、ステップ、操作、要素及び／又は構成要素が存在することを明示するが、1つ以上の他の特徴、整数、ステップ、操作、要素、構成要素、及び／又はその群が存在すること又は追加されることを排除するものではない。本明細書に記載されたこのような方法ステップ、工程、及び操作が、実行の順序として具体的に明示されない限り、必ずしも説明又は図示された特定の順序で実行することを必要とすると解釈されるべきではない。追加又は代替のステップを用いてもよいことも理解すべきである。

【0038】

ある要素又は層が別の要素又は層の「上にある」か、又は別の要素又は層に「係合されている」か、「接続されている」か、又は「結合している」と言及する場合、ある要素又は層が、他の要素又は層の直上にあるか、或いは他の要素又は層に直接係合されているか、或いは直接接続されているか、或いは直接結合してもよいか、又は介在する要素又は層が存在してもよい。対照的に、ある要素が、他の要素又は層の「直上にある」か、又は他の要素又は層に「直接係合している」か、「直接接続されている」か、又は「直接結合している」と言及されている場合、介在する要素又は層が存在しなくてもよい。要素間の関係を説明するために使用される他の言葉は、同様の態様（例えば、「間」対「直接間」、「隣接」対「直接隣接」など）で解釈されるべきである。本明細書で使用されるように、用語「及び／又は」は、列挙された1つ以上の関連物品のありとあらゆる組み合わせを含む。

【0039】

様々な要素、構成要素、領域、層及び／又は区域を説明するために「第1」、「第2」、「第3」などの用語が本明細書で使われるが、これらの要素、構成要素、領域、層及び／又は区域は、このような用語によって制限すべきではない。これらの用語は、1つの

要素、構成要素、領域、層又は区域を、別の領域、層又は区域と区別するために使用されてもよい。「第 1」、「第 2」及び他の数値的な用語のような用語が、本明細書で 사용되는場合、文脈で他に明記されない限り、シークエンス又は順序を暗示するものではない。従って、以下に説明する第 1 の要素、構成要素、領域、層、又は区域が、例示的な実施形態の教示から逸脱することなく、第 2 の要素、構成要素、領域、層又は区域と呼ぶこともある。

【0040】

「内側」、「外側」、「下」、「下部」、「下側」、「上部」、「上側」などのような空間的に相対的な用語は、本明細書で、説明の便宜上用いられるものであって、図に示された、ある要素又は特徴の別の要素又は特徴への関係を記述する。空間的に相対的な用語は、図に描かれている方向に加えて、使用中又は操作中での装置の異なる方向を包含すると意図することがある。例えば、図中の装置がひっくり返されている場合、他の要素又は特徴の「下部」又は「下」にあると記載された要素は、他の要素又は特徴の「上」に向けられる。従って、「下」の例示的な用語は、上及び下の方向の両方を含むことができる。この装置は、それ以外の方向に向けられてもよく（90度回転されるか、又は他の方向に回転される）、本明細書で使用される空間的に相対的な記述子はそれに応じて解釈される。

【0041】

図 1～3 を参照すると、断熱ガラスユニット、特に真空断熱ガラス（VIG）ユニット 12 及び枠組立体 14 を含む例示的な窓組立体 10 が提供される。窓組立体 10 は、例えば、建物又は住宅の壁 16（図 1）に設置されることができる。図 2 に示すように、VIG ユニット 12 は、第 1 ガラス基板 18 と第 2 ガラス基板 20 との間に空間 22 を定めるように協働する第 1 ガラス基板 18 及び第 2 ガラス基板 20 を含んでもよい。空間 22 は、大気圧よりも低い圧力であってもよい。第 2 ガラス基板 20 は、内部基板（即ち、建物又は住宅の内部に露出されている基板）であり、空間 22 と連通する通路 25 を定める（図 2 及び図 3 に概略的に示されている）真空口又はチューブ 24 を含む。空間 22 内のガスは、VIG ユニット 12 を枠組立体 14 に設置する前又は後に、真空口 24 を通して排気することができる。

【0042】

図 1 に示すように、枠組立体 14 は、頭部 26、敷居部 28 及び一対の縦枠部 30 を含んでもよい。頭部 26、敷居部 28、及び縦枠部 30 は、VIG ユニット 12 を支持するように協働してもよい。頭部 26、敷居部 28 及び縦枠部 30 は、木材、ビニール（vinyl）、アルミニウム、又は望ましい熱伝導率を有する任意の適切な構造材料であってもよい。頭部 26、敷居部 28 及び縦枠部 30 は、熱伝導率を減少させる特定の添加剤を含んでもよい。例えば、材料としてビニールを選択する場合、材料は組み込まれた微小球を含むことができる。組み込まれた微小球は、例えば、膨張した微小球を含んでもよい。頭部 26、敷居部 28 及び縦枠部 30 は、一般的に、類似しても同一であってもよく、従って、敷居部 28 のみが以下に詳細に説明される。

【0043】

図 2 に示されているように、敷居部 28 は、基礎部材 32 及びグレージング部材 34 を含んでもよい。グレージング部材 34 は、VIG ユニット 12 の内側に配置されてもよく（即ち、グレージング部材 34 は、建物又は住宅の内側に配置されてよく）、グレージング部材 34 と基礎部材 32 と間に VIG ユニット 12 の端部 37 の一部又は全部を収容するスロット 36 を定めるように基礎部材 32 に係合してもよい。端部 37 は、VIG ユニット 12 の遠位端 33 から約 2.5 インチ延びたものとして定められる。いくつかの実施形態では、流体がスロット 36 に入ることを制限又は防止するために、VIG ユニット 12 と基礎部材 32 との間、及び／又は VIG ユニット 12 とグレージング部材 34 との間に、ガスケット 35 が設けられてもよい。

【0044】

いくつかの構成では、VIG ユニット 12 の端部 37 は、1.25 インチ以上のバイト

深さDまでスロット36の内部に延びてもよい。いくつかの変形例では、バイト深さDは、例えば、約0.75～5インチ又は約0.75～3インチとすることもある。VIGユニット12は、遠位端33における第1ガラス基板18と第2ガラス基板20との間の端封により、遠位端33においてより高い熱伝導率を有する傾向がある。従って、大きなバイト深さは、VIGユニット12の内側と外側との間で伝導するために熱エネルギー（加熱又は冷却）が移動しなければならない通路を長くして、それによって窓組立体10の熱性能が改善される。

【0045】

第1ガラス基板18及び第2ガラス基板20の表面温度は、ガラス基板18, 20の中心から端部37に達するまで、即ち、遠位端33から約2.5インチのところまで比較的一定のままであり、表面温度が、高性能VIGユニットに特有である急な温度勾配に沿って遠位端33に遷移する。第1ガラス基板18の表面温度は、第2ガラス基板20の表面温度に向かって遷移し、第2ガラス基板20の表面温度は、第1ガラス基板18の表面温度に向かって遷移する。大きなバイト深さは、建物又は住宅の内部の環境条件（例えば、相対湿度）に露出される第2ガラス基板20の表面温度に影響を与えることによって、第2ガラス基板20上に凝縮物が蓄積することを防止する。VIGユニット12が枠組立体14と合致するところが、視線Sを定める。バイト深さDは、凝縮を防止するために、視線Sにおける第2ガラス基板20の表面温度が、内部及び外部の環境条件の範囲全体にわたって目標温度を上回るように選択される。

【0046】

VIGユニット12の遠位端33は、スロット36の底部における1つ以上のグレージングブロック47の上に置かれている。グレージングブロック47は、ゴム又は同様の高分子材料を含んでもよく、窓組立体10の組み立て中にVIGユニット12を支持するために使用される。複数のグレージングブロック47がスロット36の底部に沿って離間していてもよい。グレージングブロック47は、スロット36に入る水分がスロット36の底部で滲出孔（図示せず）を通して排出されるように離間していてもよい。

【0047】

基礎部材32は、例えば、高分子材料又は複合材料から押出成形、引抜成形又は射出成形を実行してもよく、1つ以上のポケット38を形成するように協働する複数の支持部材又はリブ39を含んでもよい。ポケット38は、基礎部材32を通る熱伝導率を減少又は妨害するのに役立つことがある。基礎部材32の下端部は、建物又は住宅の壁16に係合する1つ以上のタブ41を含んでもよい。1つ以上のポケット38は、空気42及び／又は他のガスで充填されてもよく、1つ以上のポケット38は、枠組立体14の熱伝導率を減少させるために、断熱材料44で充填されてもよい。断熱材料44は、例えば、発泡体、ゴム、ガラス微小球、パーライト、エーロゲル、溶融シリカ、及び／又は不活性ガスが充填された発泡体を含むことができる。いくつかの変形例では、ポケット38のすべてが空気及び／又は他のガスで充填されるか、又はポケット38のすべてが断熱材料44で充填されてもよいことが分かる。そのような断熱ガス又は材料の任意の組合せが、同じ又は異なるポケット38に採用されてもよい。いくつかの実施形態では、1つ以上のリブ39は、たとえばVIGユニット12の歪みによって生じる力に対して枠組立体14を補強するために枠組立体14に追加の剛性及び強度を提供する補強部材46を含んでもよい。補強部材46は、任意の適切な材料から形成することができ、そして任意の適切な方法で枠組立体14に組み込むか、又は共押出されるか、又は共引き抜きされるか又は含まれることができる。補強部材46は、円形、長方形、又は正方形のような任意の適切な断面を有してもよい。さらに、各リブ39の内部に1つ以上の補強部材46が存在してもよい。基礎部材32の第1側面49は、第1ガラス基板18に接触してもよく、枠組立体14にVIGユニット12をしっかりと保持するためにグレージング部材34と協働する。いくつかの構成では、第1側面49と第1ガラス基板18との間に、両面接着グレージングテープ51又はシリコン或いはシリコン様製品が配置される。

【0048】

いくつかの実施形態では、基礎部材 3 2 は、スロット 3 6 に隣接する凹部 4 8 を含んでもよい。図 3 に示すように、凹部 4 8 は、V I G ユニット 1 2 を遠位端 3 3 に拘束するのではなく、V I G ユニット 1 2 の歪みに対応するように設計されている。V I G ユニット 1 2 が遠位端 3 3 に拘束されると、V I G ユニット 1 2 には追加のかなりの応力が導入されることがある。基礎部材 3 2 及びグレーシング部材 3 4 は、視線 S に隣接して V I G ユニット 1 2 を拘束し、それにより、V I G ユニット 1 2 への歪みを防止又は最小化するように設計してもよい。V I G ユニット 1 2 を視線 S に隣接して拘束すると、V I G ユニット 1 2 を遠位端 3 3 に拘束する場合に導入される応力よりも小さい応力が V I G ユニット 1 2 に導入される。さらに、グレーシング部材 3 4 は、V I G ユニット 1 2 の歪みに応答して建物又は住宅の内部に向かって屈曲するか又は旋回するように設計されてもよい。V I G ユニット 1 2 の主な歪み原因は、室外温度と室内温度との大きな温度差に露出された結果としての熱膨張及び熱収縮の差であり、そしてそれは、V I G ユニット 1 2 の堅い端封によって第 1 ガラス基板 1 8 及び第 2 ガラス基板 2 0 が同じ方向に共に歪ませる原因となる。このような第 1 基板 1 8 及び第 2 基板 2 0 の熱歪みは、従来の I G 又は他の窓ユニットでは発生しないが V I G ユニットでは発生する問題となる傾向がある。従って、V I G ユニット 1 2 の端部 3 7 が、凹部 4 8 の内部へと熱歪みを経験する能力は、V I G ユニット 1 2 又は枠組立体 1 4 の、長期間使用時に可能性のある機械的応力又は故障を防止する。V I G ユニット 1 2 の歪みは、風負荷などによっても生じる可能性がある。いくつかの実施形態では、凹部 4 8 の内部に断熱障壁 5 0 を位置させてもよい。V I G ユニット 1 2 及び／又は基礎部材 3 2 に断熱障壁 5 0 を接着剤で接合してもよい。例えば、断熱障壁 5 0 は、シリコン又はポリスチレンテープを含むこともある。いくつかの構成では、断熱障壁 5 0 は、約 5 ミリメートル以上の厚さとすることもある。断熱障壁 5 0 は、構造的に基礎部材 3 2 を V I G ユニット 1 2 に接着し、そして V I G ユニット 1 2 の歪みに伴うエネルギーを吸収して変位することがある。いくつかの実施形態では、凹部 4 8 が空いていることもある（例えば、断熱障壁 5 0 ではなく気体又は空気で充填される）ことが分かる。

【0049】

いくつかの実施形態では、基礎部材 3 2 の 1 つ以上のリブ 3 9 は、1 つ以上のポケット 3 8 が他のガラス基板又は第 2 V I G ユニットの収容するための別のスロットを定めるようにトリミングしても除去してもよい。例えば、図 2 に示す構成では、第 1 リブ 5 2 及び第 2 リブ 5 4 は、第 1 ポケット 5 6 及び第 2 ポケット 5 8 が、第 2 V I G ユニットの収容するためにスロットとして機能するようにトリミングしても除去してもよい。第 1 リブ 5 2 及び第 2 リブ 5 4 の一方又は両方は、第 1 リブ 5 2 及び第 2 リブ 5 4 を容易に切断又は破砕する 1 つ以上のノッチ 6 0 を含んでもよい。

【0050】

グレーシング部材 3 4 は、補強段階を含む高分子材料又は高分子複合材料を含んでもよい。グレーシング部材 3 4 は、例えば、高分子材料又は複合材料などの押出成形、引抜成形又は射出成形によって形成してもよく、そしてポケット 6 4 を形成するように協働する複数の支持部材又はリブ 6 2 を含んでもよい。枠組立体 1 4 の熱伝導率を減少させるために、1 つ以上のポケット 6 4 は、空気、他のガス及び／又は断熱材料 6 6 で充填してもよい。断熱材料 6 6 は、例えば、発泡体、ゴム、ガラス微小球、パーライト、エーロゲル、溶融シリカ及び／又は不活性ガスが充填された発泡体を含むことができる。いくつかの実施形態では、1 つ以上のリブ 6 2 が、枠組立体 1 4 にさらなる剛性及び強度を提供するために補強部材 4 6 を含んでもよい。グレーシング部材 3 4 の第 1 側面 6 8 及び第 2 側面 7 0 は、第 2 ガラス基板 2 0 と接触し、枠組立体 1 4 に V I G ユニット 1 2 をしっかりと保持するために基礎部材 3 2 と協働する。いくつかの構成では、両面接着グレーシングテープ 5 1 又はシリコン或いはシリコン様製品が、第 1 側面 6 8 及び／又は第 2 側面 7 0 と第 2 ガラス基板 2 0 との間に配置される。

【0051】

グレーシング部材 3 4 の下端部は、基礎部材 3 2 とスナップ係合する 1 つ以上の弾性可

撓性タブ 7 2 を含んでもよい。タブ 7 2 は、V I G ユニット 1 2 の歪みに対応するようにグレージング部材 3 4 を旋回しても、及び／又はグレージング部材 3 4 を除去してもよい。このようにして窓組立体 1 0 が建物又は住宅の壁 1 6 に設置された後であっても、必要に応じてグレージング部材 3 4 が繰り返して窓組立体 1 0 にスナップ係合されたり、外されたりしてもよい。

【0052】

グレージング部材 3 4 はまた、第 1 側面 6 8 と第 2 側面 7 0 との間に形成された凹部 7 4 を含んでもよい。凹部 7 4 は、V I G ユニット 1 2 の真空口 2 4 を収容し、真空口 2 4 の損傷を防ぐことがある。凹部 7 4 は、真空口 2 4 を損傷することなく、又はより重要なことに、V I G ユニット 1 2 の真空を失わせることなく、V I G ユニット 1 2 の歪みに対応するように設計されている。凹部 7 4 は、真空口 2 4 を取り囲む断熱材料 7 6 で充填してもよい。断熱材料 7 6 は、例えば、発泡体、ゴム、ガラス微小球、パーライト、エーロゲル、溶融シリカ、及び／又は不活性ガスが充填された発泡体を含むことができる。断熱材料 7 6 は、真空口 2 4 を損傷することなく、又はより重要なことに、V I G ユニット 1 2 の真空を失わせることなく、真空口 2 4 とグレージング部材 3 4 との間で相対運動を可能にするために十分な柔軟性を有してもよい。別の実施形態では、グレージング部材 3 4 の第 2 側面 7 0 は、第 2 ガラス基板 2 0 と接触しない。むしろ、凹部 7 4 が、第 1 側面 6 8 からスロット 3 6 の底部まで延びている。

【0053】

（米国南部などの）より暖かい気候では、（米国北部などの）より寒い気候で経験する方向とは反対の方向に V I G ユニット 1 2 の歪みに対応するために、グレージング部材 3 4 が V I G ユニット 1 2 の外側に配置されてもよい（即ち、グレージング部材 3 4 が建物又は住宅の外側に配置されてもよい）と予想される。

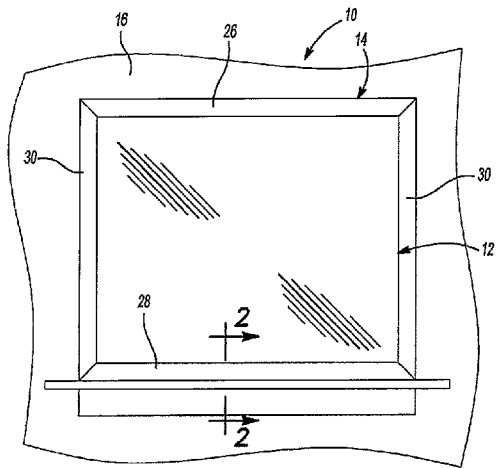
【0054】

図 4 及び図 5 を参照すると、V I G ユニット 1 2 を標準的な窓枠組立体 8 2 に適合させるために使用してもよいカブラ 8 0 が設けられている。カブラ 8 0 は、V I G ユニット 1 2 の歪みに対応するために、凹部 4 8 及び凹部 7 4 のような枠組立体 1 4 と類似又は同一の特徴を含んでもよい。カブラ 8 0 は、枠組立体 1 4 と同様に、第 1 基板 1 8 と第 2 基板 2 0 との間の熱伝達を妨害し、そして第 2 基板 2 0 上の凝縮物の蓄積を防止するために、大きなバイト深さを提供する。図 5 に示すように、カブラ 8 0 は、枠組立体 8 2 の内部に収容されても、他に枠組立体 8 2 に付着されてもよい。カブラ 8 0 の壁は、枠組立体 1 4 と同様に、上述の補強部材 4 6 のような補強部材を含んでもよい。断熱ガス又は断熱材料は、カブラ 8 0 のリブ 8 6 の間の 1 つ以上の空洞 8 4 を充填してもよい。

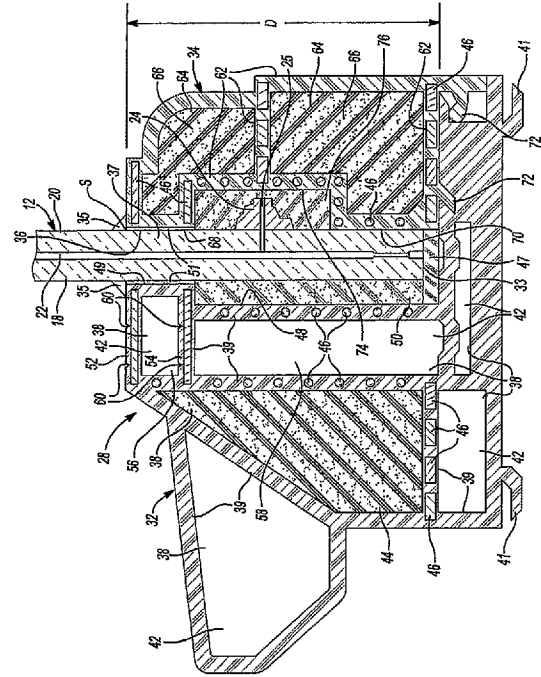
【0055】

実施形態の前述の説明は、例示及び説明のために提供されたものである。本開示を限定すること又は網羅的であることを意図するものではない。特定の実施形態の個々の要素又は特徴は一般にその特定の実施形態に限定されないが、適用可能であれば、交換可能であり、特に示されなくても記載されていなくても、選択された実施形態で 사용할ことができる。同じことは、多くの点で変化し得る。そのような変形は、本開示からの逸脱とみなされるべきではなく、そのような変更のすべては、本開示の範囲内に含まれることが意図される。

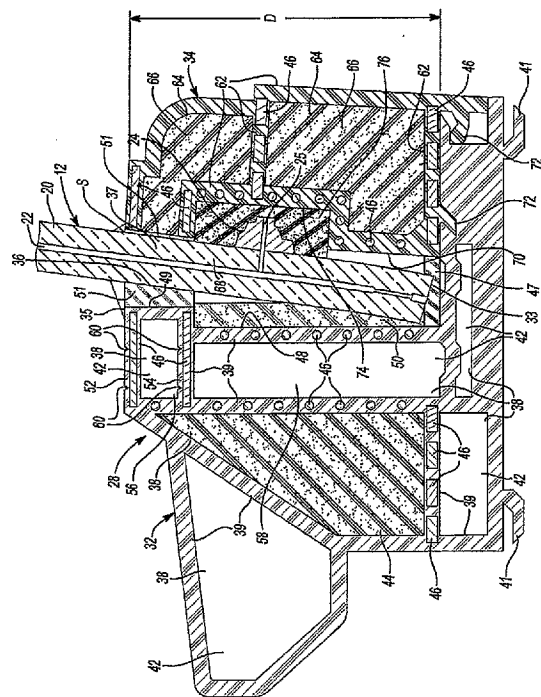
【 図 1 】



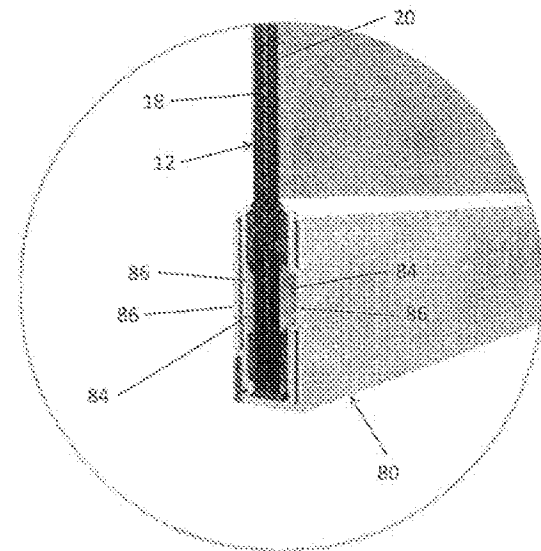
【 図 2 】



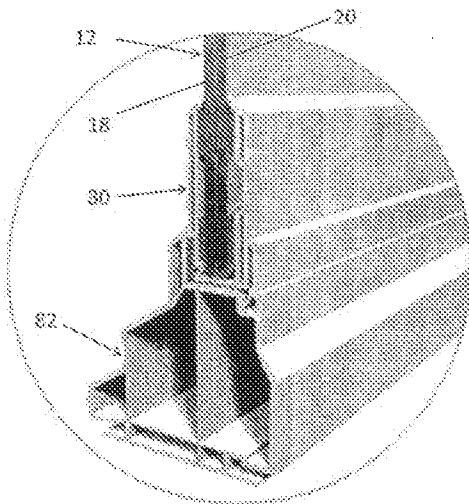
【 図 3 】



【 図 4 】



【図 5】



【手続補正書】

【提出日】 令和 年 月 日

【手続補正 1】

【補正対象書類名】 特許請求の範囲

【補正対象項目名】 全文

【補正方法】 変更

【補正の内容】

【特許請求の範囲】

【請求項 1】

窓組立体であって、

大気圧よりも低い圧力の、第 1 ガラス基板と第 2 ガラス基板との間の空間を定める第 1 ガラス基板及び第 2 ガラス基板を含む真空断熱ガラスユニットであって、前記第 1 ガラス基板及び前記第 2 ガラス基板のうちの一方は、この基板から外側に延びる真空口を含み、前記真空口は前記空間と連通する通路を定める、真空断熱ガラスユニットと、

前記真空断熱ガラスユニットを支持し、基礎部材とグレーシング部材とを含む枠組立体と、を含み、前記基礎部材及びグレーシング部材は前記真空断熱ガラスユニットの端部が収容されたスロットを定めるように協働し、前記基礎部材又は前記グレーシング部材のうちの 1 つは真空口を収容する空洞を含む、窓組立体。

【請求項 2】

窓組立体であって、

大気圧よりも低い圧力の、第 1 ガラス基板と第 2 ガラス基板との間の空間を定める第 1 ガラス基板及び第 2 ガラス基板を含む真空断熱ガラスユニットであって、前記第 1 ガラス基板及び前記第 2 ガラス基板のうちの一方は、この基板から外側に延びる真空口を含み、前記真空口は前記空間と連通する通路を定める、真空断熱ガラスユニットと、

前記真空断熱ガラスユニットを支持し、基礎部材とグレーシング部材とを含む枠組立体

と、を含み、前記基礎部材及びグレージング部材は前記真空断熱ガラスユニットのうちの第1真空断熱ガラスユニットの端部が収容された第1スロットを定めるように協働し、前記基礎部材又は前記グレージング部材のうちの1つは、前記第1真空断熱ガラスユニットの真空口を収容する空洞を含み、前記基礎部材は、前記真空断熱ガラスユニットのうちの第2真空断熱ガラスユニットの端部を収容する第2スロットを定める、窓組立体。

【請求項3】

窓組立体であって、

大気圧よりも低い圧力の、第1ガラス基板と第2ガラス基板との間の空間を定める第1ガラス基板及び第2ガラス基板を含む真空断熱ガラスユニットであって、前記第1ガラス基板及び前記第2ガラス基板のうちの一方は、この基板から外側に延びる真空口を含み、前記真空口は前記空間と連通する通路を定める、真空断熱ガラスユニットと、

第3ガラス基板と

前記真空断熱ガラスユニットと前記第3ガラス基板を支持し、基礎部材とグレージング部材とを含む枠組立体と、を含み、前記基礎部材及びグレージング部材は前記真空断熱ガラスユニットの端部が収容された第1スロットを定めるように協働し、前記基礎部材又は前記グレージング部材のうちの1つは真空口を収容する空洞を含み、前記基礎部材は、前記第3ガラス基板の端部を収容する第2スロットを定める窓組立体。

【請求項4】

前記基礎部材又は前記グレージング部材のうちの1つは前記真空断熱ガラスユニットが歪んだ状態にあるときに、前記真空断熱ガラスユニットの一部を収容する前記スロットに隣接する凹部を含む、請求項1乃至3のいずれかに記載の窓組立体。

【請求項5】

前記真空口を収容する空洞が、断熱材料で充填される、請求項1乃至4のいずれかに記載の窓組立体。

【請求項6】

前記グレージング部材及び前記基礎部材が、前記枠組立体を通る熱伝導率を減少させる複数のポケットを定める、請求項1乃至5のいずれかに記載の窓組立体。

【請求項7】

前記ポケットの少なくとも1つが空気で充填される、請求項6に記載の窓組立体。

【請求項8】

前記ポケットの少なくとも1つが発泡体で充填される、請求項6に記載の窓組立体。

【請求項9】

前記基礎部材及び前記グレージング部材の少なくとも一方が、その熱伝導率を減少させる組み込まれた添加剤を有するビニールを含む、請求項8に記載の窓組立体。

【請求項10】

前記グレージング部材が、前記基礎部材とスナップ係合するタブを含む、請求項4に記載の窓組立体。

【請求項11】

前記基礎部材が、組み込まれた補強部材を含む、請求項4に記載の窓組立体。

【請求項12】

前記凹部が、前記真空断熱ガラスユニットの歪みに伴うエネルギーを吸収するために、その内部に収容された断熱障壁を含む、請求項4に記載の窓組立体。

【請求項13】

前記グレージング部材が、構造的に前記真空断熱ガラスユニットを支持する、請求項4に記載の窓組立体。

【請求項14】

前記ガラスユニットの端部が、1.25インチ以上のバイト深さまで前記スロットに挿入される、請求項4に記載の窓組立体。

【請求項15】

前記グレージング部材が、前記ガラスユニットの負荷の少なくとも一部を支える、請求

項 4 に記載の窓組立体。

【請求項 1 6】

前記グレーシング部材及び前記基礎部材が、前記ガラスユニットの負荷を支えるように協働する、請求項 1 5 に記載の窓組立体。

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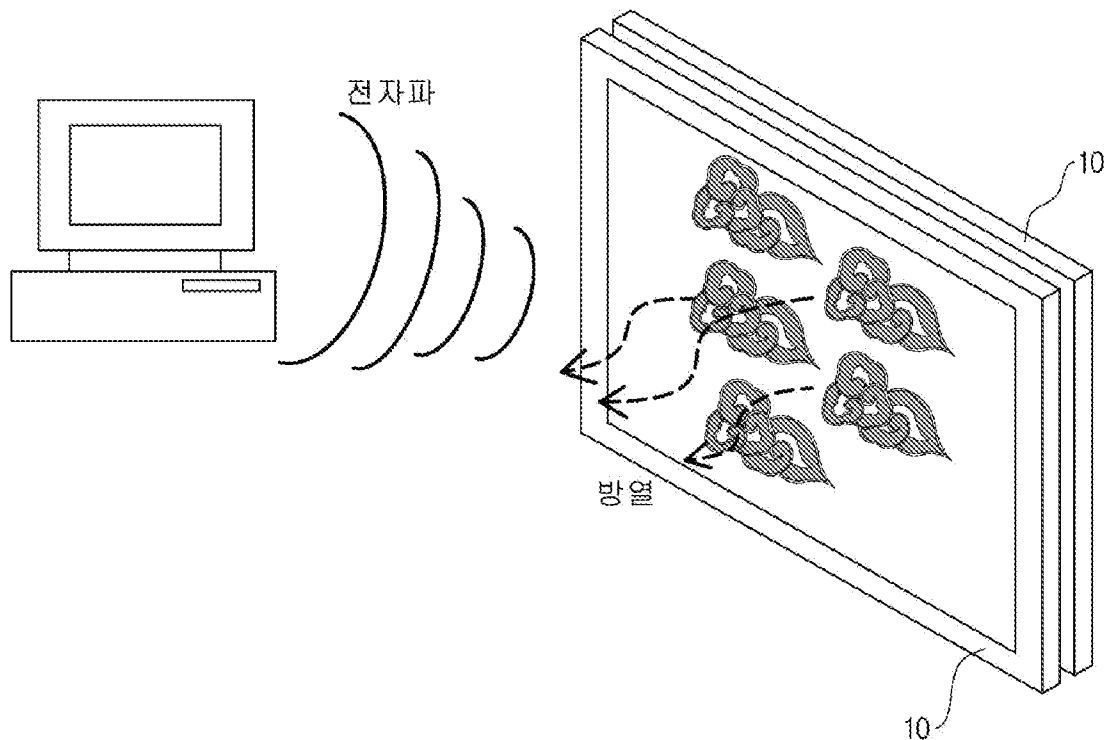
(54) 발명의 명칭 탄소나노튜브 필름을 이용한 전자파 차폐 및 결로방지 기능의 창호

(57) 요약

본 발명은 탄소나노튜브(Carbon Nanotube/ 이하, "CNT"라고 약칭함)를 포함하는 필름을 이용하여 원하는 형태의 문양을 만들어서 이중 창호를 이루는 유리판 내면에 부착함으로써, 전자파의 차폐와, 발열에 의한 결로 방지 기능을 발휘할 수 있도록 구성된 창호에 관한 것이다.

본 발명에서는, 2개의 유리판(10)이 간격재(11)를 사이에 두고 나란하게 배치되고 유리판(10) 사이가 밀봉되어 있는 구조의 복층 유리 창호로서, CNT 분말이 수지에 혼합되고 분산되어 박막형태로 만들어진 CNT 전자파 차폐 필름이, 상기 유리판(10)의 내면에 부착되어 있어, 상기 CNT 전자파 차폐 필름에 의해 전자파의 차폐가 이루어짐과 동시에 CNT 전자파 차폐 필름의 전자파 차폐과정에서의 발열에 의해 유리판(10) 내면을 결로를 방지하게 되는 구조를 가지는 것을 특징으로 하는 탄소나노튜브 필름을 이용한 전자파 차폐 및 결로방지 기능의 복층 유리 창호가 제공된다.

도 1



이 발명을 지원한 국가연구개발사업

과제고유번호 KI001865

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특허청구의 범위

청구항 1

2개의 유리판(10)이 간격재(11)를 사이에 두고 나란하게 배치되고 유리판(10) 사이가 밀봉되어 있는 구조의 복층 유리 창호에서,

CNT 분말이 수지에 혼합되고 분산되어 박막형태로 만들어진 CNT 전자파 차폐 필름이, 상기 유리판(10)의 내면에 부착되어 있어, 상기 CNT 전자파 차폐 필름에 의해 전자파의 차폐가 이루어짐과 동시에 CNT 전자파 차폐 필름의 전자파 차폐과정에서의 발열에 의해 유리판(10) 내면을 결로를 방지하게 되는 구조를 가지는 것을 특징으로 하는 탄소나노튜브 필름을 이용한 전자파 차폐 및 결로방지 기능의 복층 유리 창호.

명세서

기술분야

[0001] 본 발명은 탄소나노튜브 필름을 이용한 전자파 차폐/결로방지 기능의 창호에 관한 것으로서, 구체적으로는 탄소나노튜브(Carbon Nanotube/ 이하, "CNT"라고 약칭함)를 포함하는 필름을 이용하여 원하는 형태의 문양을 만들어서 이중 창호를 이루는 유리판 내면에 부착함으로써, 전자파의 차폐와, 발열에 의한 결로 방지 기능을 발휘할 수 있도록 구성한 창호에 관한 것이다.

배경기술

[0002] 종래의 복층 유리 창호는 도 1에 도시된 것처럼, 2개의 유리판(10)을 간격을 두고 나란하게 배치한 상태로 창호 프레임(미도시)으로 유리판(10)의 가장자리를 결합한 구조를 가지고 있다. 도 1에서 부재번호 11은 유리판(10) 사이의 간격을 유지하고 밀봉하는 간격재(11)이다.

[0003] 이러한 종래의 복층 유리 창호의 경우, 단일에는 어느 정도 효율을 발휘하고 있으나, 전자파 차폐 기능은 거의 없으며, 창호 프레임의 결합 방식에 따라서는 창호의 내부, 즉 유리판(10)이 서로 마주하고 있는 내면에 결로가 발생하는 문제점이 있다.

발명의 내용

해결하려는 과제

[0004] 본 발명은 위와 같은 종래 기술의 문제점을 해결하기 위하여 개발된 것으로서, 구체적으로는 복층 유리를 구비한 창호에 있어서, 전자파 차폐를 효율적으로 차폐할 수 있도록 함과 동시에 창호의 내부에 결로가 발생하는 것을 방지할 수 있도록 하는 것을 목적으로 한다.

과제의 해결 수단

[0005] 위와 같은 과제를 달성하기 위하여 본 발명에서는, 2개의 유리판이 간격재를 사이에 두고 나란하게 배치되고 유리판 사이가 밀봉되어 있는 구조의 복층 유리 창호에서, CNT 분말이 수지에 혼합되고 분산되어 박막형태로 만들어진 CNT 전자파 차폐 필름이, 상기 유리판의 내면에 부착되어 있어, 상기 CNT 전자파 차폐 필름에 의해 전자파의 차폐가 이루어짐과 동시에 CNT 전자파 차폐 필름의 전자파 차폐과정에서의 발열에 의해 유리판 내면을 결로를 방지하게 되는 구조를 가지는 것을 특징으로 하는 탄소나노튜브 필름을 이용한 전자파 차폐 및 결로방지 기능의 복층 유리 창호가 제공된다.

발명의 효과

- [0006] 본 발명에 의하면, 유리판의 내면에 CNT 전자파 차폐 필름을 부착하여 복층 유리 창호를 구축하게 되므로, 유리판에 부착된 CNT 전자파 차폐 필름에 포함된 CNT에 의하여, 전자파가 유리판을 투과하는 것을 방지하여 전자파 차폐 성능이 현저하게 향상되는 효과가 발휘된다.
- [0007] 또한, 본 발명에서는 CNT 전자파 차폐 필름이 전자파를 차폐하는 과정에서 발열이 일어나게 되어, 유리판 내면에 결로현상이 발생하는 것을 방지하는 효과가 발휘된다.
- [0008] 특히, 본 발명에서는 CNT 전자파 차폐 필름을 패턴재 형태로 사용할 수 있으므로, 원하는 문양이나 무늬, 문자 등의 다양한 형태로 활용할 수 있으며, 그에 따라 창호의 심미감을 더욱 향상시킬 수 있고, 창호의 양호한 시야 확보도 이룰 수 있다는 장점이 있다.

도면의 간단한 설명

- [0009] 도 1은 종래의 복층 유리 창호에서 2개의 유리판이 간격을 두고 배치된 상태를 보여주는 개략적인 사시도이다.
- 도 2는 본 발명에 따라 CNT 전자파 차폐 필름에서 패턴재를 재단하는 것을 보여주는 개념도이다.
- 도 3은 2개의 유리판이 간격을 두고 배치된 상태의 복층 유리 창호에서 유리판의 내면에 CNT 전자파 차폐 필름으로 제조된 패턴재가 부착되는 상태를 보여주는 개략적인 사시도이다.
- 도 4는 본 발명에 따른 CNT 전자파 차폐 필름의 주파수와 두께에 따른 전자파 차폐성능을 보여주는 그래프이다.
- 도 5는 본 발명에 따른 CNT 전자파 차폐 필름으로 이루어진 패턴재가 유리판 내면에 부착된 복층 유리 창호에서 전자파 차폐와 동시에 발열이 일어나는 상태를 보여주는 개념도이다.

발명을 실시하기 위한 구체적인 내용

- [0010] 이하, 본 발명의 바람직한 실시예를 첨부한 도면을 참조하여 설명한다. 본 발명은 도면에 도시된 실시예를 참고로 설명되었으나 이는 하나의 실시예로서 설명되는 것이며, 이것에 의해 본 발명의 기술적 사상과 그 핵심 구성 및 작용이 제한되지 않는다.
- [0011] 본 발명에서는 CNT가 함유된 CNT 전자파 차폐 필름을 이용한다. 구체적으로 CNT 분말을 예폭시 등과 같은 수지에 혼합하여 분산시킨 후, 이를 박막형태의 CNT 전자파 차폐 필름으로 제작한다.
- [0012] 상기 CNT 전자파 차폐 필름은 투명할 수도 있지만, CNT의 특성상 불투명할 수도 있다. 이와 같이 CNT 전자파 차폐 필름이 투명하지 않은 경우에는, CNT 전자파 차폐 필름을 필요한 문양이나 패턴, 또는 테두리 형태로 재단하게 된다. 도 2에는 CNT 전자파 차폐 필름에서 패턴재(1)를 재단하는 것을 보여주는 개념도가 도시되어 있다.
- [0013] 이와 같이 수지에 CNT가 분산 함유된 CNT 전자파 차폐 필름이 제조되면, CNT 전자파 차폐 필름을 복층 유리 창호의 내면에 접착한다. 도 3에는 2개의 유리판이 간격을 두고 배치된 상태의 복층 유리 창호에서 유리판(10)의 내면에 CNT 전자파 차폐 필름으로 제조된 패턴재(1)가 부착되는 상태를 보여주는 개략적인 사시도가 도시되어 있다.
- [0014] 도 3에 도시된 실시예에서는 CNT 전자파 차폐 필름이 투명하지 아니하기 때문에 일정한 문양으로 재단된 패턴재(1) 형태로 만들어지고, 이러한 CNT 전자파 차폐 필름으로 만들어진 패턴재(1)를 용이하게 유리판(10)에 부착할 수 있도록, 투명 필름(2)을 이용하여 유리판(10)에 부착하는 것으로 도시되어 있다. 즉, 투명필름(2)의 일면에 CNT 전자파 차폐 필름으로 만들어진 패턴재(1)를 위치시키고, 패턴재(1)가 위치한 방향으로 투명필름(2)을 2개의 복층으로 배치된 유리판(10)의 내면에 부착하는 것이다. 도 3에서 부재번호 11은 2개의 유리판(10)의 간격을 유지하고 유리판(10) 사이의 공간을 밀봉하기 위한 간격재(11)이다. 즉, 본 발명에 따른 복층 유리 창호는 기본적으로 2개의 유리판(10)이 간격재(11)를 사이에 두고 밀봉된 간격을 가진 상태로 배열되는 구조를 가지고 있다.
- [0015] 만일 CNT 전자파 차폐 필름이 투명한 상태라면, 별도의 투명필름(2)을 이용하지 않고 투명한 CNT 전자파 차폐 필름을 직접 유리판(10)의 내면에 부착할 수도 있다. 또한 CNT 전자파 차폐 필름이 불투명한 상태라도 위와 같이 패턴재(1)로 만들어서, 투명필름(2) 없이, 패턴재(1)를 직접 유리판(10)의 내면에 부착할 수도 있다. 물론 복층 유리 창호를 불투명한 상태로 만들 필요가 있는 경우에는 불투명한 CNT 전자파 차폐 필름을 직접 유리판(10)의 내면에 부착할 수도 있다.

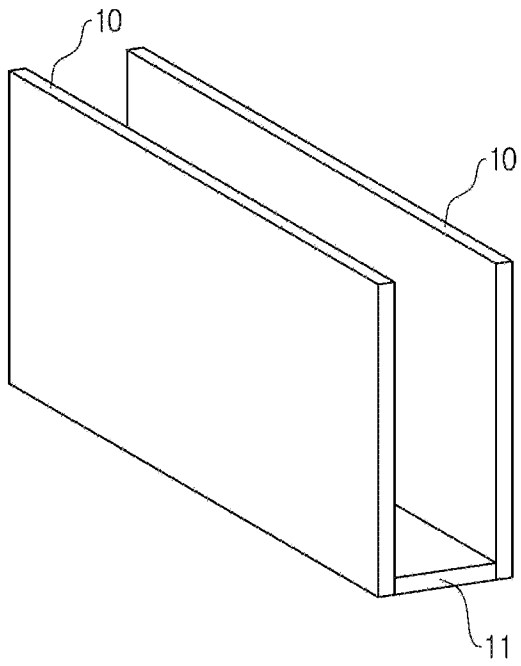
- [0016] 이와 같이, 2개의 유리판(10)이 간격을 두고 배치되는 복층 유리 창호에서, 본 발명에 따라 유리판(10)의 내면에 CNT 전자파 차폐 필름을 부착하게 되면, CNT의 역할에 의하여, 전자파가 유리판(10)을 투과하는 것을 방지할 수 있게 된다. 즉, CNT 전자파 차폐 필름의 존재에 의해 복층 유리 창호의 전자파 차폐 성능이 현저하게 향상되는 것이다.
- [0017] 도 4는 에폭시, 경화제, 촉매제 및 CNT의 총 중량에 대해 CNT를 5 중량%로 혼입하여 두께가 각각 0.8mm, 1.6mm, 2.4mm 및 2.6mm인 필름으로 제작하여 전자파 차폐성능을 실험한 결과를 도시한 그래프이다. 도 4에서 알 수 있듯이, 전자파의 주파수와 필름 두께가 상승할수록 전자파 차폐성능이 향상된다.
- [0018] 한편, 종래의 복층 유리 창호에서는 열을 2개의 유리판 사이에 가둬둠으로써 단열을 이루게 되는데, 복층 유리 창호의 제작시에 2개의 유리판 사이가 완전하게 밀봉되지 못하는 경우가 빈번하게 발생하게 되고, 그로 인하여 유리판의 내면에 이슬이 맺히는 결로현상이 발생하게 되는 문제점이 있다.
- [0019] 그러나 본 발명에서는 위와 같이 CNT 전자파 차폐 필름이 전자파를 차폐하는 과정에서 발열이 일어나게 되어, 이러한 결로현상의 발생을 방지하게 된다. 도 5에는 본 발명에 따른 CNT 전자파 차폐 필름으로 이루어진 패턴재(1)가 유리판(10) 내면에 부착된 복층 유리 창호에서 전자파 차폐와 동시에 발열이 일어나는 상태를 보여주는 개념도가 도시되어 있다.
- [0020] CNT 전자파 차폐 필름의 발열은 필름으로 흡수된 전자파가 탄소원자들의 진동을 일으켜 열에너지가 전달되는 방식에 의한 것이다. 같은 질량을 가지는 원자들의 경우 가장 효율적으로 진동에 의해 열을 전달하게 되는데 이러한 이유로 탄소로만 이루어진 CNT의 경우 열전달에 매우 유리하다.
- [0021] 도 5에 도시된 것처럼, CNT 전자파 차폐 필름으로 이루어진 패턴재(1)가 유리판(10) 내면에 부착된 본 발명의 복층 유리 창호에서는, CNT 전자파 차폐 필름이 전자파에 노출되면서, 발열이 일어나게 된다. CNT는 탄소원자로만 이루어지므로, 열을 효율적으로 전달할 수 있으며 우수한 열전도성을 가지고 있다. 따라서 복층 유리 창호의 유리판(10) 내면에 부착된 CNT 전자파 차폐 필름이 전자파를 차폐하고 흡수하는 과정에서 CNT 전자파 차폐 필름이 자체적으로 발열하게 되고, 이러한 액티브한 발열을 통해서 유리판의 내면에 이슬이 맺히는 결로현상의 발생을 방지할 수 있다.
- [0022] 본 발명의 CNT 전자파 차폐 필름을 이용한 복층 유리 창호를 구현함에 있어서, 필요에 따라서는 CNT 전자파 차폐 필름을 복수개의 층으로 적층하여 부착할 수도 있다.
- [0023] 특히, 본 발명에서는 CNT 전자파 차폐 필름을 패턴재 형태로 사용할 수 있으므로, 원하는 문양이나 무늬, 문자 등의 다양한 형태로 활용할 수 있으며, 그에 따라 창호의 심미감을 더욱 향상시킬 수 있고, 창호의 양호한 시야 확보도 이룰 수 있다는 장점이 있다.

부호의 설명

- [0024] 1: 패턴재
2: 투명필름
10 : 유리판

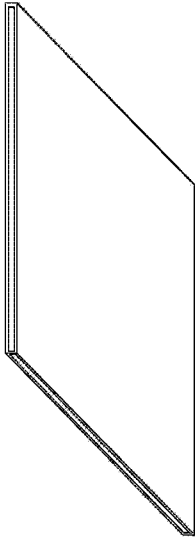
도면

도면1

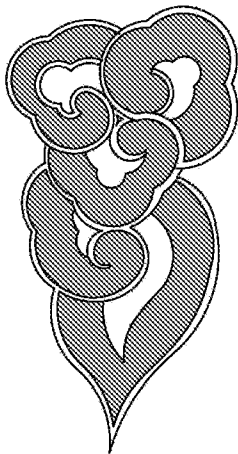


도 1

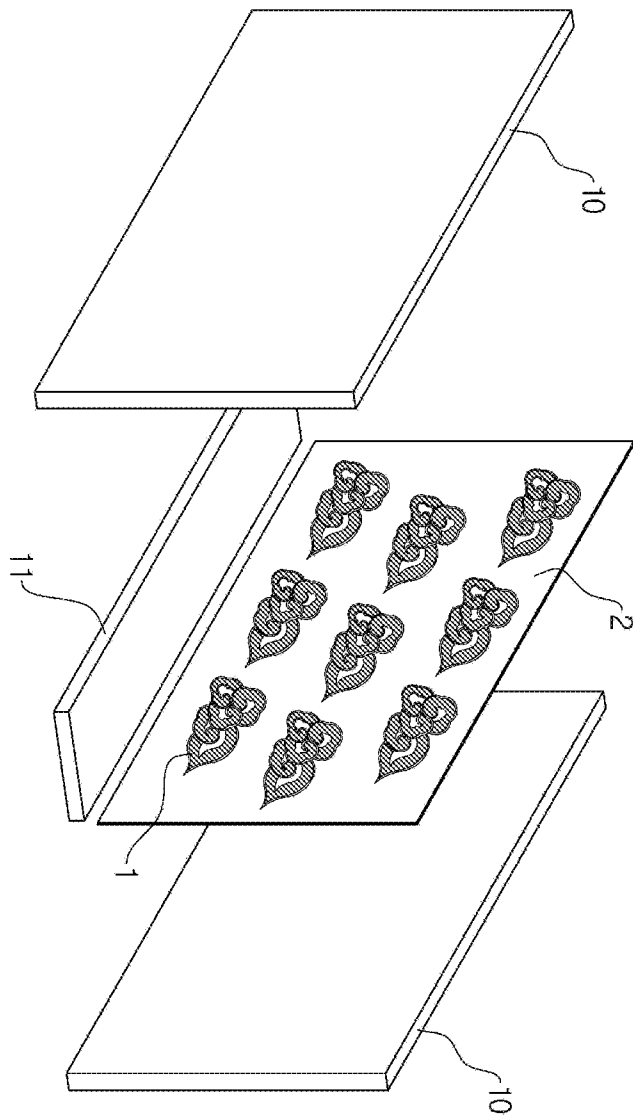
CNT 전자파 차폐 필름



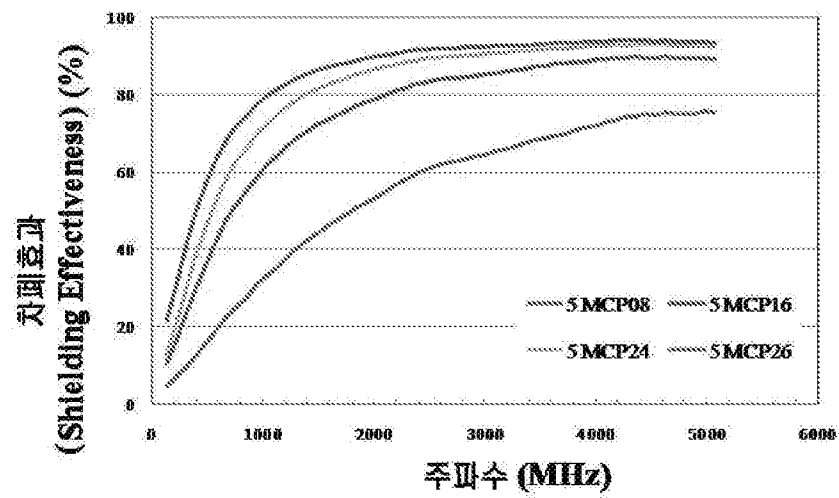
패턴재(1)



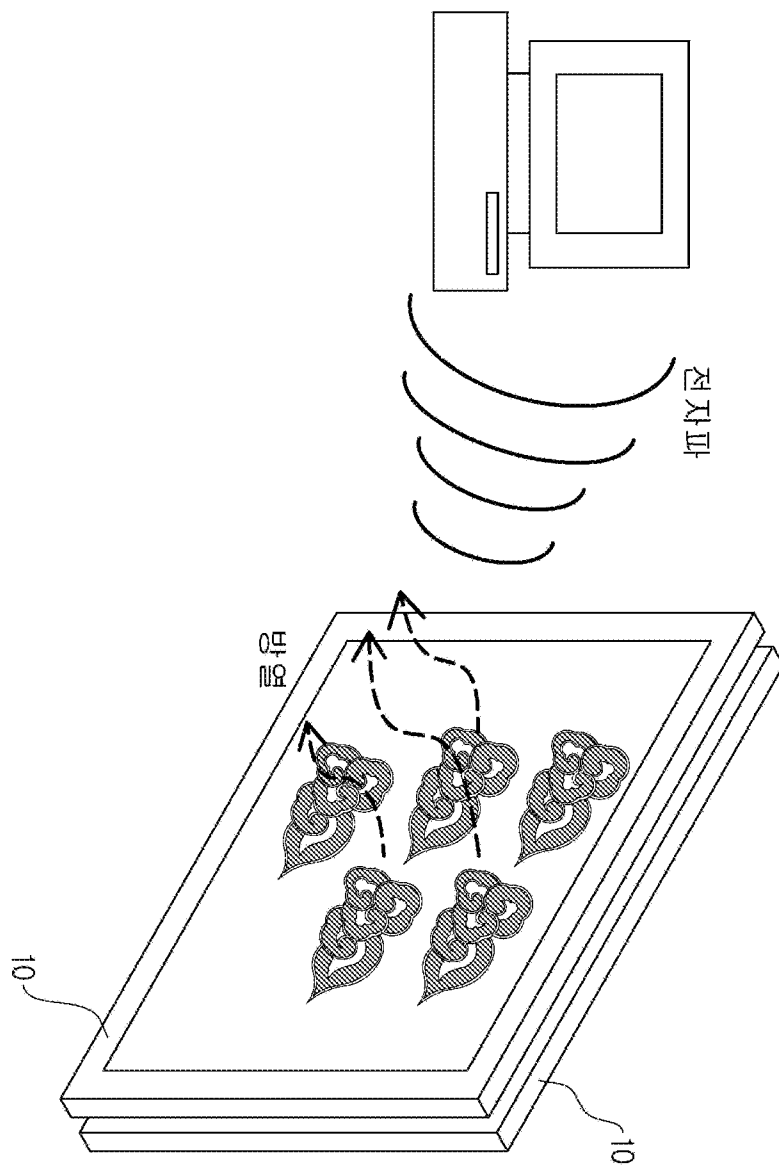
도면3



도면4



도면5



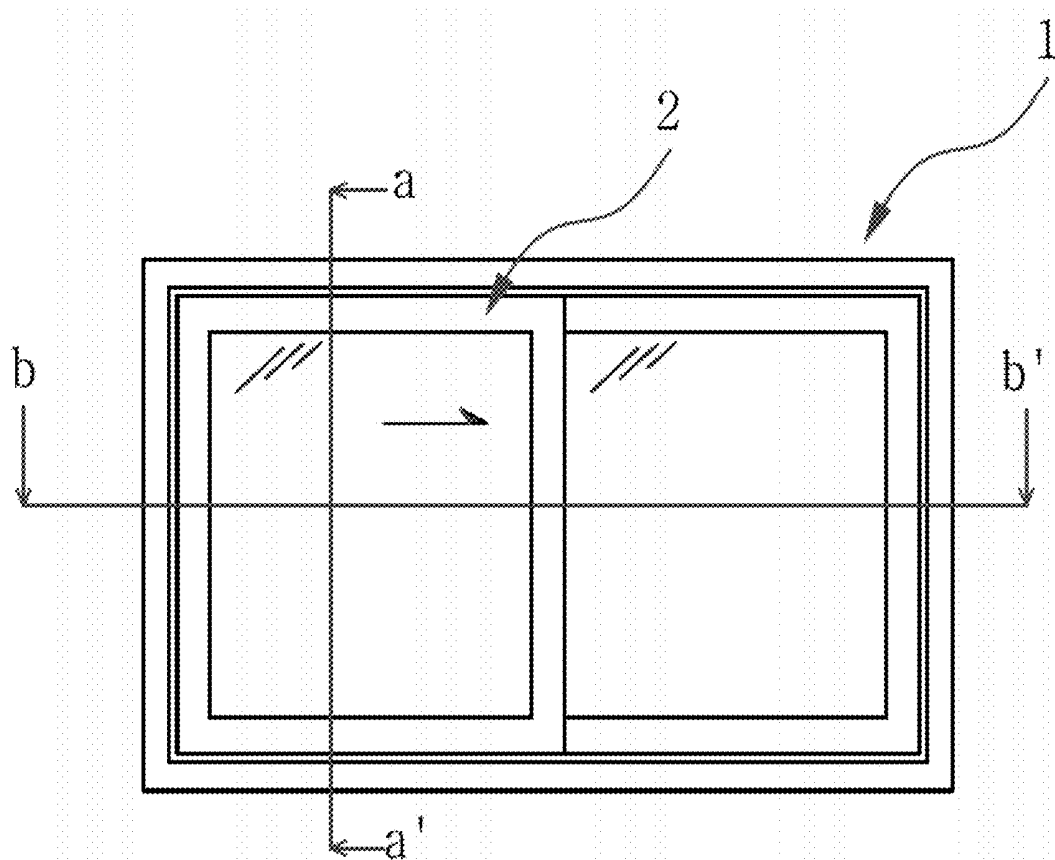


FIG. 1a

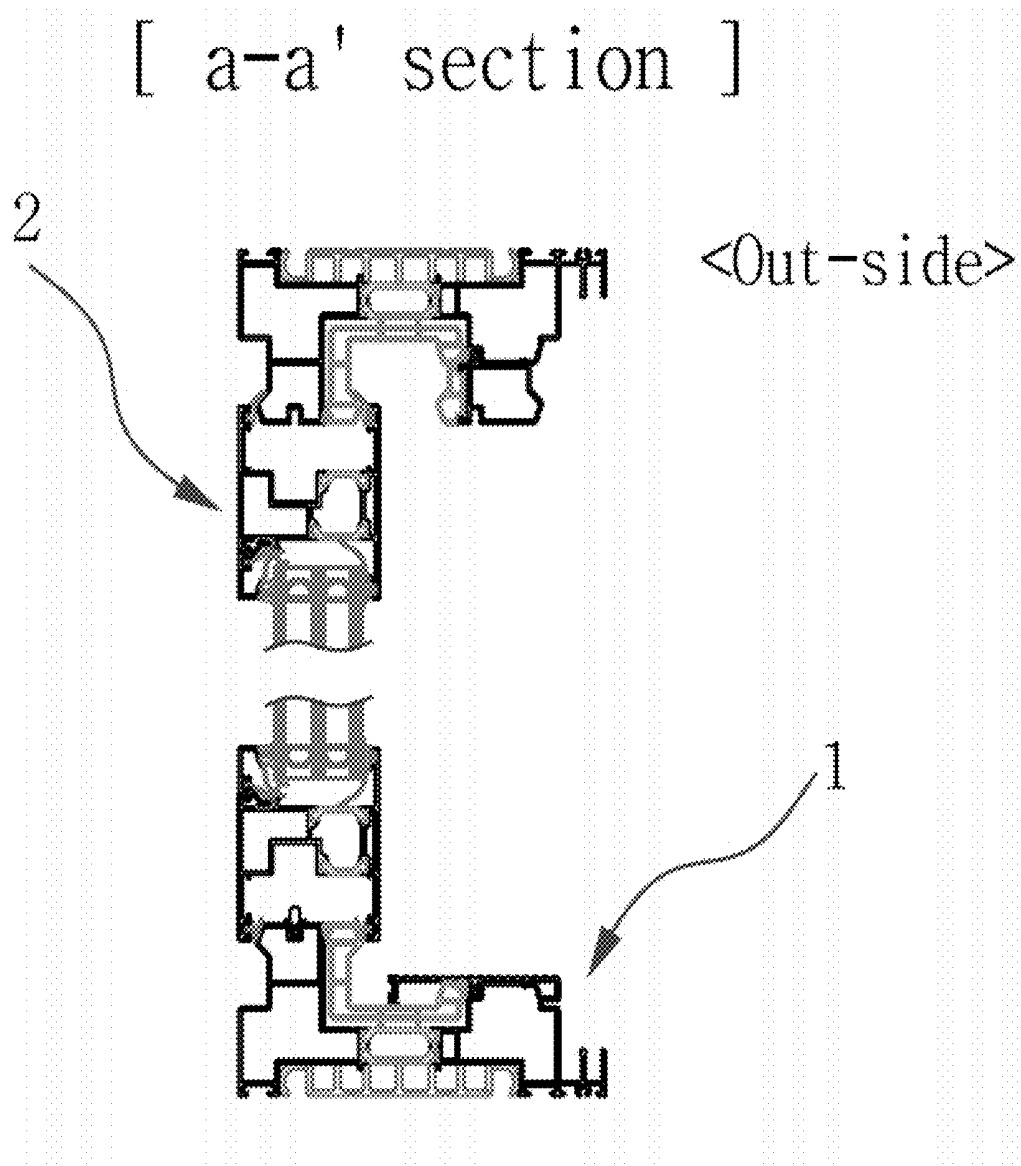


FIG. 1b

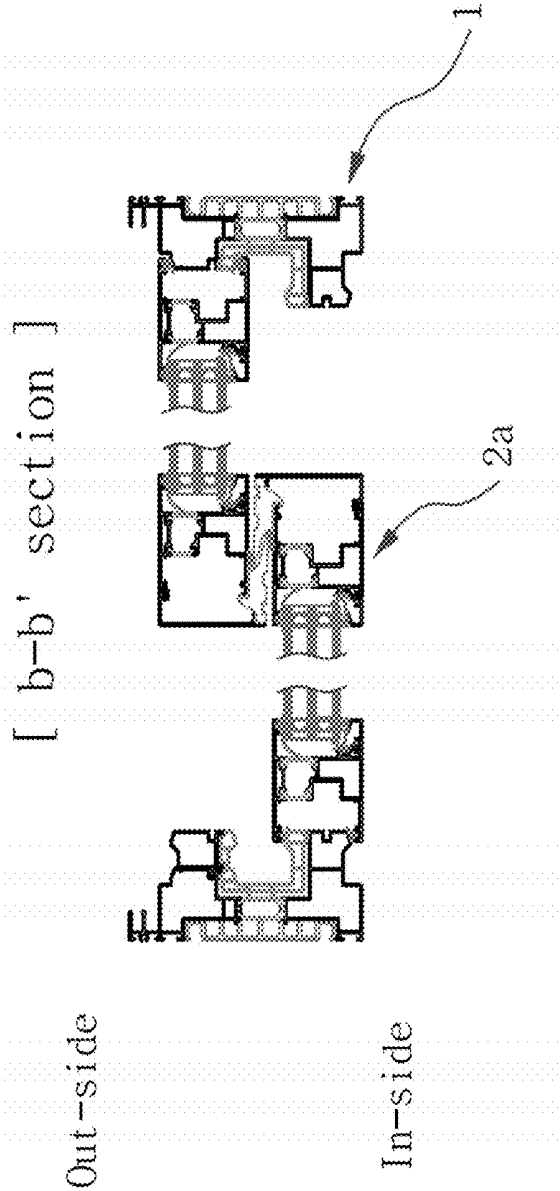


FIG. 1c

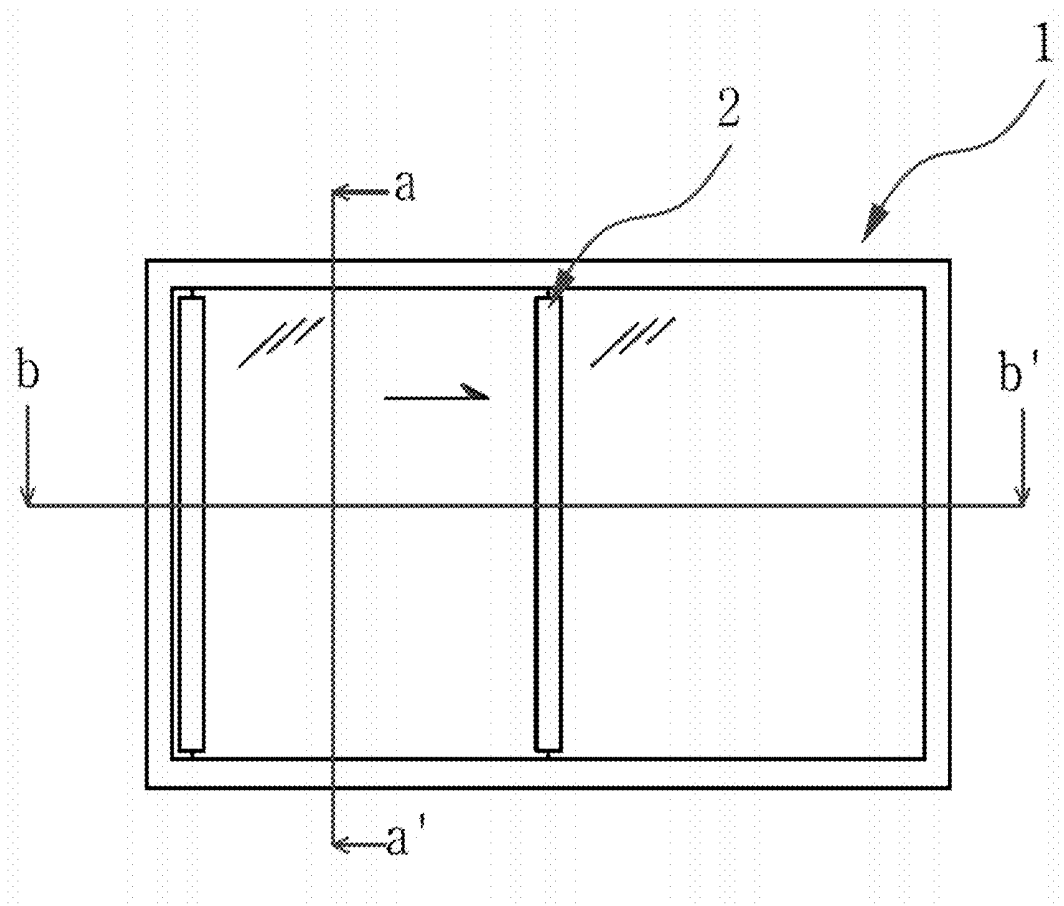


FIG. 2a

[a-a' section]

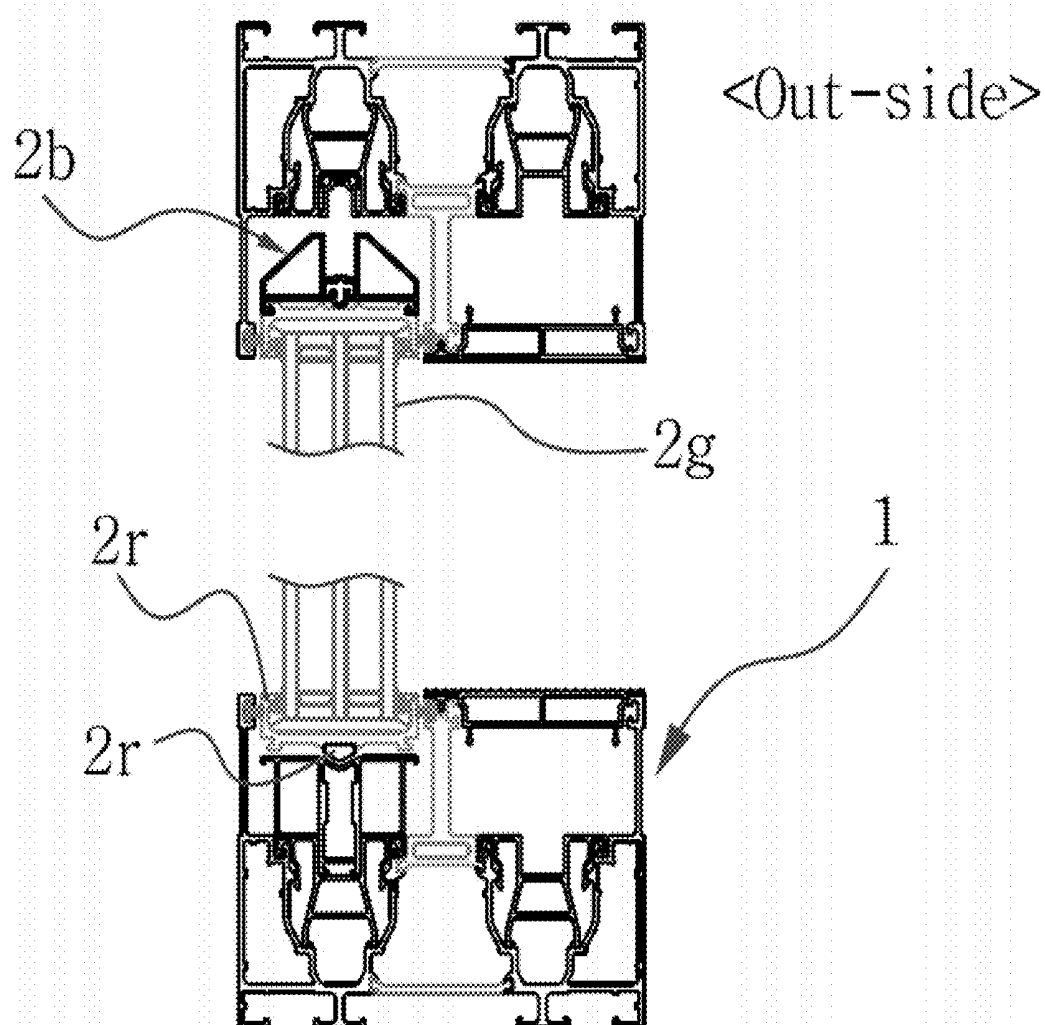


FIG. 2b

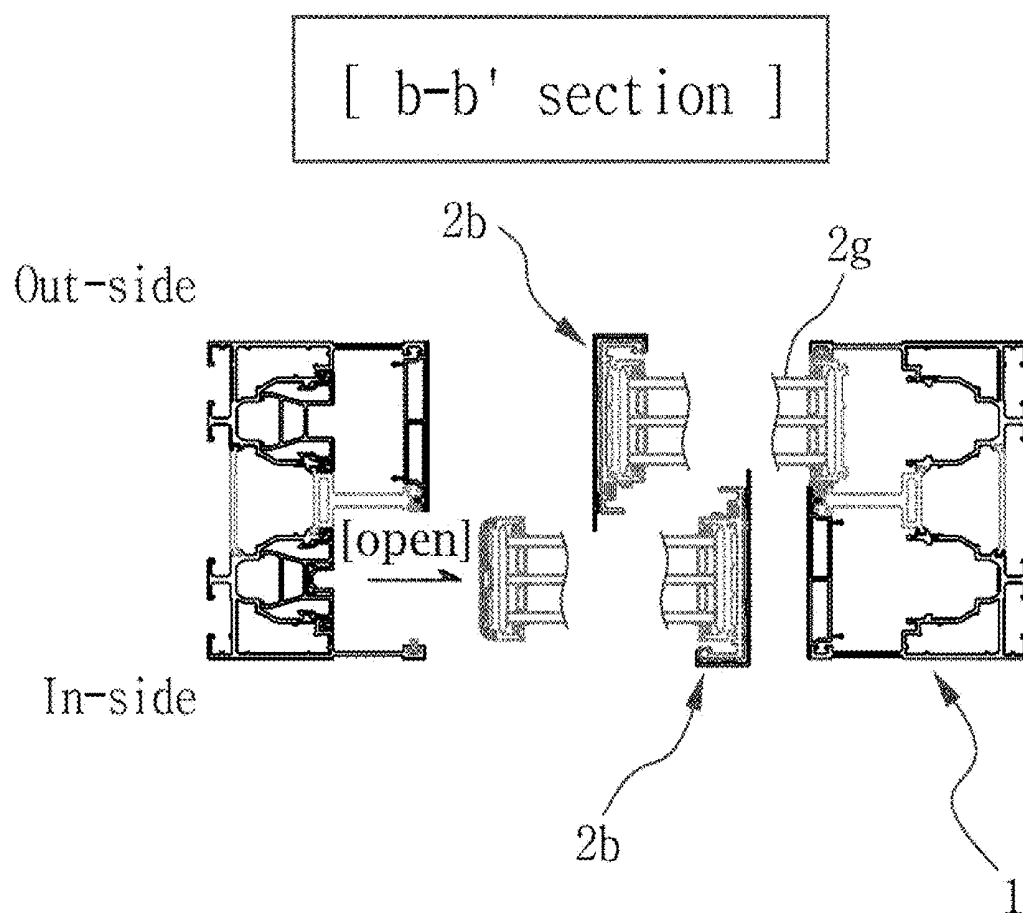


FIG. 2c

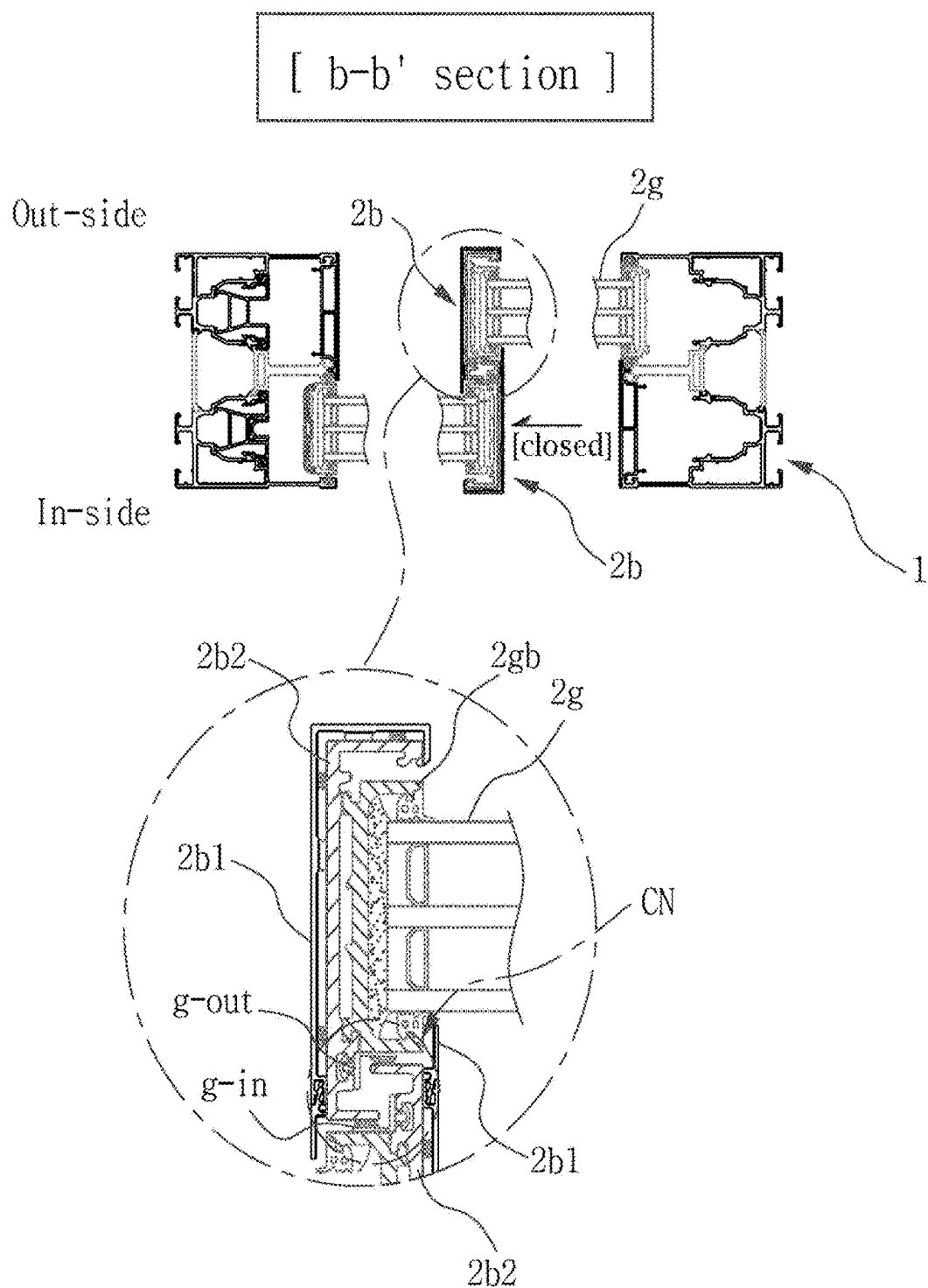


FIG. 2d

[a-a' section]

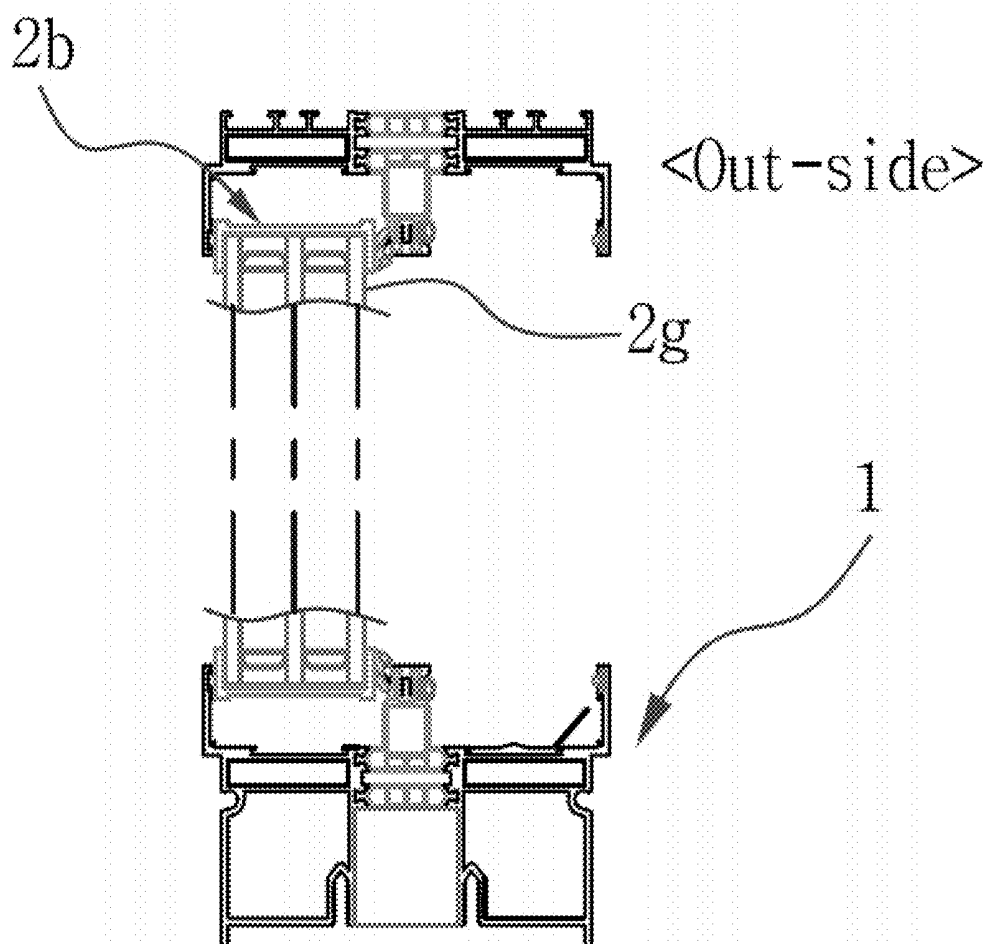


FIG. 3a

[b-b' section] - A type

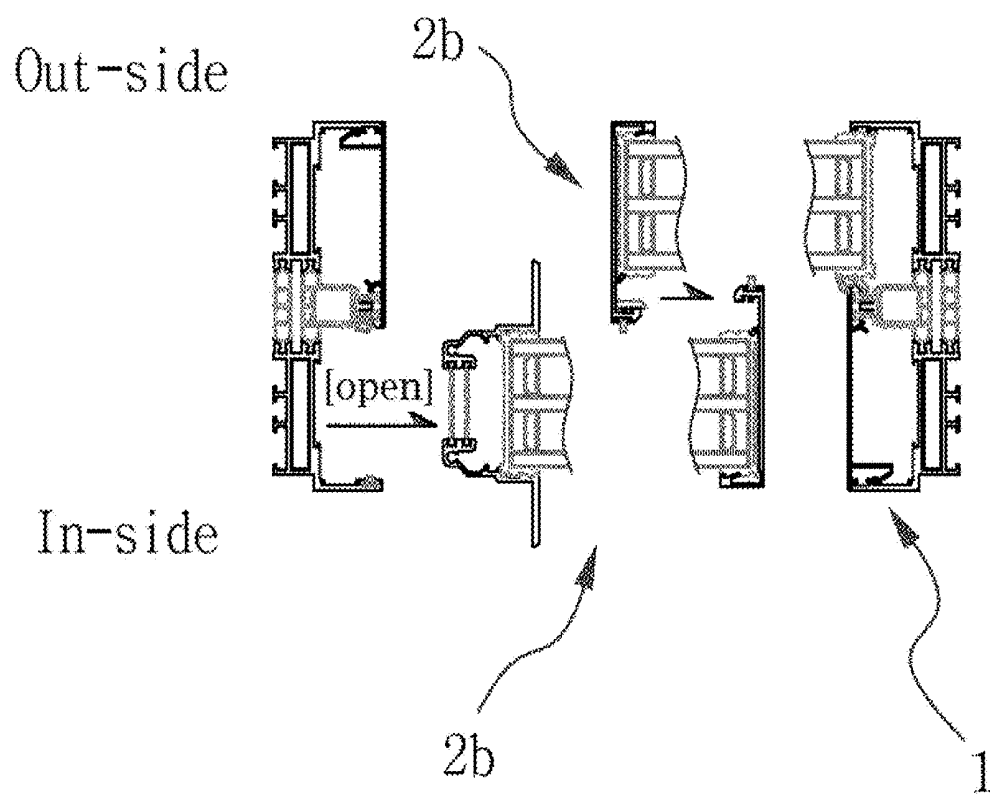


FIG. 3b

[b-b' section] - B type

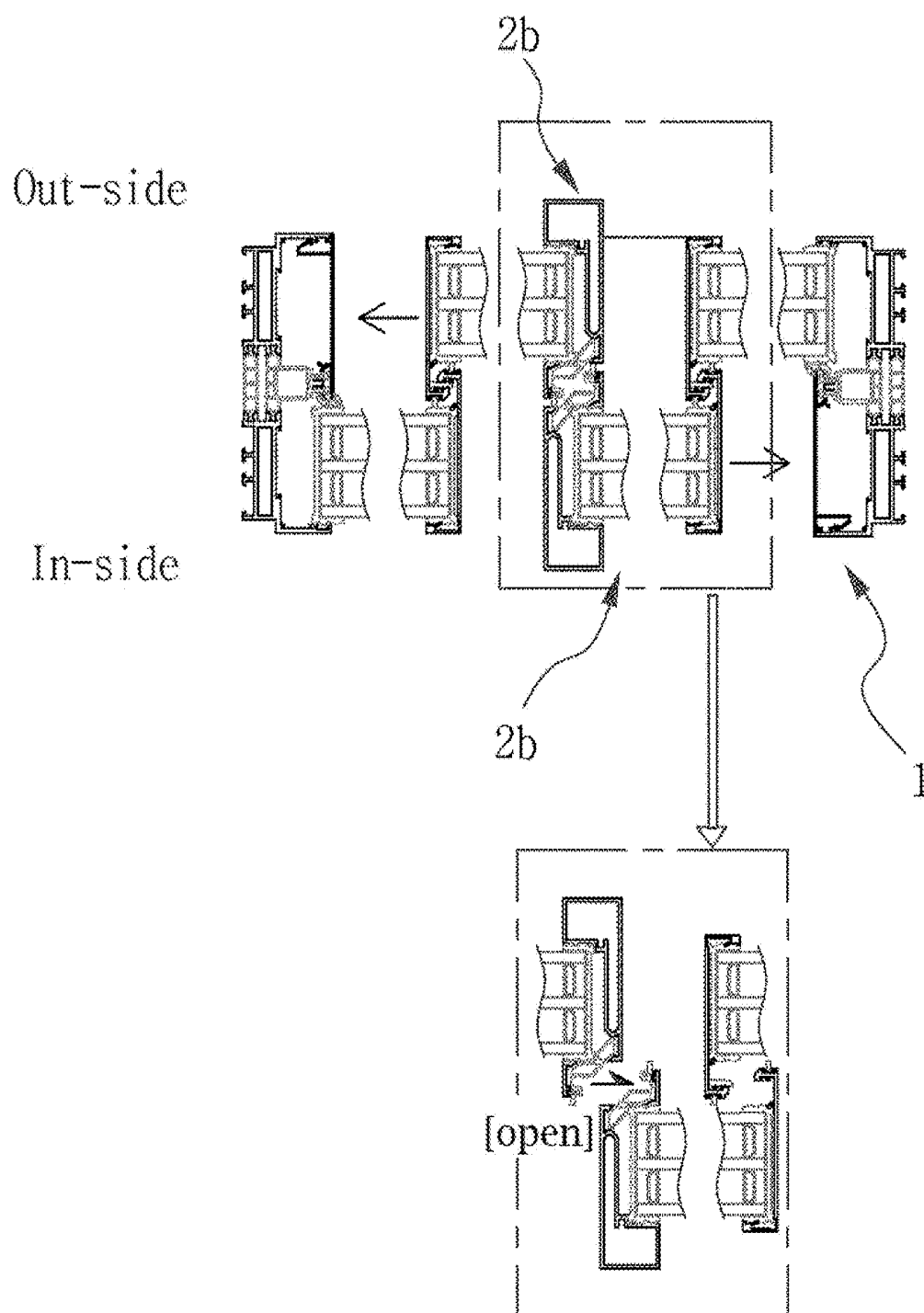


FIG. 3c

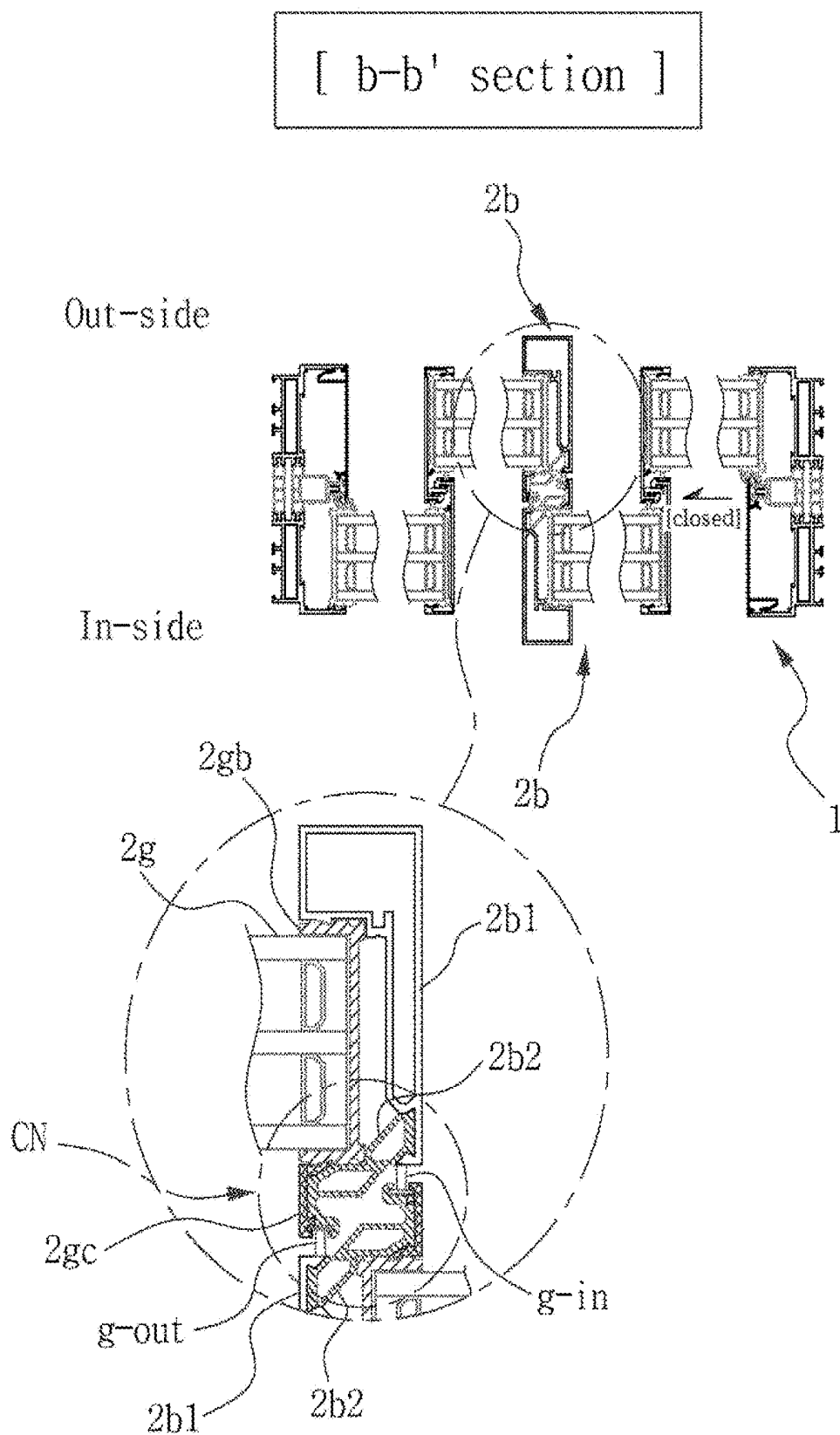


FIG. 3d

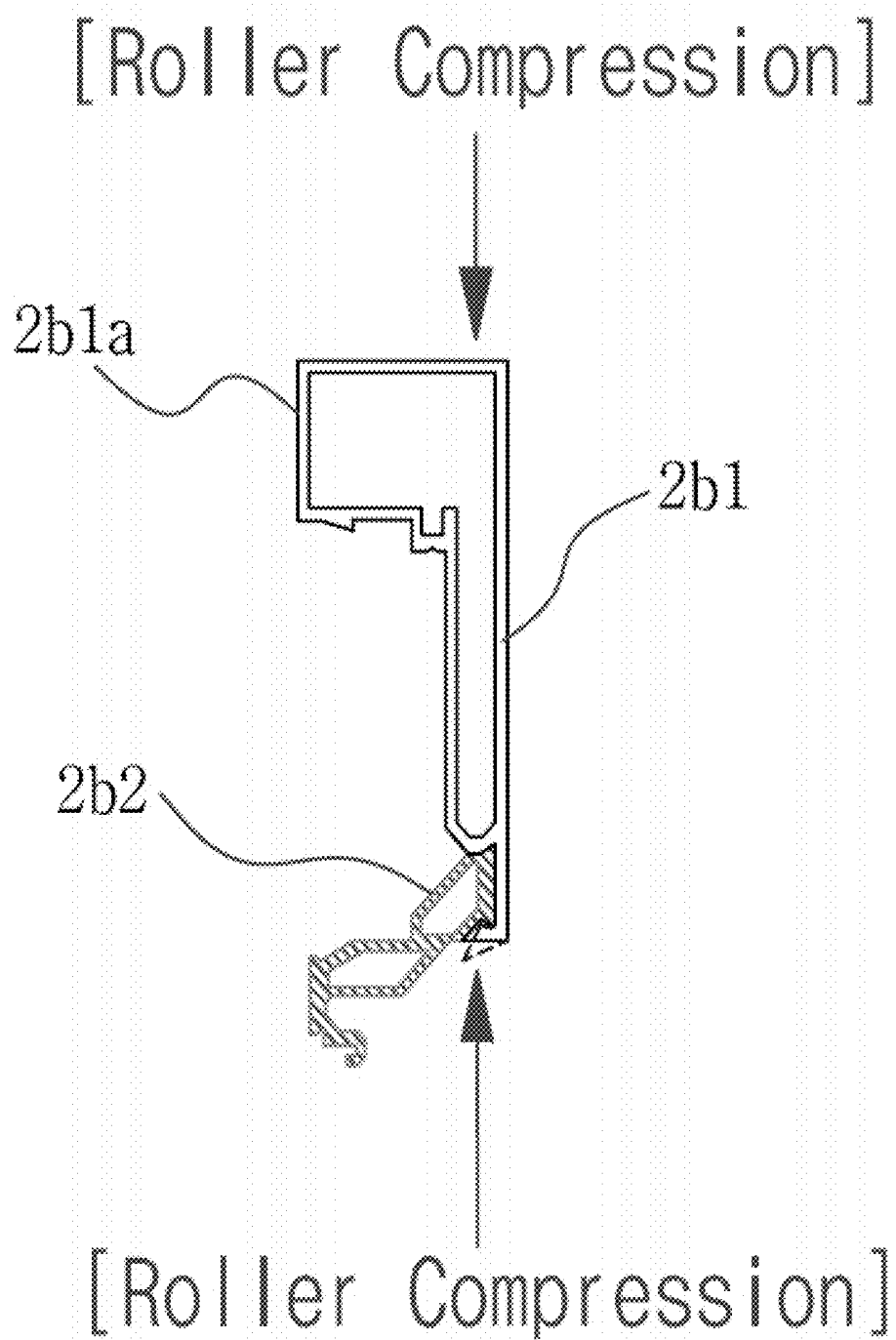


FIG. 3e

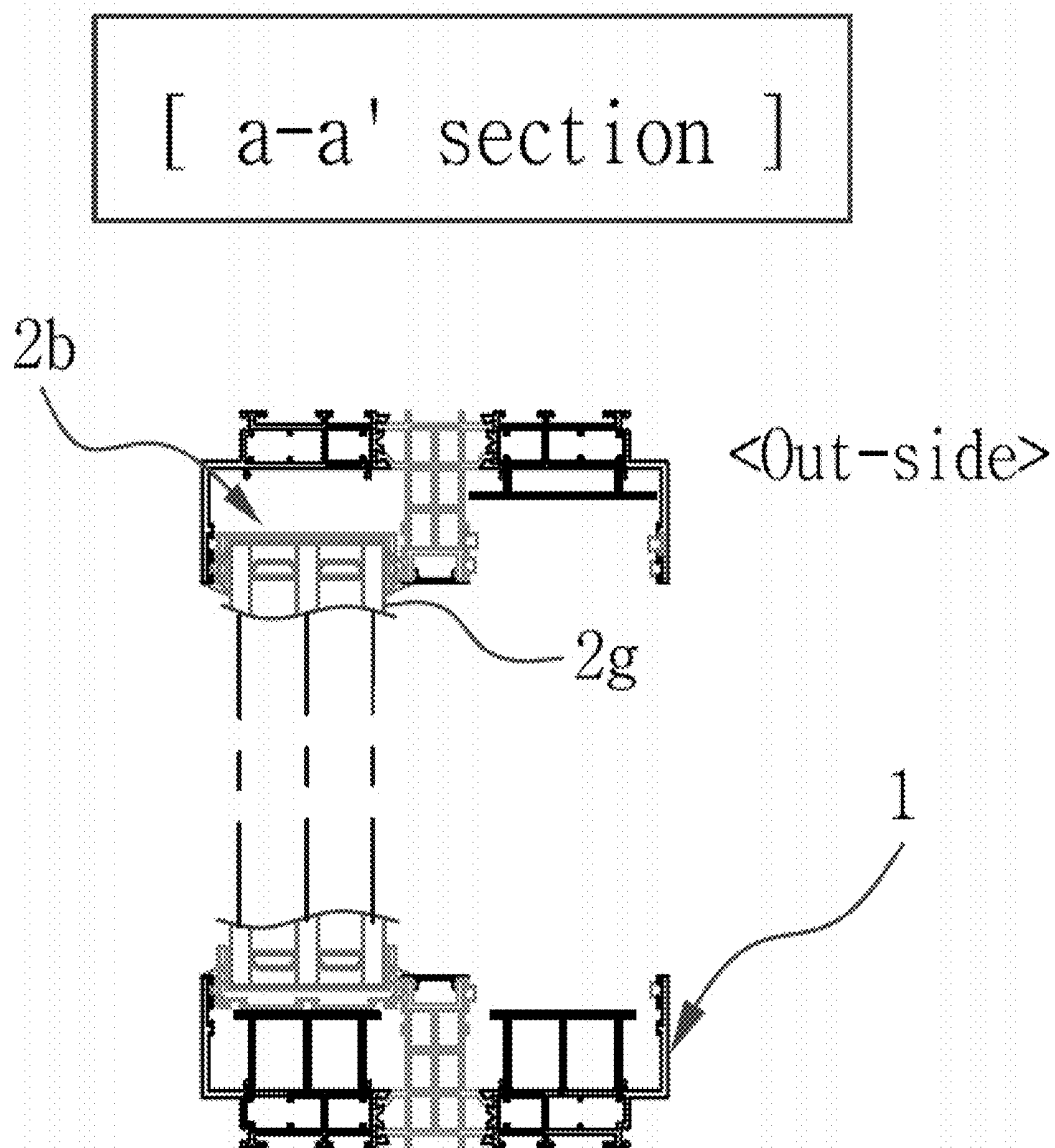


FIG. 4a

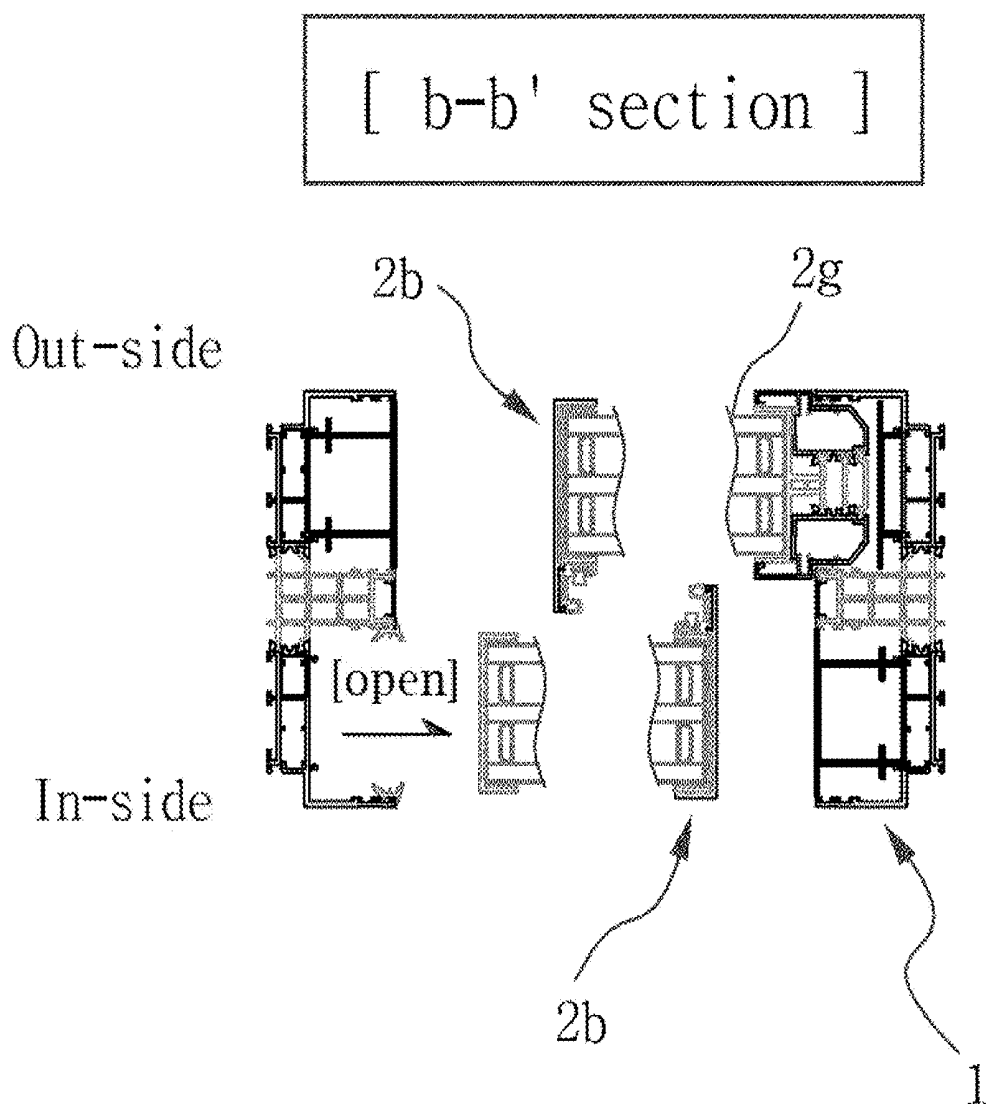


FIG. 4b

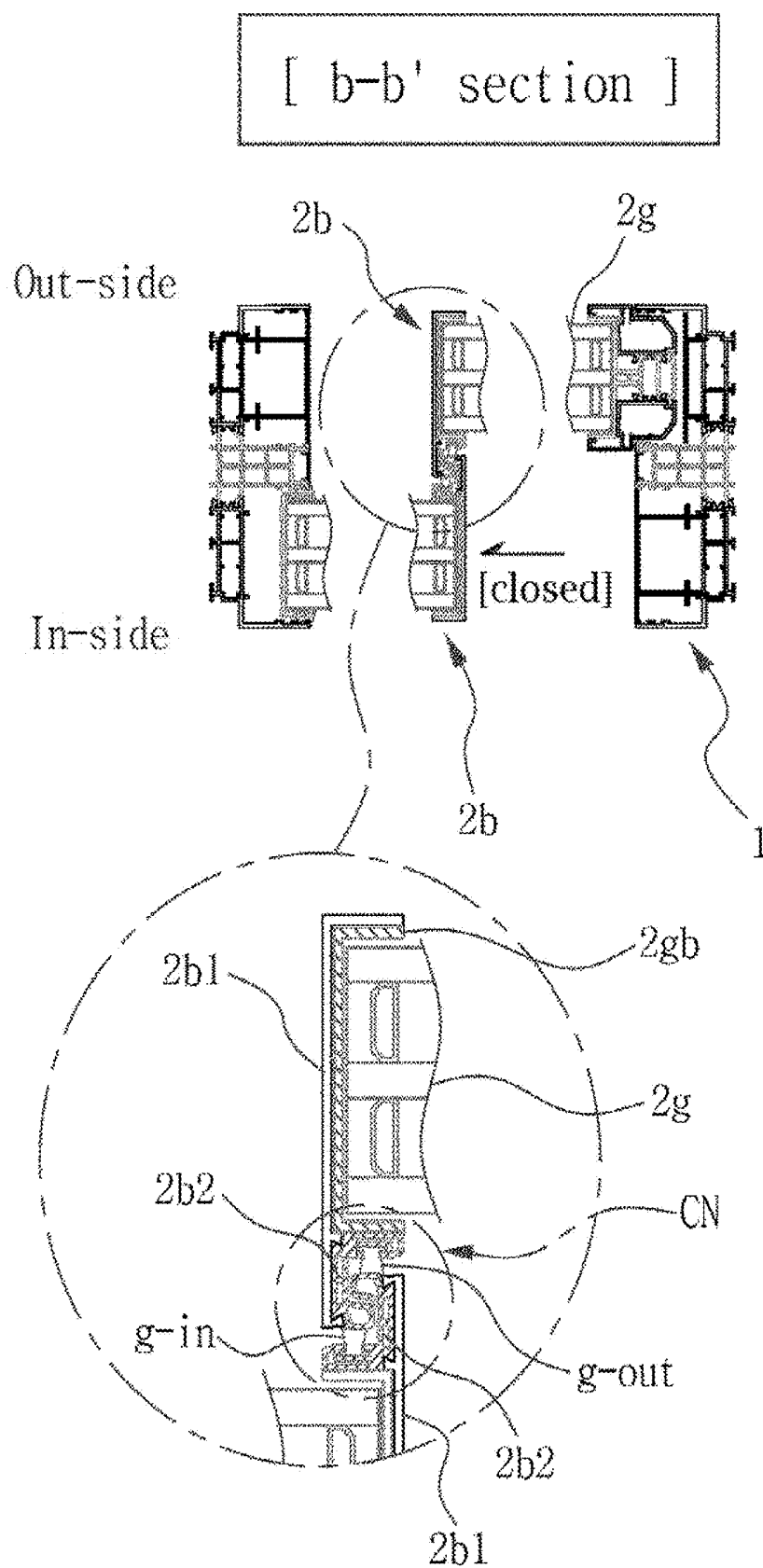


FIG. 4c

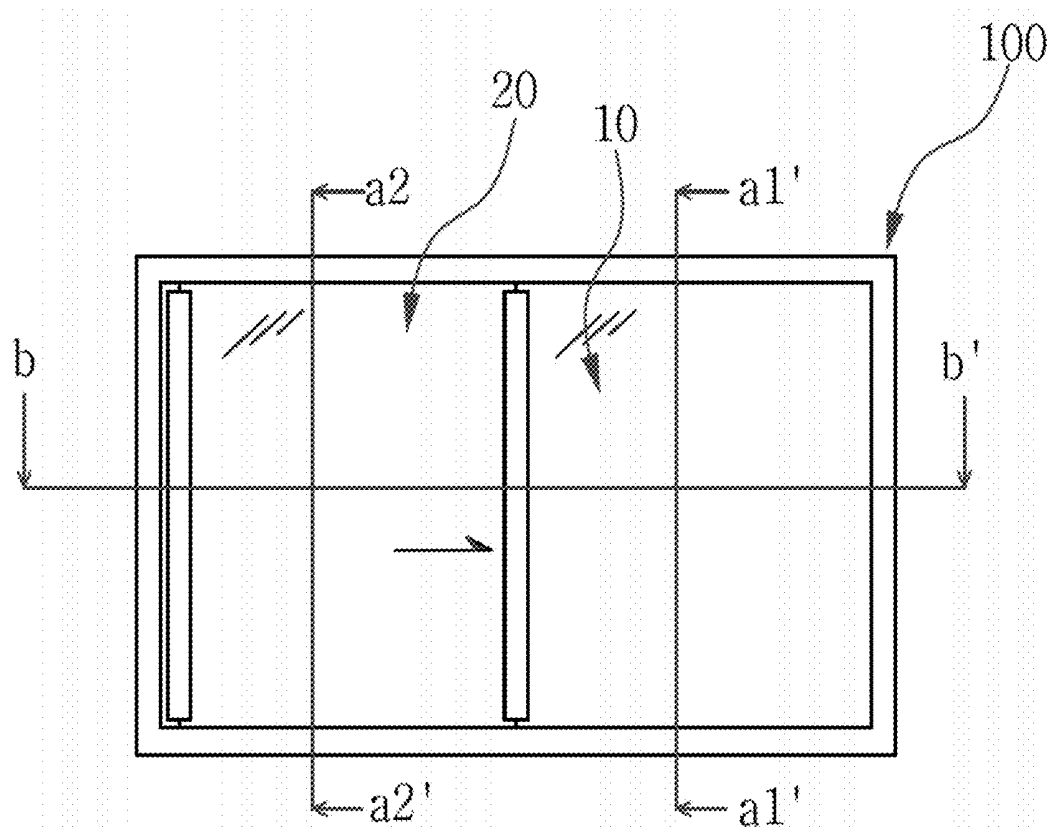


FIG. 5a

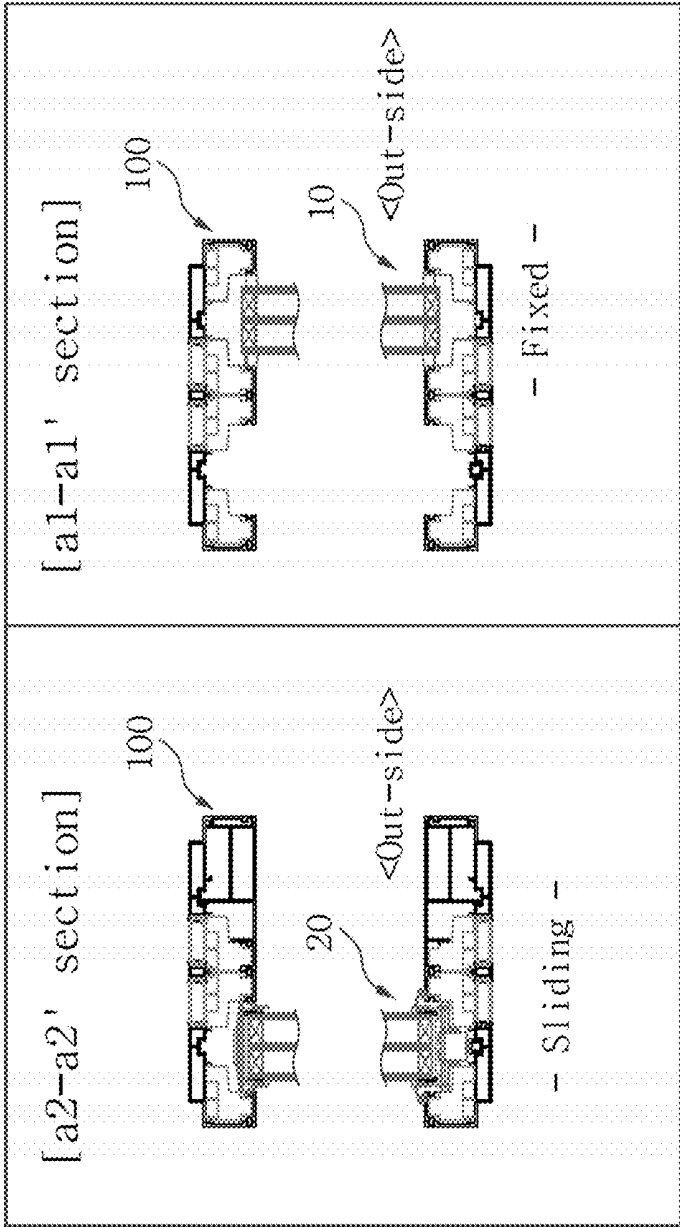


FIG. 5b

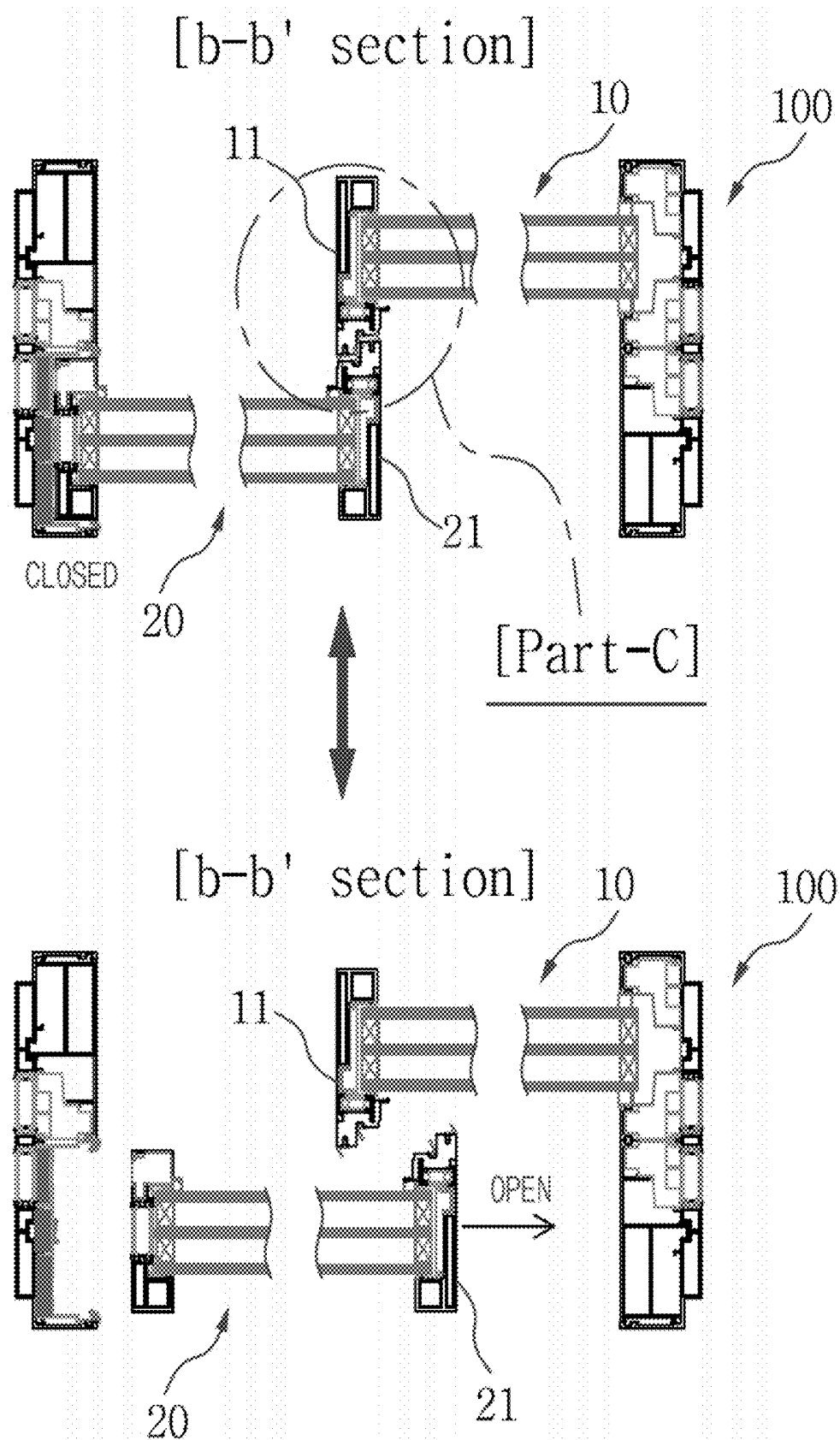


FIG. 5c

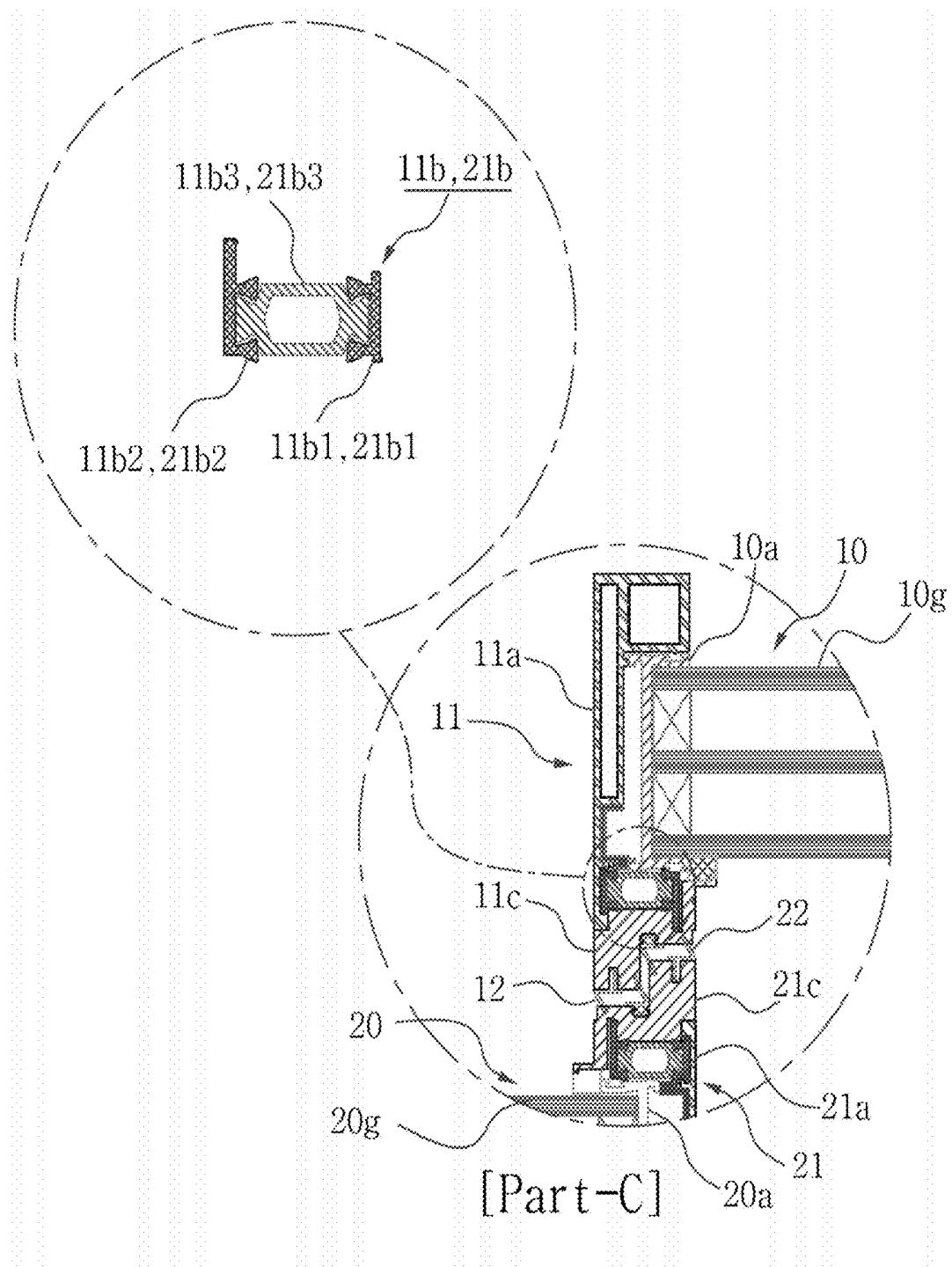


FIG. 5d

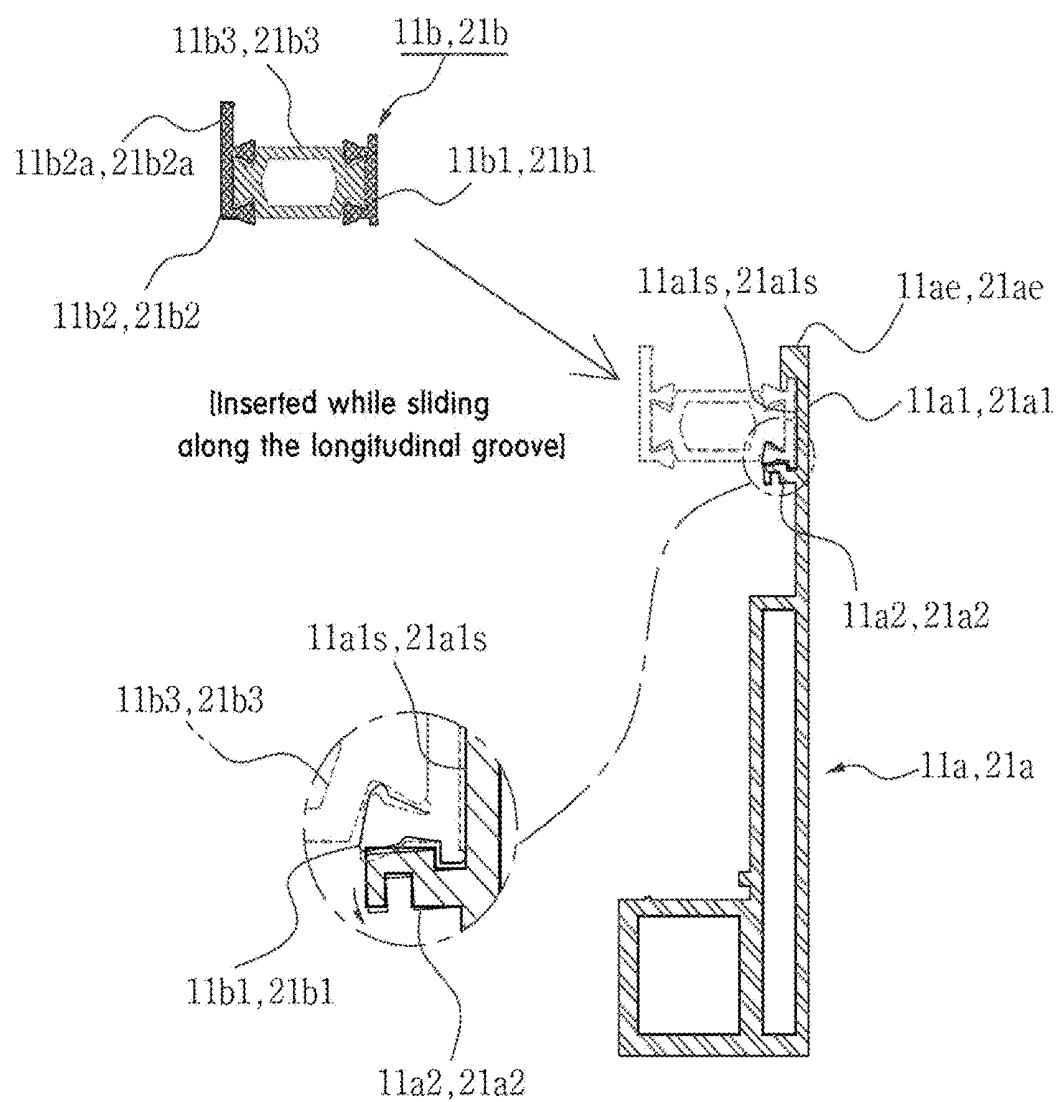


FIG. 6a

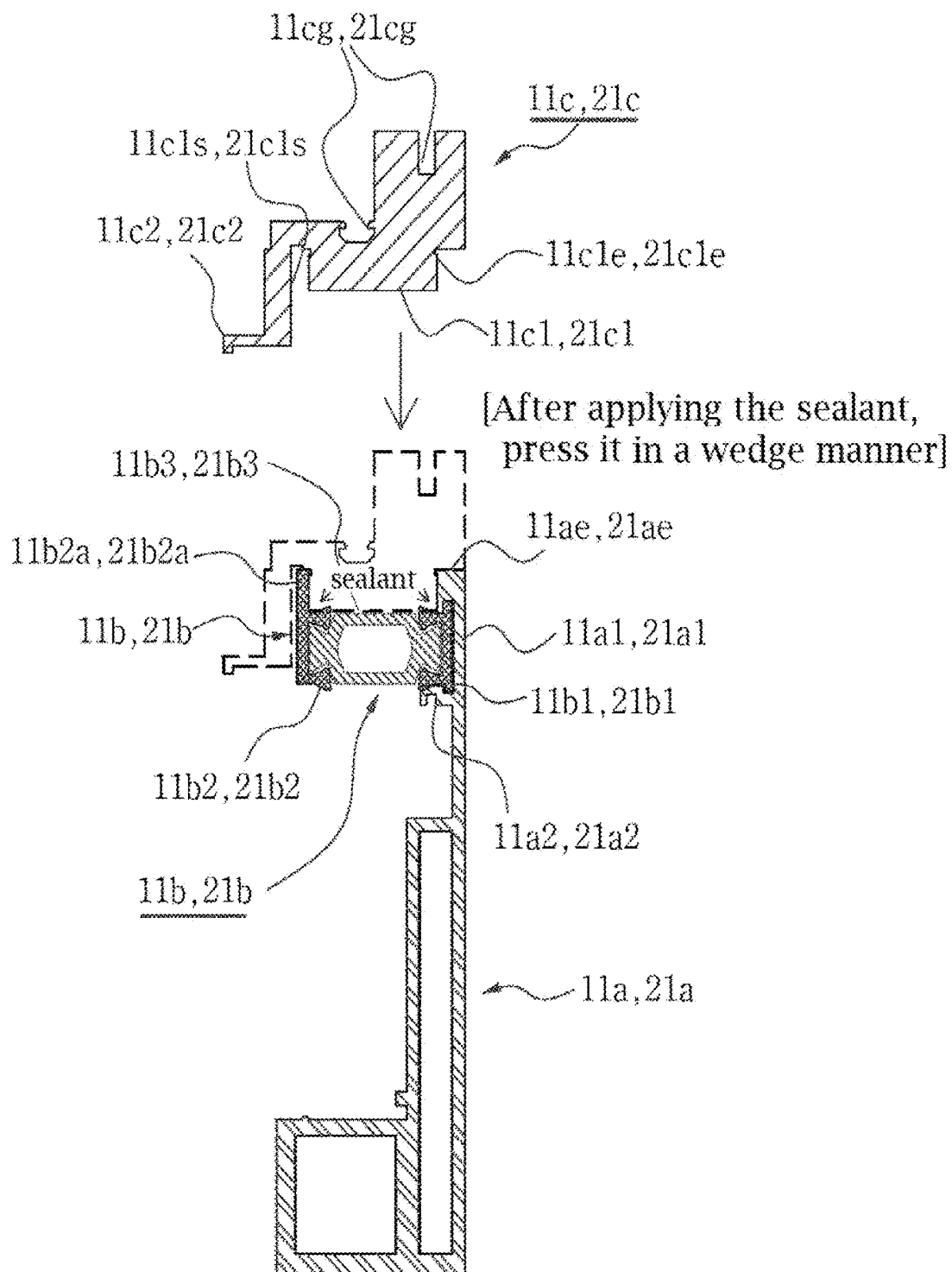


FIG. 6b

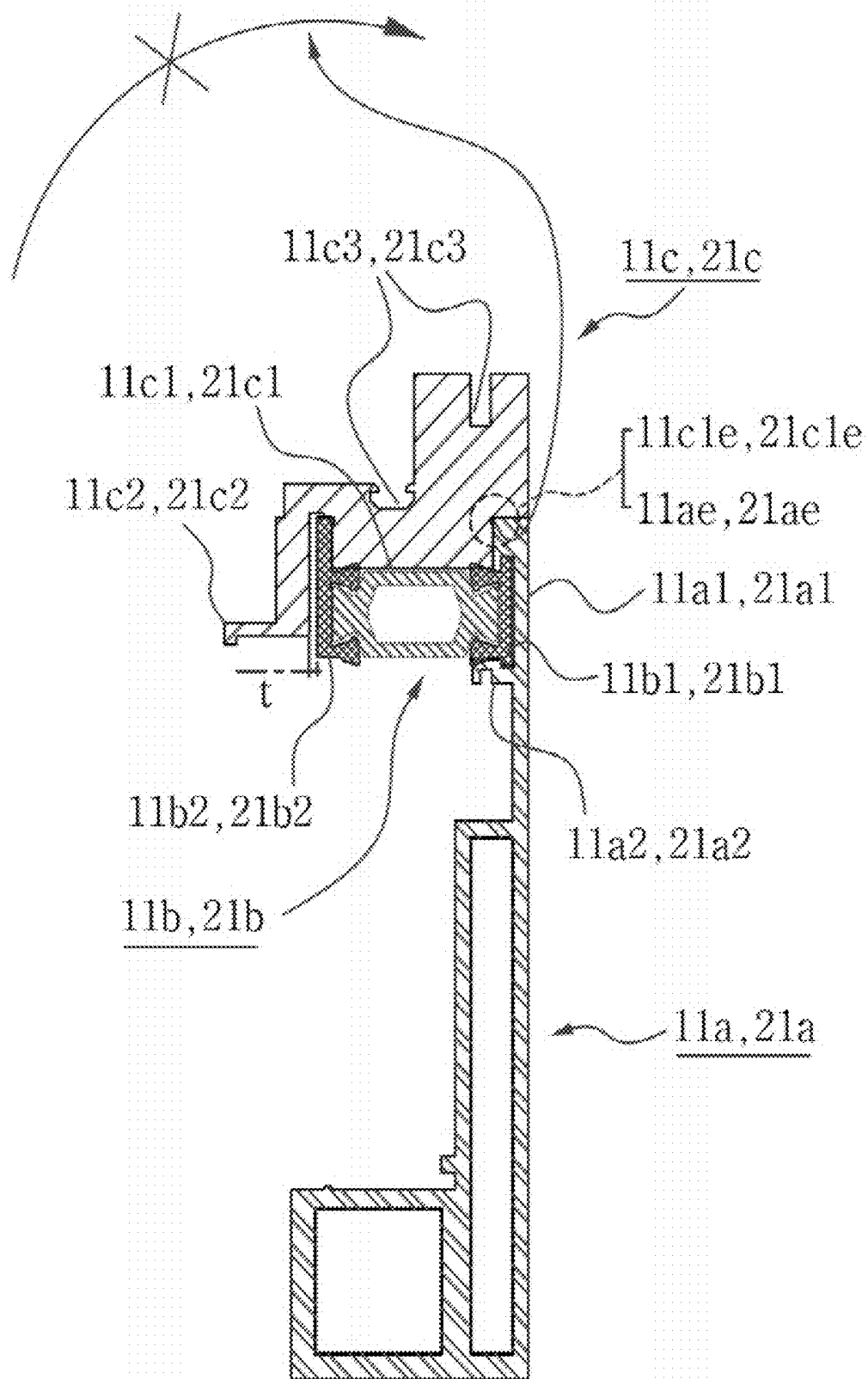


FIG. 6c

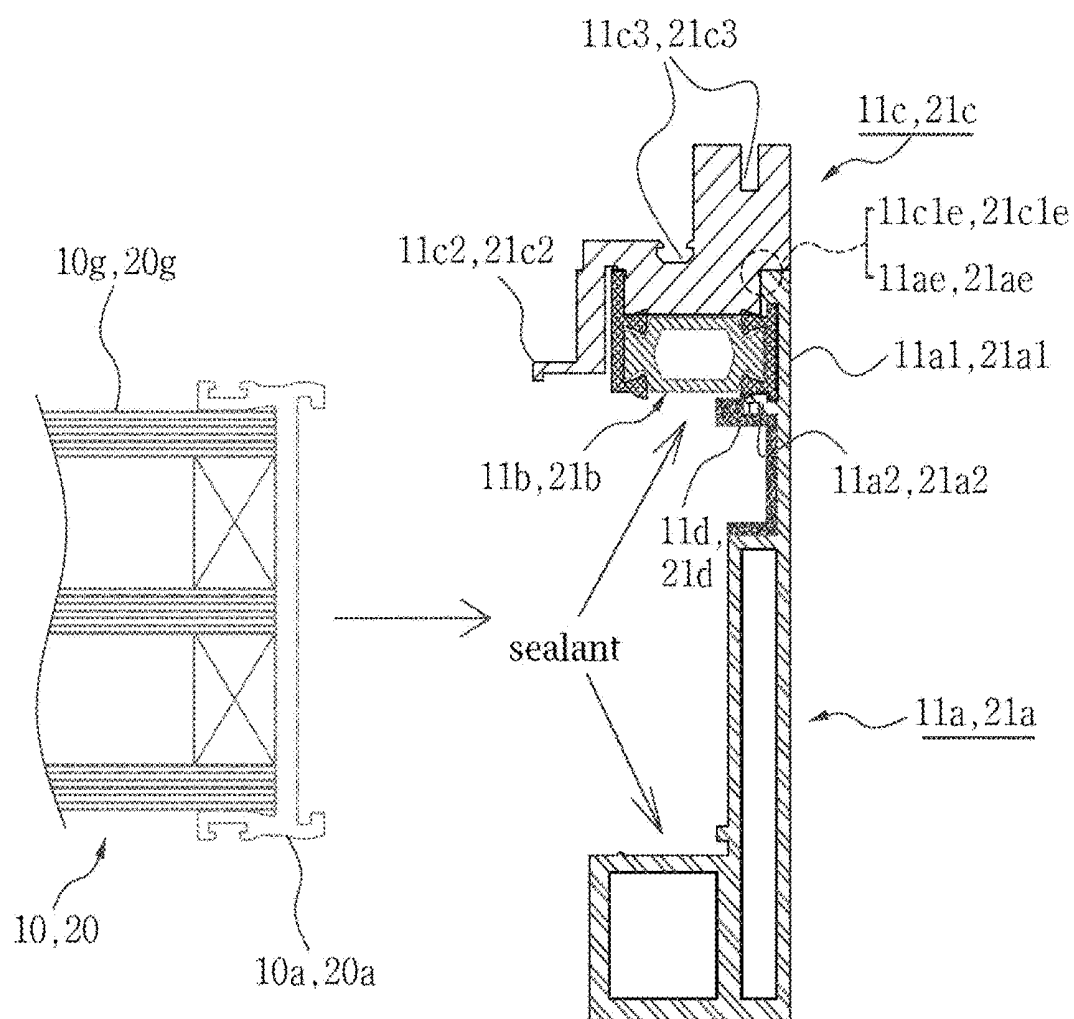


FIG. 6d

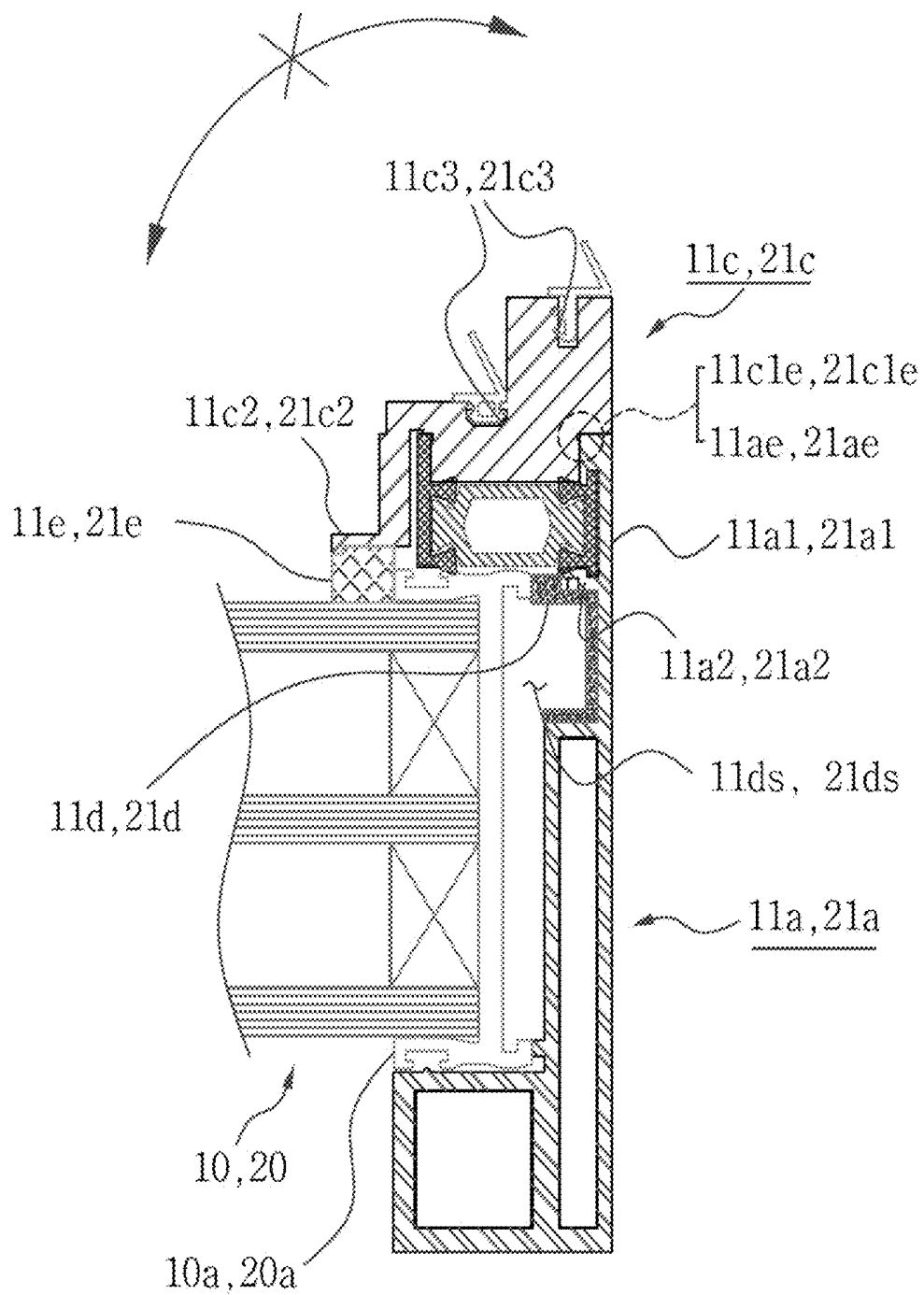


FIG. 6e

**INSULATING AND GLASS PANEL
SUPPORTING STRUCTURE OF WINDOW
FRAME SASH IN CENTER BAR PORTION
AT WHICH TWO-SIDE SUPPORTING
FRAME WINDOW SASHES OF SLIDING
WINDOW OVERLAP**

TECHNICAL FIELD

[0001] The present invention relates to a heat insulation and support structure between a moving window (sliding window) and a fixed window constituting a sliding window system, or between a moving window and another moving window. More particularly, the present invention relates to a window chassis insulating structure and a glass panel supporting (mounting) structure in a center bar portion in which a window chassis of a movable window and a fixed window (or other movable window) overlap each other when a sliding window of a two-side supporting frame window having a two-sided supporting frame for supporting only both sides of a glass window constituting a sliding window system, is closed,

BACKGROUND ART

[0002] In general, when a sliding window (moving window) and a fixed window of four-side supporting frame window type that support the four sides of the glass window with thick supporting frames as a movable window (sliding window) and a fixed window constituting a sliding window system are used (FIG. 1a), as shown in a-a' cross-sectional view (longitudinal cross-sectional view) of FIG. 1b, the sliding window system has a structure in which a roller slides along a roller guide rail on a chassis frame 1 by providing the roller installed on a lower part of a window chassis 2a in which a glass is fitted. However, in case of a four-side supporting frame window type, as shown in the b-b' cross-sectional view (cross-sectional view) of FIG. 1b, there was no great difficulty in achieving both solid glass supporting function and good thermal insulating function through a shape and a structure of a portion where the glass (glass panel) is inserted and fixed and a thick (80-100 mm) center bar portion of the window chassis 2a that can provide insulating and sealing function as well as glass supporting function when the sliding window (moving window) and the fixed window are overlapped.

[0003] However, in recent years, as the openness of windows is emphasized, a two-side supporting frame window type sliding window (refer to FIG. 2a) supporting only both sides of a glass window constituting a sliding window is increasingly used. In an example of this two-side support frame window type sliding window (example of Schueco's product in Germany), a two-sided window chassis 2b into which a glass 2g is fitted exists only on both sides of the glass 2g, and moreover for wide openness, the two-sided window chassis 2b should have a narrow chassis width of about 40 mm. And as shown in the cross-sectional view of the [a-a'] line in FIG. 2b, under the glass 2g, a lower glass support insulation brackets 2p as a member (organic product such as polyamide or PVC) that wraps the glass end for the purpose of preventing damage, buffering, and insulation without an aluminum chassis, is provided. As a roller 2r is directly coupled to the lower glass support insulation bracket 2p, the sliding window of the two-side support frame window type has a structure in which the roller 2r slides

along the roller guide rail on the window frame 1. In addition, as shown in the b-b' cross-sectional view of the open state of FIG. 2c and the b-b' cross-sectional view of the closed state of FIG. 2d and the enlarged view of the main parts, among a thin side chassis parts 2b1 and 2b2 provided in the inner and outer surfaces to support a glass side support insulation bracket 2gb attached to and coupled to the side of the glass 2g, an aluminum metal outer cap 2b1 which has relatively excellent holding force, should not extend to the overlapping (closed state) portion CN of the sliding window in order to improve thermal insulation performance. (When aluminum is formed in a 'C' shape, a heat transfer path is connected from the inside to the outside, resulting in rapid heat loss, which leads to a problem in that energy efficiency is reduced and therefore surface condensation of water is induced.) On the other hand, a synthetic resin (or carbon fiber) inner cap 2b2 and the glass side support insulation bracket 2gb are arranged adjacent to each other to form a center bar portion. Here, mohair for wind/dust protection or external and internal elastic gaskets (g-out, g-in in FIG. 2d) for insulation are symmetrically installed and provide a windproof structure.

[0004] Thanks to this structure, it is possible to achieve a certain level of thermal insulation performance, however, when the sliding window is closed, the force holding the glass (2g) in the overlapping portion (CN) is weak. As a result, there is a problem of exposing structural weakness that excessive deformation occurs in the glass side support insulation bracket 2gb made of synthetic resin in an environment where strong wind acts on the glass.

[0005] On the other hand, as an example of a sliding window of another two-side supporting frame window type (refer to FIG. 2a) having a structure different from the structure described above, in the example shown in FIGS. 3a to 3d (Example of Sky-frame's product in Switzerland), a window chassis 2b into which a glass 2g is fitted exists only on both sides of the glass 2g, and there is no aluminum chassis under the glass 2g as shown in the cross-sectional view of the line [a-a'] of FIG. 3a. In addition, as shown in the b-b' cross-sectional view of the open state of the general window of FIG. 3b and the double-opening window of FIG. 3c, and the b-b' cross-sectional view and enlarged view of the closed state of the double-opening window of FIG. 3d, among a thin side chassis parts 2b1 and 2b2 provided to support a glass side support insulation bracket 2gb attached and coupled to the side surfaces of the glass 2g from the side, an aluminum metal outer cap 2b1 does not extend to the overlapping (closed) portion (CN) of the sliding window for improved insulation performance, and only a synthetic resin inner cap 2b2 and the glass side support insulation bracket 2gb are disposed adjacent to each other in the closed state. However, in order to solve the problem of insufficient rigidity (excessive deformation) according to the properties of the material of the synthetic resin inner cap in the overlapping portion CN when the sliding window is closed, in the state where the assembly of the glass 2g is completed, another cap 2gc being inserted into the gap portion between synthetic resin inner cap 2b2 and the glass side support insulation bracket 2gb in a wedge shape so that there is no loose gap between them, is additionally provided.

[0006] However, before the assembly of the glass 2g is completed, as shown in FIG. 3d of the accompanying drawings, in the process of coupling the synthetic resin inner cap 2b2 into the aluminum metal outer cap 2b1, as shown in

FIG. 3d, they must be interconnected through a roller compression processing process. At this time, due to a protruding outer stepped portion 2b1a of the aluminum metal outer cap 2b1, it is difficult to draw into the roller, so that processing thereof is difficult. Furthermore, it is possible to achieve a certain level of rigidity increase performance, but due to the high deformability and plasticity of the synthetic resin inner cap 2b2, there is a problem in that structural weaknesses due to large deformation occurring in the synthetic resin inner cap 2b2 and the glass side support insulation bracket 2gb made of synthetic resin cannot be completely eliminated in the environments where strong winds act on the glass. This situation occurs because the force itself that holds the glass 2g from the side at the overlapping portion CN when the sliding window is closed is not increased.

[0007] As an example of a sliding window (refer to FIG. 2a) of a two-side support frame window type of another structure, in the example shown in FIGS. 4a to 4c (an example of a product manufactured by 'Panoramah' of Switzerland), the material of an inner cap 2b2 that supports, from the inside, a glass side support insulation bracket 2gb corresponding to the portion holding the glass 2g from the side in the overlapping portion (CN) when the sliding window is closed, is also a soft synthetic resin material. Therefore, it has structural weaknesses in the same meaning.

Technical Problem

[0008] The present invention is to solve the problems of the prior invention of the applicant of the present application described above. It is a technical problem of the present invention to provide a specially improved structure for the component corresponding to the inner cap 2b2 in the prior art so as to control the deformation of the glass side support insulation bracket 2gb in a window type sliding window with a two-side supporting frame that supports only both sides of the glass window constituting the sliding window, in order to maintain good thermal insulation function and to secure better glass panel fixing function in constituting a narrow window chassis 2b that exists only on both sides of the glass 2g, even if a structure is adopted that the aluminum metal outer cap 2b1, which has relatively excellent fixing support, does not extend to the portion CN where the sliding window overlaps (when closed) in order to improve its thermal insulation performance, among the thin side chassis parts 2b1 and 2b2 provided to support the glass side support insulation bracket 2gb attached to and coupled to the side surface of the glass 2g from the inner and outer surfaces.

Technical Solution

[0009] In order to solve the above-described technical problem, the present invention provides a window chassis insulating structure and glass panel supporting structure of two-side support frame window chassis at the center bar portions where the two-side support frame window chassis overlap each other when a sliding window closed, in a sliding window system of two-side support frame window type that supports only both sides of the glass windows constituting the sliding window,

[0010] wherein a structure is provided in which a roller is directly coupled to a lower glass support insulating bracket

(soft material) without an aluminum chassis under the glass panel and slides along the roller guide rail on the window frame,

[0011] wherein the window chassis insulating structure and glass panel supporting structure comprises,

[0012] glass support insulation brackets attached to a side of each of glass panels;

[0013] side chassis portions made of an aluminum material provided to support the glass support insulation brackets from inner and outer surfaces;

[0014] protruding edge portions and first fitting slots provided on inner extension support ends extending from the side chassis portions to the center bar portions;

[0015] side elastic insulating support assemblies comprising a first plates slidably coupled to the first fitting slots: a second plates disposed to be spaced apart from the first plates in a side direction of the glass panels and provided to support the side surface of the glass support insulation brackets: and heat insulating connectors of elastic material coupled between the first plates and the second; and

[0016] rigid support members formed to be additionally fitted in a wedge manner into the first plates of the side elastic insulating support assemblies and, at the same time, into the protruding edge portions of the side chassis portions,

[0017] wherein the rigid support members being provided as a reinforced synthetic resin material in a symmetrical direction in which the window chassis overlap each other on the side surfaces of the side elastic insulation support assemblies, respectively, in order to control displacement or deformation width of the side elastic insulating support assemblies so as to increase force holding the glass panels at side.

[0018] Herein, the rigid support members preferably comprise;

[0019] fitting slots into which extended ends of the second plates of the side elastic insulating support assemblies are fitted and coupled;

[0020] step edge portions engaged with the protruding edge portions provided on inner extension support ends extending from the side chassis portions to the center bar portions; and

[0021] protruding side support ends between the fitting slots and the stepped edge portions.

[0022] Furthermore, protruding fitting ends are provided on opposite surfaces of the first plates and the second plates, respectively, into which both ends of the heat insulating connectors coupled therebetween are fitted, and the protruding fitting ends are formed to abut against and support the protruding side support ends of the rigid support members.

[0023] More preferably, the rigid support members further comprise gasket grooves 11c3, 21c3 to which elastic gaskets 12, 22 are coupled as air tightness blocking members in a direction opposite to the other symmetrically overlapping window chassis.

Advantageous Effects

[0024] According to the insulating structure and glass panel supporting structure of the window chassis at the center bar portion where the two-side support frame window chassis overlap each other in the sliding window of the present invention, through a heat insulating connector made of an elastic material coupled between the first plate and the second plate constituting the side elastic heat insulating support assembly that is slidably coupled to the inner

extension support ends extending from the side chassis portions to the center bar portions, a basic heat insulation function can be obtained. In addition, the force for holding the glass panels from the side may be increased through the rigid support members provided to be simultaneously wedge-coupled to the first plate of the side elastic insulating support assemblies and the protruding edge portions of the side chassis portions.

[0025] In the sliding window system employing the structure according to the present invention, while maintaining good thermal insulation performance, at the same time, by increasing the force holding the glass panels from the side, it has a more stable deformation absorption capacity against the displacement or deformation of the glass panel support brackets (glass support insulation brackets made of flexible and soft material) generated by wind pressure. In addition, by allowing the width of displacement or deformation to be controlled within an appropriate range, it also provides the effect of securing more excellent stability by alleviating the risk that may be caused by excessive deformation.

DESCRIPTION OF DRAWINGS

[0026] FIGS. 1a to 1c are views showing a conventional general sliding window system, showing a sliding window having a window chassis supporting glass at four sides.

[0027] FIGS. 2a to 2d are views showing sliding windows improved from the general sliding window system shown in FIGS. 1a to 1c, and the openness of the windows is emphasized in this improvement. These drawings are a schematic view showing an example of a sliding window installation structure in which the two-side supporting frame supports only both sides of the glass panels constituting the sliding windows (two-side supporting windows type) and glass is directly placed on the upper part of the roller without an aluminum window chassis under the lower part of the sliding window.

[0028] FIGS. 3a to 3e are views showing another example of a sliding window of a two-side supporting frame window type, and FIGS. 4a to 4c are views showing additional example for two-side supporting frame window type.

[0029] FIG. 5a is a front view showing a sliding window installation structure (insulating structure and glass panel supporting structure of a window chassis at a center bar portion where two side support frame window chassis overlap each other) according to the present invention, and FIG. 5b shows a cross-sectional view along line a1-a1' of FIG. 5a and a cross-sectional view along line a2-a2' of FIG. 5a.

[0030] FIG. 5c is a cross-sectional view taken along line b-b' of FIG. 5a, and is a view showing a change operation between an open state and a closed state of the sliding window.

[0031] FIG. 5d is an enlarged view of [Part-C] of FIG. 5c.

[0032] FIGS. 6a to 6e show step-by-step diagrams in which the insulating structure of the window chassis and the glass panel support structure are assembled in stages at the center bar portion where the two-side support frame window chassis overlap each other in order to achieve the sliding window installation structure according to the present invention.

MODES OF THE INVENTION

[0033] Hereinafter, embodiments that are easily performed by those skilled in the art will be described in detail with reference to the accompanying drawings. However, the embodiments of the present invention may be achieved in several different forms and are not limited to the embodiments described herein.

[0034] As described above, in the sliding window improved to increase the openness of the windows, the present invention provides new window chassis insulating structure and glass panel supporting structure at the center bar portion where the two-side support frame window chassis having a relatively narrow frame width compared to the four-side support window chassis, overlap each other. According to a preferred embodiment of the present invention illustrated through the drawings shown in the accompanying drawings FIGS. 5a to 6e, glass panels 10g, 20g forming a fixed window 10 or a movable window 20 constituting the sliding window supports only both sides of the chassis with an aluminum chassis, and a structure is provided in that rollers are directly coupled to the lower glass support insulation brackets without an aluminum chassis at the lower portions of the glass panels 10g and 20g, so that they slide along roller guide rails on the window frame 100.

[0035] According to such a preferred embodiment of the present invention, when the sliding windows 10 and 20 in the sliding window system of the two-side supporting frame window type are closed (the state of the upper figure in FIG. 5c), a structure for insulating and supporting glass panels of the window chassis 11 and 21 at the center bar portion ([Part-C]) where the two-side support frame window chassis 11 and 21 overlap each other, is provided.

[0036] the window chassis insulating structure and glass panel supporting structure comprises, as shown in FIG. 5c and FIG. 5d which are enlarged views of its main part,

[0037] glass support insulation brackets 10a, 20a attached to a side of each of glass panels 10g, 20g;

[0038] side chassis portions 11a, 21a made of an aluminum material provided to support the glass support insulation brackets 10a, 20a from inner and outer surfaces;

[0039] protruding edge portions 11ae, 21ae and first fitting slots 11a1s, 21a1s provided on inner extension support ends 11a1, 21a1 extending from the side chassis portions 11a, 21a to the center bar portions;

[0040] side elastic insulating support assemblies 11b, 21b comprising a first plates 11b1, 21b1 slidably coupled to the first fitting slots 11a1s, 21a1s; a second plates 11b2, 21b2 disposed to be spaced apart from the first plates 11b1, 21b1 in a side direction of the glass panels and provided to support the side surface of the glass support insulation brackets 10a, 20a; and heat insulating connectors 11b3, 21b3 of elastic material coupled between the first plates 11b1, 21b1 and the second plates 11b2, 21b2; and

[0041] rigid support members 11c, 21c formed to be additionally fitted in a wedge manner into the first plates 11b1, 21b1 of the side elastic insulating support assemblies 11b, 21b and, at the same time, into the protruding edge portions 11ae, 21ae of the side chassis portions 11a, 21a,

[0042] wherein the rigid support members 11c, 21c being provided as a reinforced synthetic resin material in a symmetrical direction in which the window chassis 11, 21 overlap each other on the side surfaces of the side elastic insulation support assemblies 11b, 21b, respectively, in

order to control displacement or deformation width of the side elastic insulating support assemblies 11b, 21b so as to increase force holding the glass panels 10g, 20g at side while maintaining the thermal insulation performance.

[0043] Herein, the rigid support members 11c, 21c preferably comprise; fitting slots 11c1s, 21c1s into which extended ends 11b2a, 21b2a of the second plates 11b2, 21b2 of the side elastic insulating support assemblies 11b, 21b are fitted and coupled; step edge portions 11c1e, 21c1e engaged with the protruding edge portions 11ae, 21ae provided on inner extension support ends 11a1, 21a1 extending from the side chassis portions 11a, 21a to the center bar portions; and protruding side support ends 11c1, 21c1 between the fitting slots 11c1s, 21c1s and the stepped edge portions 11c1e, 21c1e.

[0044] On the other hand, as shown in FIG. 6c, a certain gap t of clearance is maintained between the fitting slots 11c1s, 21c1s and the extended ends 11b2a, 21b2a of the second plates 11b2, 21b2 of the side elastic insulation support assemblies 11b, 21b, whereby enabling a certain range of elastic movement or deformation of the second plates 11b2, 21b2, and elastically supporting the side surfaces of the glass support insulation brackets 10a, 20a supporting the glass panels within a set displacement or deformation range. Therefore, it becomes possible to alleviate deformation or damage so that glass breakage can be prevented.

[0045] In addition, protruding fitting ends are provided on opposite surfaces of the first plates 11b1, 21b1 and the second plates 11b2, 21b2, respectively, into which both ends of the heat insulating connectors 11b3, 21b3 coupled therebetween are fitted, and the protruding fitting ends (both sides rolling pressing process may be performed for a strong bond) are formed to abut against and support the protruding side support ends 11c1, 21c1 of the rigid support members 11c, 21c.

[0046] Preferably, the rigid support members 11c, 21c further comprise gasket grooves 11c3, 21c3 to which elastic gaskets 12, 22 are coupled as air tightness blocking members in a direction opposite to the other symmetrically overlapping window chassis.

[0047] And the elastic gaskets 12, 22 serving as air tightness blocking members comprises fixed ends fitted into the gasket grooves 11c3, 21c3 and fixed to the sliding window; and elastically deformable ends elastically deformed outwardly in contact with the rigid support members of the other opposing window chassis.

[0048] On the other hand, the insulating and glass panel supporting structure of the window chassis 11 and 21 at the center bar portions ([Part-C]) where the two-side support frame window chassis 11 and 21 configured as described above overlap each other, is completed through the assembly steps shown in the drawings of FIGS. 6a to 6e and is implemented in the sliding window system.

[0049] Firstly, as shown in FIG. 6a, by inserting and assembling the first plates 11b1 and 21b1 of the side elastic insulation support assemblies 11b and 21b into the first fitting slots 11a1s, 21a1s on one surface of the inner extension support ends 11a1 and 21a1 of the side chassis portions 11a and 21a made of aluminum, in a sliding manner along the longitudinal groove, and the side ends of the first plates 11b1 and 21b1 are elastically deformed by the rear surfaces of the protruding edge portions 11ae and 21ae and the rear surfaces of the outer protruding ends 11a2 and 21a2

providing both jaws of the first fitting slots 11a1s and 21a1s, and therefore the first plates 11b1 and 21b1 are firmly fitted and fixed into the first fitting slots 11a1s and 21a1s.

[0050] After that, as shown in FIG. 6b, sealant is applied to one side of the side elastic insulating support assembly 11b and 21b, and the rigid support members 11c and 21c are press-fitted in a wedge manner to strengthen the side support and structurally make a symbol of 'C' (channel type) complete.

[0051] Here, the second fitting slots 11c1s, 21c1s of the rigid supports 11c, 21c are plugged in and joined to the extension ends 11b2a, 21b2a of the second plates 11b2, 21b2 of the side elastic insulation support assemblies 11b, 21b, simultaneously the stepped edge portions 11c1e, 21c1e are engaged with the protruding edge portions 11ae, 21ae provided on the inner extension support ends 11a1, 21a1 extending from the side chassis portions 11a, 21a to the center bar portions, and the protruding side support ends 11c1, 21c1 are inserted into the space between the second fitting slots 11c1s, 21c1s and the stepped edge portions 11c1e, 21c1e, thereby in a state in which the stepped edge portions 11c1e, 21c1e and the protruding edge portions 11ae, 21ae are pressed in a wedge manner by corner engagement, rotation or deformation of the rigid support members 11c, 21c in the direction indicated by arrows as shown at the top of the FIG. 6c is strongly prohibited. In this way, while forming one strong support structure to the outside, meanwhile to the inside, the extension ends 11b2a, 21b2a of the second plates 11b2, 21b2 of the side elastic insulating support assemblies 11b, 21b are fitted into the second fitting slots with an appropriate clearance t, it is possible to solve the assembly tolerance problem. As well as, even when the continuous strong wind exerts pressure on the glass panels 10g, 20g, the glass panels 10g and 20g and the glass support insulation brackets 10a and 20a supporting them can elastically absorb this displacement even in a situation in which displacement must occur within a set range.

[0052] In addition, the first plates 11b1, 21b1 and the second plates 11b2, 21b2 of the elastic insulating support assemblies 11b, 21b are made of an aluminum material so as to have a predetermined rigidity and elasticity necessary for a function as a glass panel supporting. It is also made possible to prevent heat loss (blocking heat flow) by the insulating connectors 11b3, 21b3 made of an elastic material that interconnects them in the middle.

[0053] As shown in FIG. 6d in the state of FIG. 6c, in concave portions adjacent to outer protruding ends 11a2, 21a2 forming the first fitting slots 11a1s, 21a1s on one surface of the inner extension support ends 11a1 and 21a1 of the side chassis portions 11a and 21a, left and right height correction insulation supports 11d, 21d are provided so as to provide a heat insulation function while supporting the glass support insulation brackets 10a, 20a at the same height from the inside and the outside, after additionally applying the sealant, the glass supporting insulation brackets 10a, 20a supporting the glass panels 10g, 20g are fitted together with the glass panels 10g, 20g. At this time, the inner spaces 11ds, 21ds are filled with silicon, and in addition, second protruding side support ends 11c2, 21c2 are provided in the rigid support members 11c and 21c as shown in FIG. 6e. The finishing work is completed by additionally extending and providing foam rubber insulating gaskets 11e and 21e between the second protruding side support ends 11c2 and

21c2 and the glass panels **10g** and **20g**. Thereby, the rotation of the rigid support members **11c**, **21c** in a direction opposite to the direction of the arrow in FIG. **6d** (rotation in the opposite direction to the rotation prevented in FIG. **6d**) is also controlled and prevented by the assembled glass panels **10g**, **20g** and the glass supporting insulation brackets **10a**, **20a**, the stability of the entire device can be further supplemented and maintained.

[0054] In the above, while describing in detail a preferred embodiment of the present invention is applied to window having a pair of glass in which a plurality of glass panels **10g**, **20g** are formed by overlapping each other by bonding with a predetermined interval and a sealing member there between to realize a vacuum in the gap. However, it should be understood that the terms of glass panels are not to be constructed as limiting the scope of the present invention, and various modifications and improvements by those skilled in the art using the basic concept of the present invention defined in the following claims are also within the scope of the present invention.

1-7. (canceled)

8. A structure of auxiliary locking device of a hinged door, characterized in that as an opening and closing device for a hinged door **1**, the driving plate **110**: **110[1]**, **110[2]** upwardly and downwardly moved by a switching device **100** constituting the auxiliary locking device of a hinged door, is respectively disposed in the upper section and in the lower section of the area in which the first locking tool **1h**, **1s**, **1sa** and the second locking tool **1ph**, **1p**, **1pv** are installed, which are provided as the main locking device for security between the rotating opening side of the hinged door **1** and the door frame **1a** side, and sliding pockets **110a** at the upper and lower portions are installed separately in the longitudinal direction on the side of the door frame **1a** in order to accommodate the driving plates, respectively,

a connecting plate **210** is provided as a connecting means installed so as to reciprocate between the upper and lower sliding pockets **110a** and interconnect the upper and lower drive plates **110[1]**, **110[2]** that are separately installed up and down, wherein the connecting plate **210** comprising an upper connecting plate **211** connected to the lower end of the upper driving plate **110[1]**, and a lower connecting plate **212** connected to the upper end of the lower driving plate **110[2]** and connected so that the upper connecting plate **211** is not separated in the longitudinal direction but can be separated only in the front-rear direction,

a base plate **220** is provided, wherein the base plate **220** being installed between the upper and lower sliding pockets **110a** separated and separated to each other to support the bottom surface of the connecting plate **210** and to guide the vertical movement of the connecting plate **210**, and

a cover plate **230** is provided on an upper surface of the base plate **220** to be spaced apart from each other by a height exceeding the thickness of the connecting plate **210** in order to form an operating space allowing the connecting plate **210** to move in the longitudinal direction,

wherein a pocket installation groove **233** in which a cylinder pocket **1sa** accommodating a locking cylinder is constituting the first locking tool is installed is provided on the upper surface of the cover plate **230**, and

wherein the cover plate **230** and the connecting plate **210** are provided with locking piston through holes **234**, **212b**, respectively, so that the lateral operating range of the locking piston **1p** constituting the second locking tool can reach the base plate region.

9. The structure of auxiliary locking device of a hinged door of claim **8**, wherein the auxiliary locking device for a hinged door including the switching device **100** is additionally provided in order to realize a close contact state to a door frame **1a** of a hinged door **1** provided with two or more locking tools '**1h**, **1s**, **1sa**', '**1ph**, **1p**, **1pv**' as a main locking device for security, the auxiliary locking device of a hinged door comprises;

a plurality of close contact guide plates **130** that are installed longitudinally and spaced apart from the rotating opening side of the hinged door **1**;

a plurality of pressure rolls **120** provided longitudinally spaced apart from the door frame **1a** side so that in a state in which the rotating opening side of the hinged door **1** is closed on the door frame **1a** side, in a contact state with the close contact guide plates **130**, the rotating opening side of the hinged door **1** is pulled toward the door frame **1a** side, thereby implementing a compressed locked state, and so that in a non-contact state with the close contact guide plates **130**, an uncompressed locked state of the rotating opening side of the hinged door **1** against the door frame **1a** side is implemented;

a driving plate **110** installed in a sliding pocket **110a** provided in a longitudinal direction on the door frame side so that the pressure rolls **120** can be installed to be slidably movable in a longitudinal direction from the side of the door frame **1a**, and provided so that the pressure rolls **120** are spaced apart in the longitudinal direction on the front side; and

a switching device **100** installed in the door frame **1a** so that the second pressure roll **120b** switches between a contact compressed state position with the close contact guide plate **130** and a non-contact uncompressed state position through a longitudinal movement displacement, so that can induce a corresponding longitudinal movement displacement of the driving plate **110** by providing a longitudinal movement displacement by engaging with at least one first pressure roll **120a** among the pressure rolls **120** installed on the driving plate **110**, and so that can generate the longitudinal movement displacement of the remaining second pressure roll **120b** induced by the longitudinal movement displacement of the drive plate **110**.

10. The structure of auxiliary locking device of a hinged door of claim **8**, wherein the connecting plate **210** installed to interconnect the upper driving plate **110[1]** and the lower driving plate **110[2]** installed separately in the vertical direction, in order to be connected so that the upper connecting plate **211** and the lower connecting plate **212** are not separated from each other in the longitudinal direction but can be separated only in the front and rear direction, is characterized in that the lower end of the upper connecting plate **211** includes a male fastener **211a**, and the upper end of the lower connecting plate **212** includes a female fastener **212a** that is fastened in a front-rear direction fitting method.

11. The structure of auxiliary locking device of a hinged door of claim **10**, characterized in that the cover plate **230** is rigidly fixed to the door frame **1a** by a fastening piece **f1**

penetrating the cover plate **230** and the base plate **220**, and so that the movement of the connecting plate **210** in the vertical direction is not disturbed by the fastening piece **fs1** that is fastened through the cover plate **230** and the base plate **220**, a fastening piece through-hole **211b** having a long hole shape is provided at a predetermined central position of the upper connecting plate **211**, and a locking piston through-hole **212b** is provided at a predetermined central position of the lower connecting plate **212**.

12. The structure of auxiliary locking device of a hinged door of claim **8**, wherein the structure in which the cover plate **230** is spaced apart from the base plate **220**, is implemented through a spacer **222** provided to support a portion of the upper surface of the base plate **220** and a portion of the bottom surface of the cover plate **230**.

13. The structure of auxiliary locking device of a hinged door of claim **12**, wherein the spacer **222** is integrally protruded from the upper surface of the base plate **220**, and a mounting groove is additionally provided on the lower surface of the cover plate **230**.

14. The structure of auxiliary locking device of a hinged door of claim **11**, wherein a pocket installation groove **233** in which a cylinder pocket **1sa** for accommodating the locking cylinder is constituting the first locking tool is fixedly installed is provided on the upper surface of the cover plate **230**, and

a locking piston through-hole **234** is also provided in the cover plate **230** at a position corresponding to the formation position of the locking piston through-hole **212b** of the lower connecting plate **212** so that the lateral operating range of the locking piston **1p** constituting the second locking tool can reach the base plate **220** region.

15. The structure of auxiliary locking device of a hinged door of claim **14**, wherein the base plate **220** is provided with a locking piston through-hole **224** at a position corresponding to the provision position of the locking piston through-hole **212b** of the lower connecting plate **212**.

16. The structure of auxiliary locking device of a hinged door of claim **9**, wherein the connecting plate **210** installed to interconnect the upper driving plate **110[1]** and the lower driving plate **110[2]** installed separately in the vertical direction, in order to be connected so that the upper connecting plate **211** and the lower connecting plate **212** are not separated from each other in the longitudinal direction but can be separated only in the front and rear direction, is characterized in that the lower end of the upper connecting plate **211** includes a male fastener **211a**, and the upper end of the lower connecting plate **212** includes a female fastener **212a** that is fastened in a front-rear direction fitting method.

17. The structure of auxiliary locking device of a hinged door of claim **16**, characterized in that the cover plate **230** is rigidly fixed to the door frame **1a** by a fastening piece **fs1** penetrating the cover plate **230** and the base plate **220**, and so that the movement of the connecting plate **210** in the

vertical direction is not disturbed by the fastening piece **fs1** that is fastened through the cover plate **230** and the base plate **220**, a fastening piece through-hole **211b** having a long hole shape is provided at a predetermined central position of the upper connecting plate **211**, and a locking piston through-hole **212b** is provided at a predetermined central position of the lower connecting plate **212**.

18. The structure of auxiliary locking device of a hinged door of claim **17**, wherein a pocket installation groove **233** in which a cylinder pocket **1sa** for accommodating the locking cylinder is constituting the first locking tool is fixedly installed is provided on the upper surface of the cover plate **230**, and

a locking piston through-hole **234** is also provided in the cover plate **230** at a position corresponding to the formation position of the locking piston through-hole **212b** of the lower connecting plate **212** so that the lateral operating range of the locking piston **1p** constituting the second locking tool can reach the base plate **220** region.

19. The structure of auxiliary locking device of a hinged door of claim **18**, wherein the base plate **220** is provided with a locking piston through-hole **224** at a position corresponding to the provision position of the locking piston through-hole **212b** of the lower connecting plate **212**.

20. The structure of auxiliary locking device of a hinged door of claim **9**, wherein the structure in which the cover plate **230** is spaced apart from the base plate **220**, is implemented through a spacer **222** provided to support a portion of the upper surface of the base plate **220** and a portion of the bottom surface of the cover plate **230**.

21. The structure of auxiliary locking device of a hinged door of claim **20**, wherein the spacer **222** is integrally protruded from the upper surface of the base plate **220**, and a mounting groove is additionally provided on the lower surface of the cover plate **230**.

22. The structure of auxiliary locking device of a hinged door of claim **11**, wherein a pocket installation groove **233** in which a cylinder pocket **1sa** for accommodating the locking cylinder is constituting the first locking tool is fixedly installed is provided on the upper surface of the cover plate **230**, and

a locking piston through-hole **234** is also provided in the cover plate **230** at a position corresponding to the formation position of the locking piston through-hole **212b** of the lower connecting plate **212** so that the lateral operating range of the locking piston **1p** constituting the second locking tool can reach the base plate **220** region.

23. The structure of auxiliary locking device of a hinged door of claim **14**, wherein the base plate **220** is provided with a locking piston through-hole **224** at a position corresponding to the provision position of the locking piston through-hole **212b** of the lower connecting plate **212**.

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(54) **THERMAL INSULATION DEVICE**

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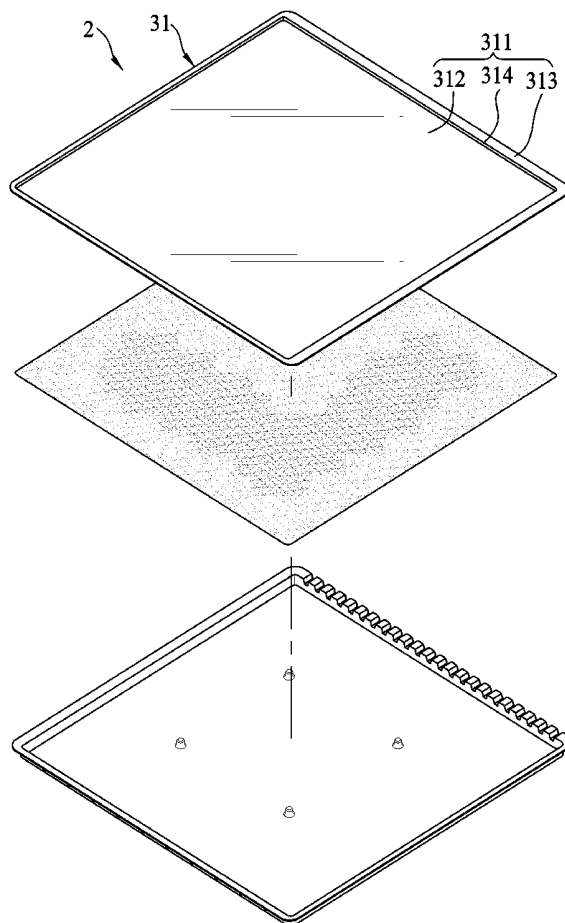
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B32B 2307/304 (2013.01); *B32B 2307/732*
(2013.01); *B32B 2605/006* (2013.01)

(57) **ABSTRACT**

A thermal insulation device includes a film unit including inner and outer layers and a thermal insulation unit. The outer layer is mounted to a window of a vehicle. The inner layer has a peripheral portion connected sealingly to the outer layer, and a center portion spaced apart from and cooperating with the outer layer to define a thermal insulation space therebetween. The film unit is formed with inlet holes communicating with the thermal insulation space and a seating space of the vehicle, and outlet holes communicating with the thermal insulation space and open toward the bodyspace, such that air in the seating space flows into the thermal insulation space through the inlet holes and is discharged from the thermal insulation space toward the bodyspace through the outlet holes. The thermal insulation unit includes a heat insulation layer disposed on the outer layer.



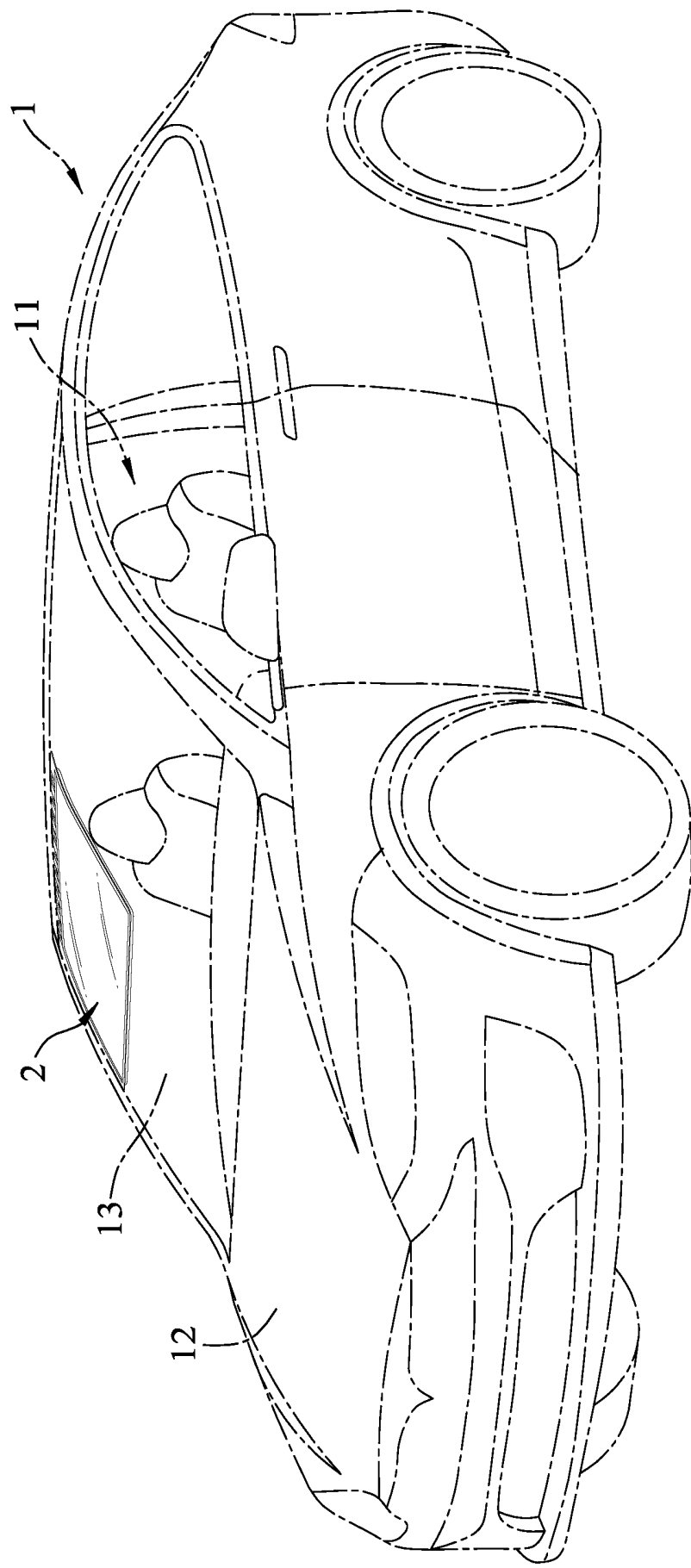


FIG.1

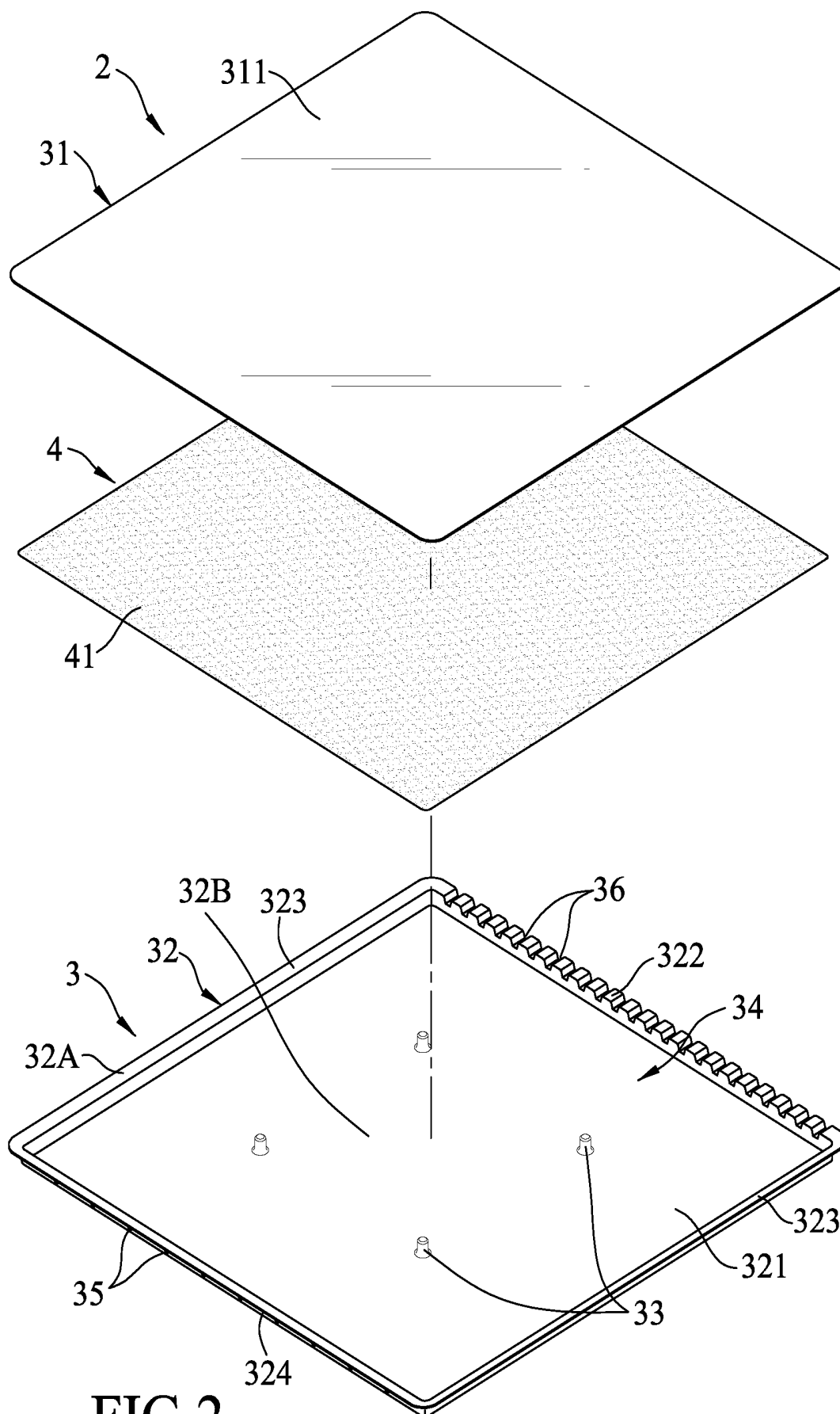


FIG.2

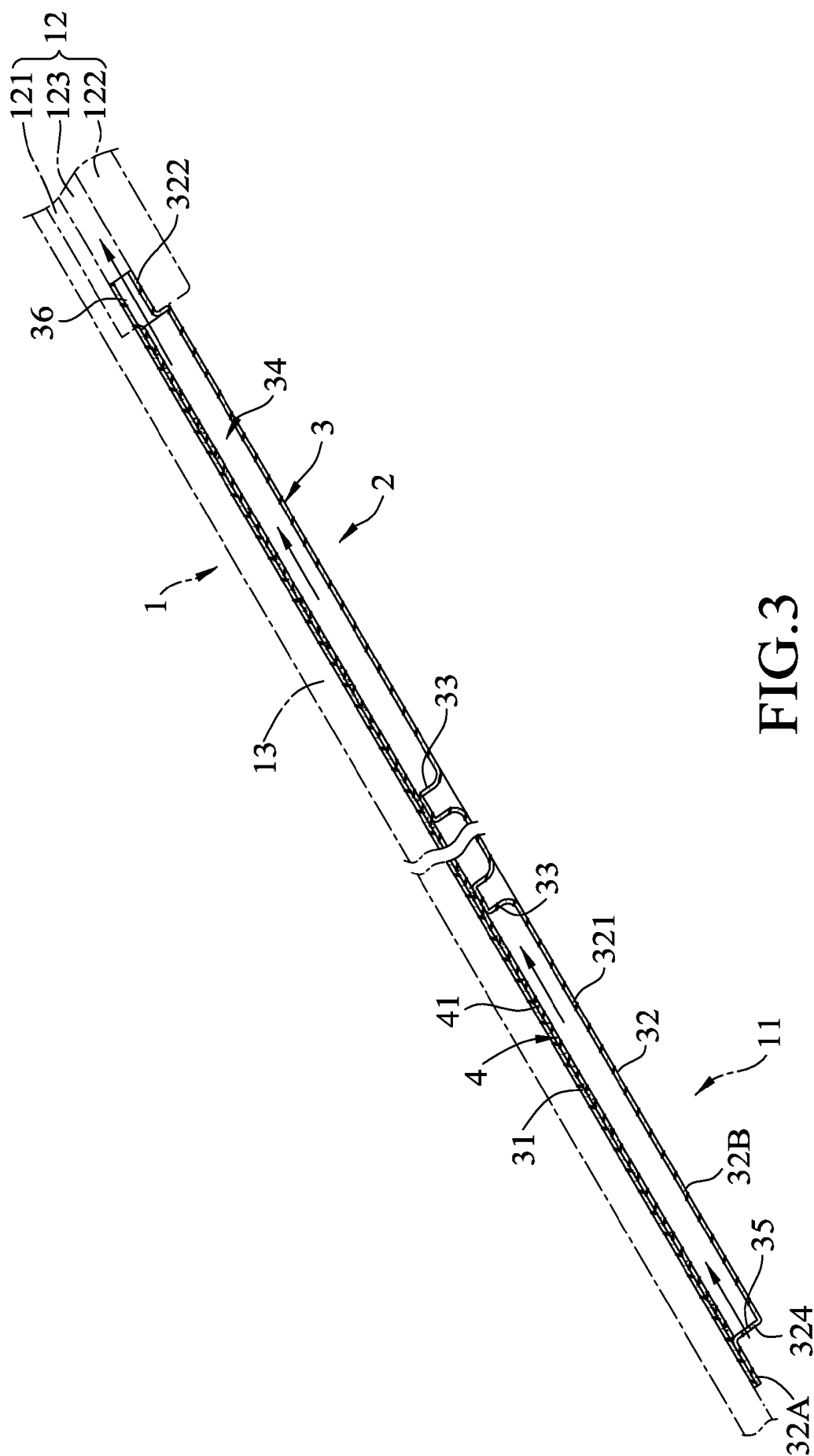


FIG. 3

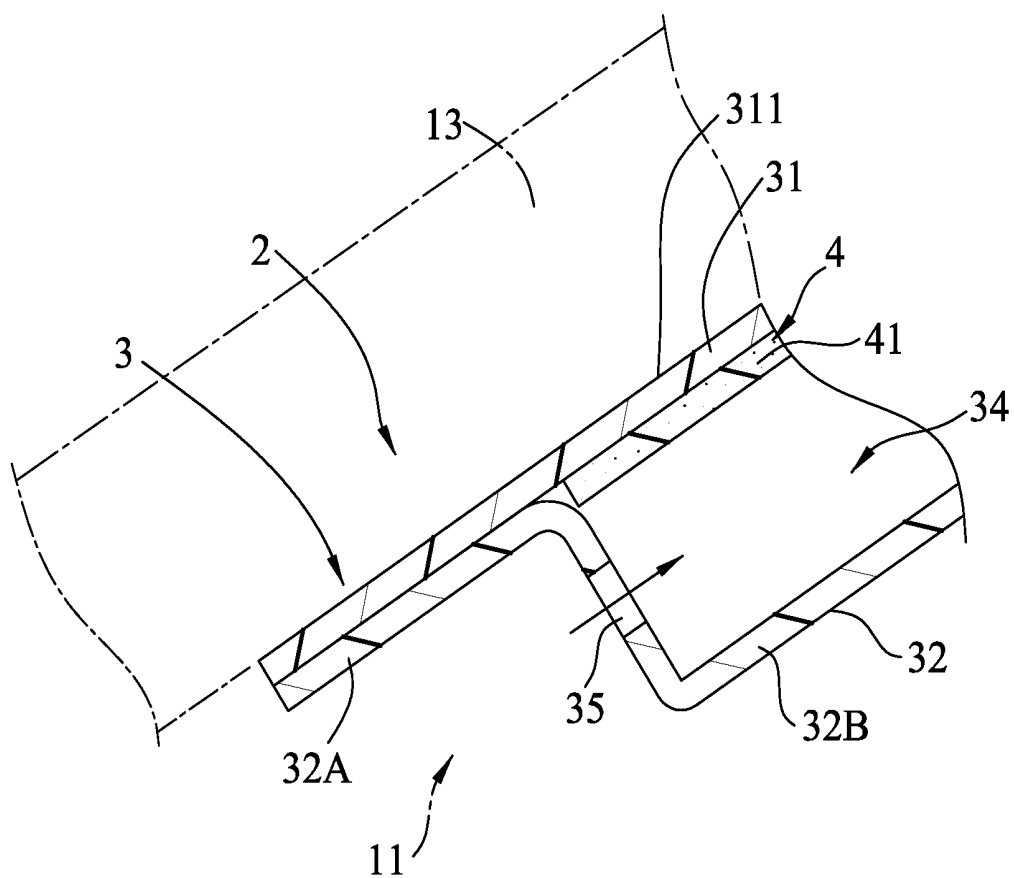


FIG.4

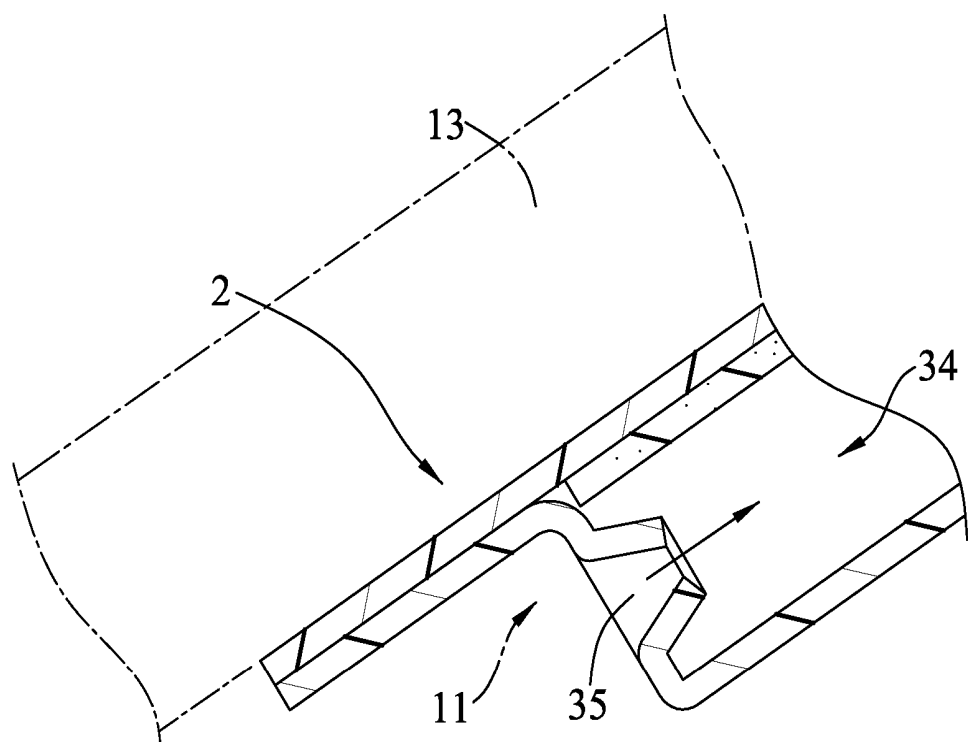


FIG.5

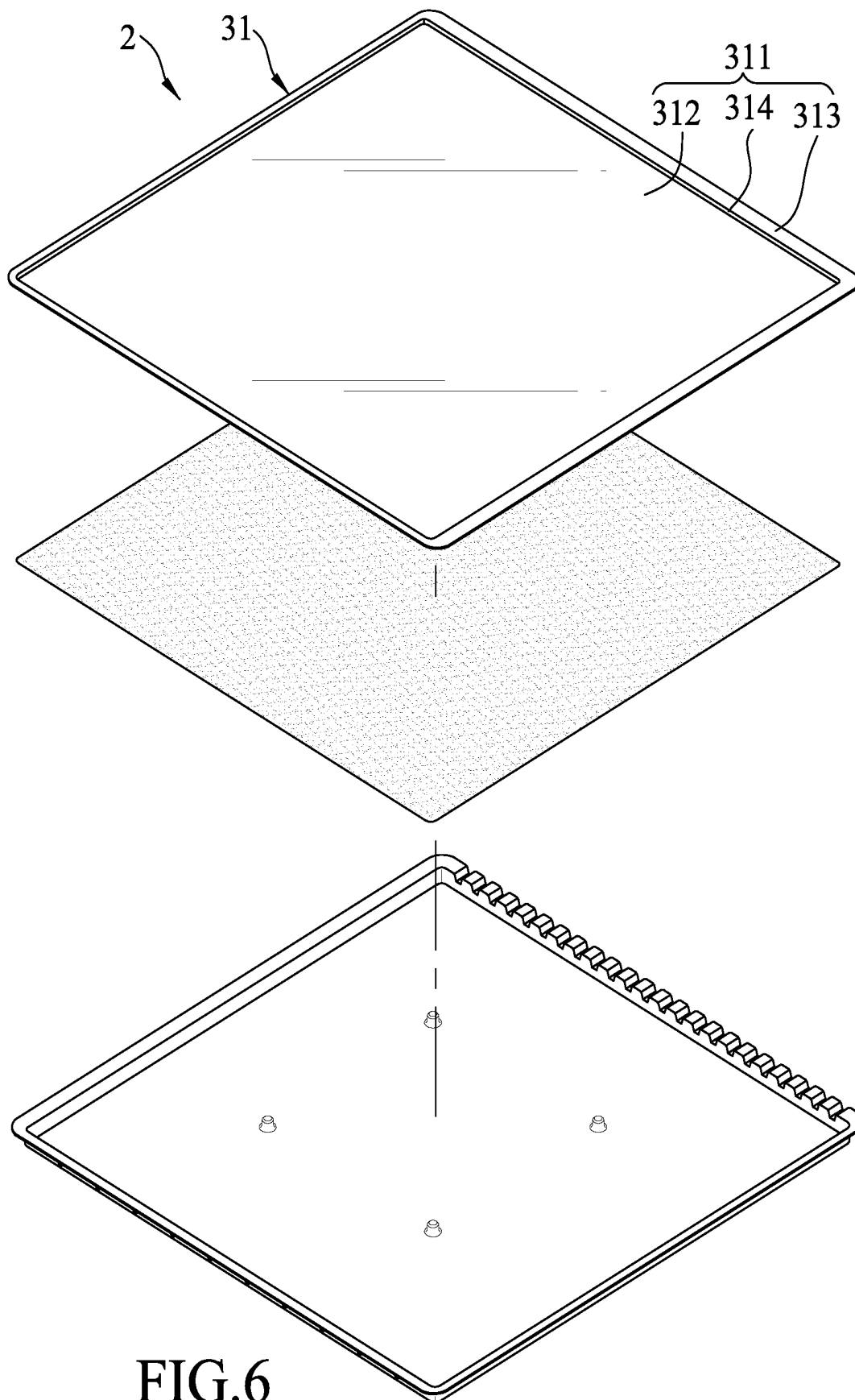


FIG.6

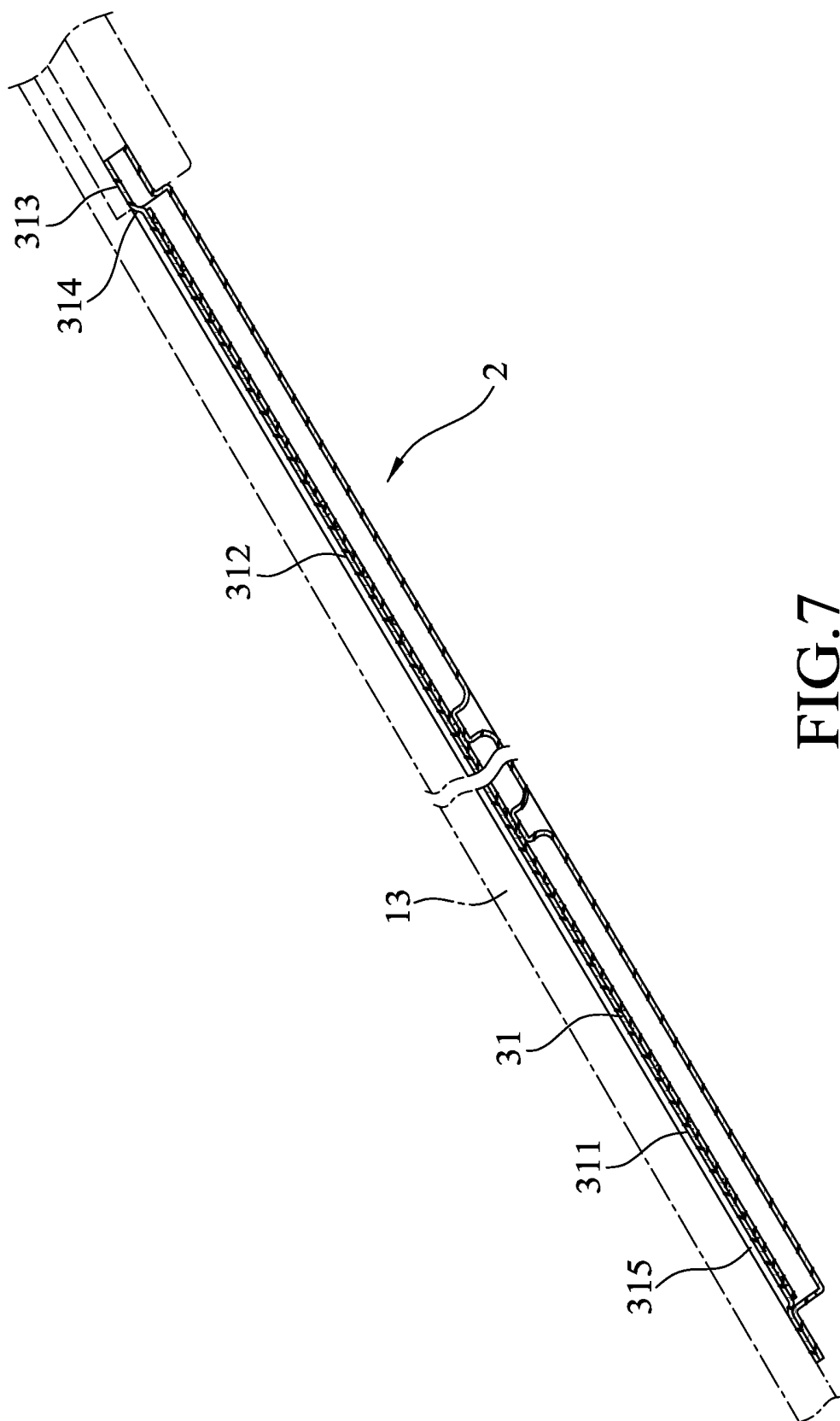


FIG. 7

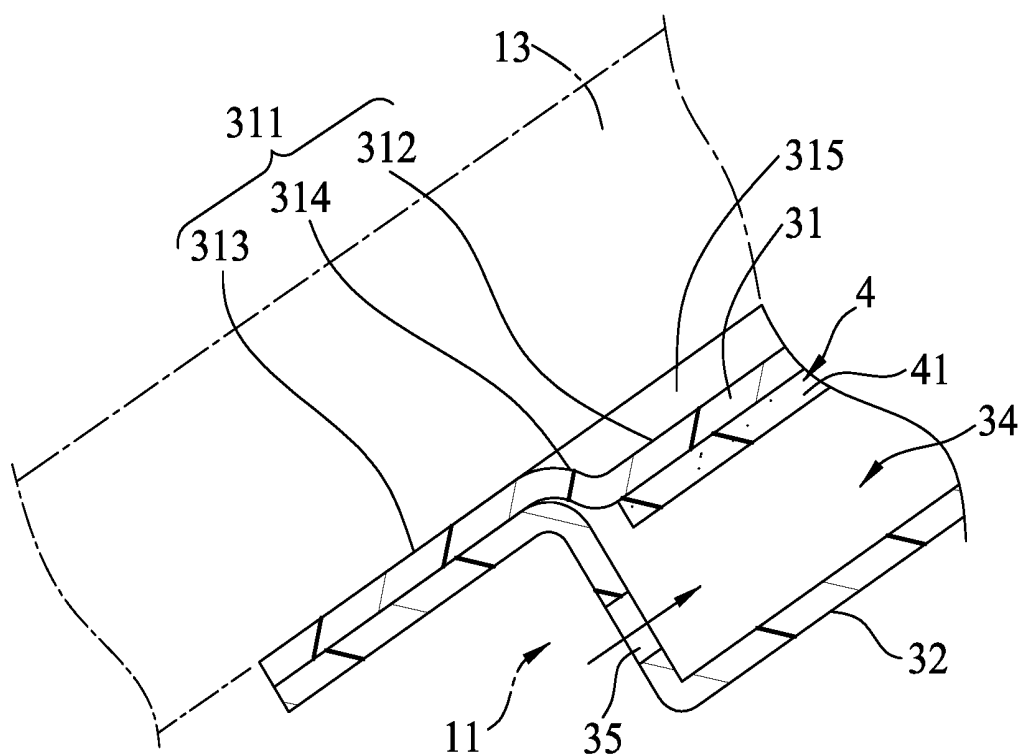


FIG.8

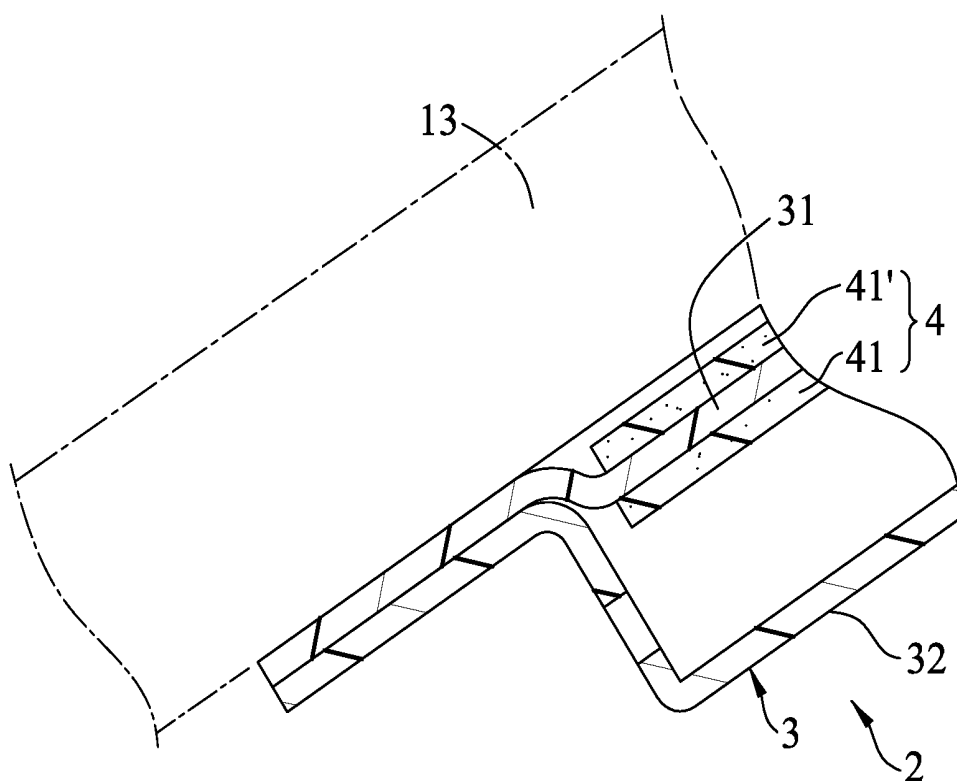


FIG.9

THERMAL INSULATION DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority of Taiwanese Invention Patent Application No. 110130734, filed on Aug. 19, 2021.

FIELD

[0002] The disclosure relates to a thermal insulation device, and more particularly to a thermal insulation device adapted to be mounted on a vehicle.

BACKGROUND

[0003] In general, a black body radiation of a window glass of a car, which is also known as an emissivity of the window glass after being exposed to sunlight, is about 0.84. When sunlight hits the car window, a portion of the sunlight is reflected back directly, another portion of the sunlight enters into an interior space of the car through the window glass, and a remaining portion of the sunlight, e.g., 84% of the sunlight, is absorbed by the window glass as radiant heat. Next, the radiant heat absorbed by the window glass will also radiate into the interior space of the car and then out of the car. As a result, temperature inside the car will rise. In response to the rising temperature, some manufacturers or car owners would attach a conventional thermal insulation film to the window glass for shielding against the sunlight. However, performance of the conventional thermal insulation film is generally unsatisfactory because heat absorbed by the conventional thermal insulation film may also radiate into the interior space of the car.

SUMMARY

[0004] Therefore, an object of the disclosure is to provide a thermal insulation device capable of alleviating at least one of the drawbacks of the prior art.

[0005] According to an aspect of the disclosure, a thermal insulation device is adapted to be mounted to a vehicle. The vehicle defines a seating space therein and includes a vehicle body. The vehicle body includes a bodyshell and a window that is mounted to the bodyshell. The thermal insulation device includes a film unit and a thermal insulation unit. The film unit is adapted to be mounted to the vehicle body for covering an inner surface of the window that faces the seating space, is light transmissive, and includes an outer layer and an inner layer. The outer layer is adapted to be mounted to the inner surface of the window. The inner layer is mounted to the outer layer such that the outer layer is disposed between the inner layer and the window. The inner layer has a peripheral portion connected sealingly to the outer layer, and a center portion spaced apart from and cooperating with the outer layer to define a thermal insulation space therebetween. The film unit is formed with a plurality of inlet holes that are in spatial communication with the thermal insulation space and that are adapted to communicate with the seating space, and a plurality of outlet holes that are in spatial communication with the thermal insulation space, that are disposed above the inlet holes, and that are adapted to be open toward the bodyshell, such that air in the seating space flows into the thermal insulation space through the inlet holes and is discharged from the thermal insulation space toward the bodyshell through the outlet holes, so as to ventilate the thermal insulation space. The

thermal insulation unit includes a heat insulation layer that is disposed on a side surface of the outer layer facing the thermal insulation space, and that is adapted to reflect and absorb heat conducted from the window.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Other features and advantages of the disclosure will become apparent in the following detailed description of the embodiments with reference to the accompanying drawings, of which:

[0007] FIG. 1 is a schematic perspective view of a first embodiment of a thermal insulation device according to the present disclosure being mounted to a vehicle;

[0008] FIG. 2 is an exploded perspective view of the first embodiment;

[0009] FIG. 3 is a fragmentary schematic sectional view of the first embodiment;

[0010] FIG. 4 is a fragmentary schematic sectional view illustrating an inlet hole formed in a film unit of the first embodiment;

[0011] FIG. 5 is a fragmentary schematic sectional view illustrating the inlet hole of a second embodiment of the thermal insulation device according to the present disclosure;

[0012] FIG. 6 is an exploded perspective view illustrating a third embodiment of the thermal insulation device according to the present disclosure;

[0013] FIG. 7 is a fragmentary schematic sectional view of the third embodiment;

[0014] FIG. 8 is a fragmentary schematic sectional view illustrating the film unit and a thermal insulation unit of the third embodiment; and

[0015] FIG. 9 is a fragmentary schematic sectional view illustrating the film unit and the thermal insulation unit of a fourth embodiment of the thermal insulation device according to the present disclosure.

DETAILED DESCRIPTION

[0016] Before the disclosure is described in greater detail, it should be noted that where considered appropriate, reference numerals or terminal portions of reference numerals have been repeated among the figures to indicate corresponding or analogous elements, which may optionally have similar characteristics.

[0017] Referring to FIGS. 1 to 4, a first embodiment of a thermal insulation device 2 according to the present disclosure is adapted to be mounted to a vehicle 1. The vehicle 1 defines a seating space 11 therein, and includes a vehicle body 12 and a window 13. The vehicle body 12 includes a bodyshell 121 (see FIG. 3) made of metal and a car interior 122 made of a foam material and cooperating with the bodyshell 121 to define a gap 123 therebetween. The window 13 is mounted to the bodyshell 121, and can be a front windshield, a rear windshield, a panoramic windshield, a side window or a skylight window. In this embodiment, the window 13 is a panoramic windshield. The thermal insulation device 2 includes a film unit 3 and a thermal insulation unit 4.

[0018] The film unit 3 is adapted to be mounted to the vehicle body 12 for covering an inner surface of the window 13, which faces the seating space 11, and is light transmissive. Specifically, as shown in FIG. 1, a right side and an upper side of the film unit 3 are inserted into the gap 123 and clamped between the bodyshell 121 and the car interior 122 by a user sitting in the seating space 11, and can be mounted to the bodyshell 121 by means of hanging, adher-

ing, fastening, etc. It should be noted that, in this embodiment, the thermal insulation device 2 is rectangular and is mounted in front of a front passenger seat of the vehicle 1. However, the shape and the mounting position of the insulation device 2 are not limited to this example.

[0019] The film unit 3 includes an outer layer 31, an inner layer 32, and four supporting pillars 33. The outer layer 31 is adapted to be mounted to the inner surface of the window 13. The inner layer 32 is mounted to the outer layer 31 such that the outer layer 31 is disposed between the inner layer 32 and the window 13, and has a peripheral portion 32A that is connected sealingly to the outer layer 31 and a center portion 32B that is spaced apart from and that cooperates with the outer layer 31 to define a thermal insulation space 34 therebetween. The supporting pillars 33 are disposed between the outer layer 31 and the center portion 32B of the inner layer 32 to separate the outer layer 31 from the center portion 32B of the inner layer 31. The outer layer 31 has an outer surface 311 that is planar and that is adapted to face and adjoin the window 13. As shown in FIG. 2, the inner layer 32 is configured as an indented plate and has a rectangular central wall 321, a toothed upper side wall 322 extending from an upper side of the central wall 321 toward the outer layer 31 and then bent in a direction parallel to the central wall 321, a lower side wall 324 extending from a lower side of the central wall 321 toward the outer layer 31 and then bent in a direction parallel to the central wall 321, and two lateral walls 323, which extend respectively from left and right sides of the central wall 321 toward the outer layer 31 and then bent in a direction parallel to the central wall 321 and each of which interconnects to a respective one of two opposite ends of the upper side wall 322 and a respective one of two opposite ends of the lower side wall 324. In this embodiment, the supporting pillars 33 are formed integrally with the central wall 321 and extend toward the outer layer 31. It should be noted that the number of the supporting pillars 33 is not limited to four, and may be one or any number more than one. Each of the outer layer 31 and the inner layer 32 is made of one of polycarbonate (PC), polyethylene terephthalate (PET), tantalum carbide (TAC), polyvinyl chloride PVC and a combination thereof. In this embodiment, each of the outer layer 31 and the inner layer 32 is made of PC and has a thickness ranging from 0.1 mm to 2 mm. In one embodiment, the thickness of each of the outer layer 31 and the inner layer 32 is 0.5 mm.

[0020] By virtue of the abovementioned structure, the outer layer 31 cooperates with the inner layer 32 to define the thermal insulation space 34 therebetween. The film unit 3 is formed with a plurality of inlet holes 35 that are in spatial communication with the thermal insulation space 34 and that are adapted to communicate with the seating space 11, and a plurality of outlet holes 36 that are in spatial communication with the thermal insulation space 34, that are disposed above the inlet holes 35, and that are adapted to be open toward the bodyshell 121, such that air in the seating space 11 can flow into the thermal insulation space 34 through the inlet holes 35 and be discharged from the thermal insulation space 34 toward the bodyshell 12 through the outlet holes 36, so as to ventilate the thermal insulation space 34. As shown in FIG. 4, in this embodiment, the inlet holes 35 are formed in the lower side wall 324, each of the inlet holes 35 has a uniform diameter, and the outlet holes 36 are defined by the upper side wall 322 and the outer layer 31. Since the upper side wall 322 and a portion of the outer layer 31 are inserted into the gap 123, the outlet holes

36 are in spatial communication with the gap 123. It should be noted that the configuration of the outer layer 31 and the upper side wall 322 may be modified as long as the outlet holes 36 are formed adjacent to the gap 123 and open toward the bodyshell 121 to transfer heat thereto. In addition, the positions of the upper side wall 322 and the lower side wall 324 are interchangeable, and the configurations of the upper side wall 322 and the lower side wall 324 may also be modified. In this embodiment, the film unit 3 is adapted to be inclinedly mounted in the vehicle body 12, and the outlet holes 36 are disposed higher than the inlet holes 35.

[0021] The thermal insulation unit 4 includes a heat insulation layer 41 that is disposed on a side surface of the outer layer 31 facing the thermal insulation space 34, and that is adapted to reflect and absorb heat conducted from the window 13. The heat insulation layer 41 is made of one of tungsten oxide nanowires, zinc oxide nanowires, and a combination thereof. However, the heat insulation layer 41 is not limited to the examples described herein and can be a commercially available optical film or sun control film.

[0022] When sunlight hits the window 13 of the vehicle 1, a portion of the sunlight is reflected back, yet another portion of the sunlight enters through the window 13, radiates into the thermal insulation device 2 and generates heat energy therein, which will be reflected again and absorbed by the insulation layer 41. The heat absorbed by the insulation layer 41 will also radiate into the thermal insulation space 34 so the temperature in the thermal insulation space 34 will increase. The air in the seating space 11 will flow into the thermal insulation space 34 through the inlet holes 35 to cool down the temperature in the thermal insulation space 34 and be discharged from the thermal insulation space 34 toward the gap 123 through the outlet holes 36 so that the thermal insulation space 34 will be ventilated and the heat conducted to the body shell 121 will be dissipated quickly.

[0023] Referring to FIG. 5, a second embodiment of the thermal insulation device according to the present disclosure is similar to the first embodiment, and the difference therebetween resides in the shape of the inlet holes 35. In the second embodiment, each of the inlet holes 35 is frustoconical, and has an inner end that is proximate to the thermal insulation space 34 and an outer end that is distal from the thermal insulation space 34 and that has a diameter greater than that of the inner end. Thus, air in the seating space 11 may smoothly flow into the thermal insulation space 34 while the air in the thermal insulation space 34 is prevented from flowing reversely into the seating space 11 through the inlet holes 35.

[0024] Referring to FIGS. 6 to 8, a third embodiment of the thermal insulation device according to the present disclosure is similar to the first embodiment, and the differences therebetween reside in the following. In the third embodiment, the outer layer 31 has an indented outer surface 311 adapted to face the window 13 and having a peripheral portion 313 and a central portion 312. The peripheral portion 313 is adapted to abut against the window 13. The central portion 312 is adapted to be spaced apart from and cooperates with the window 13 to define a room 315 therebetween. By virtue of the structure of the outer layer 31, a contact area between the window 13 and the outer layer 31 is reduced so that wear on the outer layer 31 can also be reduced. In addition, the room 315 can reduce heat conducted and radiated from the window 13 to the seating

space 11 so that the performance of the heat insulation device 2 can be enhanced.

[0025] Referring to FIG. 9, a fourth embodiment of the thermal insulation device according to the present disclosure is similar to the third embodiment, and the difference therebetween resides in the following. In the fourth embodiment, the thermal insulation unit 4 further includes an auxiliary heat insulation layer 41' that is disposed in the room 315 and on a side surface of the outer layer 31 facing away from the heat insulation layer 41, and that is adapted to reflect and absorb heat conducted from the window 13. This way, the performance of the heat insulation device 2 can be further enhanced. It should be noted that the auxiliary heat insulation layer 41' may be applied on the side surface of the outer layer 31 facing away from the heat insulation layer 41 by a known processing method such that the outer layer 31 is sandwiched between the heat insulation layer 41 and the auxiliary heat insulation layer 41'.

[0026] To sum up, by virtue of the heat insulation device 2 that is mounted to the vehicle body 12 for covering the inner surface of the window 13, the thermal insulation unit 4 of the heat insulation device 2 can effectively reflect and absorb heat conducted from the window 13. Furthermore, the heat absorbed by the thermal insulation unit 4 can also be dissipated toward the bodyshell 121 through the thermal insulation space 34, which can prevent the temperature in the seating space 11 from rising, and in turn can reduce the use of air conditioning.

[0027] In the description above, for the purposes of explanation, numerous specific details have been set forth in order to provide a thorough understanding of the embodiments. It will be apparent, however, to one skilled in the art, that one or more other embodiments may be practiced without some of these specific details. It should also be appreciated that reference throughout this specification to “one embodiment,” “an embodiment,” an embodiment with an indication of an ordinal number and so forth means that a particular feature, structure, or characteristic may be included in the practice of the disclosure. It should be further appreciated that in the description, various features are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of various inventive aspects, and that one or more features or specific details from one embodiment may be practiced together with one or more features or specific details from another embodiment, where appropriate, in the practice of the disclosure.

[0028] While the disclosure has been described in connection with what are considered the exemplary embodiments, it is understood that this disclosure is not limited to the disclosed embodiments but is intended to cover various arrangements included within the spirit and scope of the broadest interpretation so as to encompass all such modifications and equivalent arrangements.

What is claimed is:

1. A thermal insulation device adapted to be mounted to a vehicle, the vehicle defining a seating space therein and including a vehicle body that includes a bodyshell and a window that is mounted to the bodyshell, said thermal insulation device comprising:

a film unit being adapted to be mounted to the vehicle body for covering an inner surface of the window that faces the seating space, being light transmissive, and including an

outer layer which is adapted to be mounted to the inner surface of the window, and an inner layer which is mounted to said outer layer such that said outer layer is disposed between said inner layer and the window, and which has a peripheral portion connected sealingly to said outer layer and a center portion spaced apart from and cooperating with said outer layer to define a thermal insulation space therebetween, said film unit being formed with a plurality of inlet holes that are in spatial communication with said thermal insulation space and that are adapted to communicate with the seating space, and a plurality of outlet holes that are in spatial communication with said thermal insulation space, that are disposed above said inlet holes, and that are adapted to be open toward the bodyshell, such that air in the seating space flows into said thermal insulation space through said inlet holes and is discharged from said thermal insulation space toward the bodyshell through said outlet holes, so as to ventilate said thermal insulation space; and a thermal insulation unit including a heat insulation layer that is disposed on a side surface of said outer layer facing said thermal insulation space, and that is adapted to reflect and absorb heat conducted from the window.

2. The thermal insulation device as claimed in claim 1, wherein said film unit further includes at least one supporting pillar disposed between said outer layer and said center portion of said inner layer to separate said outer layer from said center portion of said inner layer.

3. The thermal insulation device as claimed in claim 1, wherein said outer layer has an outer surface being planar and adapted to face and adjoin the window.

4. The thermal insulation device as claimed in claim 1, wherein said outer layer has an outer surface adapted to face the window and having a peripheral portion that is adapted to abut against the window and a central portion that is adapted to be spaced apart from and cooperate with the window to define a room therebetween for reducing heat transfer and radiation from the window.

5. The thermal insulation device as claimed in claim 1, wherein each of said inlet holes has a uniform diameter.

6. The thermal insulation device as claimed in claim 1, wherein each of said inlet holes is frustoconical, and has an inner end proximate to said thermal insulation space, and an outer end distal from said thermal insulation space and having a diameter greater than that of said inner end.

7. The thermal insulation device as claimed in claim 1, wherein said thermal insulation unit further includes an auxiliary heat insulation layer that is disposed in said room and on a side surface of said outer layer facing away from said heat insulation layer, and that is adapted to reflect and absorb heat conducted from the window.

8. The thermal insulation device as claimed in claim 1, wherein each of said outer layer and said inner layer is made of one of polycarbonate (PC), polyethylene terephthalate (PET), tantalum carbide (TAC), polyvinyl chloride (PVC) and a combination thereof.

9. The thermal insulation device as claimed in claim 1, wherein each of said outer layer and said inner layer has a thickness ranging from 0.1 mm to 2 mm.

10. The thermal insulation device as claimed in claim 1, wherein said heat insulation layer is made of one of tungsten oxide nanowires, zinc oxide nanowires and a combination thereof.

* * * * *



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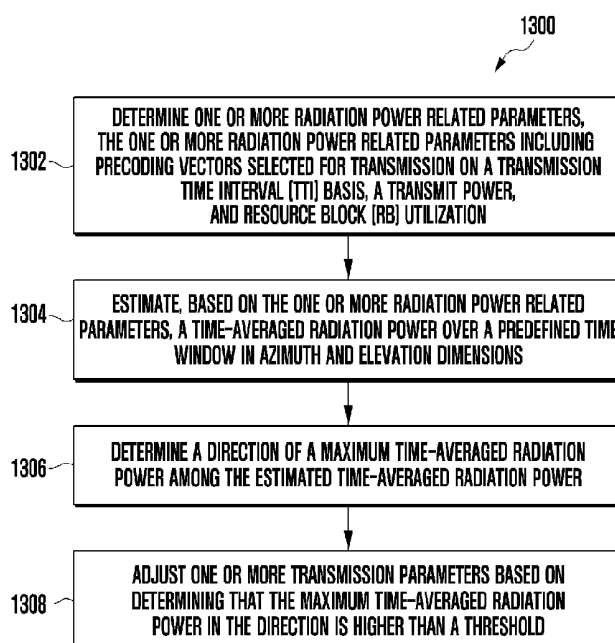
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(54) Title: APPARATUS AND METHOD FOR MANAGING THE EXPOSURE TO ELECTRIC AND MAGNETIC FIELDS



(57) Abstract: Apparatuses and methods for managing electromagnetic field (EMF) radiation. A method includes determining one or more radiation power related parameters, the one or more radiation power related parameters including precoding vectors selected for transmission on a transmission time interval (TTI) basis, a transmit power, and resource block (RB) utilization. The method also includes estimating, based on the one or more radiation power related parameters, a time-averaged radiation power over a predefined time window in azimuth and elevation dimensions. The method also includes determining a direction of a maximum time-averaged radiation power among the estimated time-averaged radiation power; and adjusting one or more transmission parameters based on determining that the maximum time-averaged radiation power in the direction is higher than a threshold.

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Description

Title of Invention: APPARATUS AND METHOD FOR MANAGING THE EXPOSURE TO ELECTRIC AND MAGNETIC FIELDS

Technical Field

- [1] This disclosure relates generally to wireless networks. More specifically, this disclosure relates to complying with regulations of exposure to electric and magnetic fields (EMF).

Background Art

- [2] The International Commission on Non-Ionizing Radiation Protection (ICNIRP) establishes guidelines for limiting EMF exposure. These guidelines are intended to provide protection against adverse health effects that may be caused by EMF exposure. Country specific regulations may set exposure limits for that country. EMF exposure levels in wireless networks should comply with applicable exposure limits and regulations. Solutions that meet the requirements of each country's regulations are critical to selling products in these countries.

Disclosure of Invention

Technical Problem

- [3] This disclosure provides methods and apparatuses for complying with EMF exposure related regulations.

Solution to Problem

- [4] In a first embodiment, a base station for managing EMF radiation in a wireless communication system is disclosed. The base station comprises a transceiver and a processor, operably connected to the transceiver. The processor is configured to determine one or more radiation power related parameters, the one or more radiation power related parameters including precoding vectors selected for transmission on a transmission time interval (TTI) basis, a transmit power, and resource block (RB) utilization. The processor is also configured to estimate, based on the one or more radiation power related parameters, a time-averaged radiation power over a predefined time window in azimuth and elevation dimensions. The processor is further configured to determine a direction of a maximum time-averaged radiation power among the estimated time-averaged radiation power, and adjust one or more transmission parameters based on determining that the maximum time-averaged radiation power in the direction is higher than a threshold.
- [5] In a second embodiment, a method for managing EMF radiation is disclosed. The

method includes determining one or more radiation power related parameters, the one or more radiation power related parameters including precoding vectors selected for transmission on a TTI basis, a transmit power, and RB utilization. The method also comprises estimating, based on the one or more radiation power related parameters, a time-averaged radiation power over a predefined time window in azimuth and elevation dimensions. The method further comprises determining a direction of a maximum time-averaged radiation power among the estimated time-averaged radiation power. The method further comprises adjusting one or more transmission parameters based on determining that the maximum time-averaged radiation power in the direction is higher than a threshold.

- [6] Other technical features may be readily apparent to one skilled in the art from the following figures, descriptions, and claims.
- [7] Before undertaking the DETAILED DESCRIPTION below, it may be advantageous to set forth definitions of certain words and phrases used throughout this patent document. The terms "transmit," "receive," and "communicate," as well as derivatives thereof, encompass both direct and indirect communication. The terms "include" and "comprise," as well as derivatives thereof, mean inclusion without limitation. The term "or" is inclusive, meaning and/or. The phrase "associated with," as well as derivatives thereof, means to include, be included within, interconnect with, contain, be contained within, connect to or with, couple to or with, be communicable with, cooperate with, interleave, juxtapose, be proximate to, be bound to or with, have, have a property of, have a relationship to or with, or the like.
- [8] Moreover, various functions described below can be implemented or supported by one or more computer programs, each of which is formed from computer readable program code and embodied in a computer readable medium. The terms "application" and "program" refer to one or more computer programs, software components, sets of instructions, procedures, functions, objects, classes, instances, related data, or a portion thereof adapted for implementation in a suitable computer readable program code. The phrase "computer readable program code" includes any type of computer code, including source code, object code, and executable code. The phrase "computer readable medium" includes any type of medium capable of being accessed by a computer, such as read only memory (ROM), random access memory (RAM), a hard disk drive, a compact disc (CD), a digital video disc (DVD), or any other type of memory. A "non-transitory" computer readable medium excludes wired, wireless, optical, or other communication links that transport transitory electrical or other signals. A non-transitory computer readable medium includes media where data can be permanently stored and media where data can be stored and later overwritten, such as a rewritable optical disc or an erasable memory device.

- [9] As used here, terms and phrases such as "have," "may have," "include," or "may include" a feature (like a number, function, operation, or component such as a part) indicate the existence of the feature and do not exclude the existence of other features. Also, as used here, the phrases "A or B," "at least one of A and/or B," or "one or more of A and/or B" may include all possible combinations of A and B. For example, "A or B," "at least one of A and B," and "at least one of A or B" may indicate all of (1) including at least one A, (2) including at least one B, or (3) including at least one A and at least one B. Further, as used here, the terms "first" and "second" may modify various components regardless of importance and do not limit the components. These terms are only used to distinguish one component from another. For example, a first user device and a second user device may indicate different user devices from each other, regardless of the order or importance of the devices. A first component may be denoted a second component and vice versa without departing from the scope of this disclosure.
- [10] It will be understood that, when an element (such as a first element) is referred to as being (operatively or communicatively) "coupled with/to" or "connected with/to" another element (such as a second element), it can be coupled or connected with/to the other element directly or via a third element. In contrast, it will be understood that, when an element (such as a first element) is referred to as being "directly coupled with/to" or "directly connected with/to" another element (such as a second element), no other element (such as a third element) intervenes between the element and the other element.
- [11] As used here, the phrase "configured (or set) to" may be interchangeably used with the phrases "suitable for," "having the capacity to," "designed to," "adapted to," "made to," or "capable of" depending on the circumstances. The phrase "configured (or set) to" does not essentially mean "specifically designed in hardware to." Rather, the phrase "configured to" may mean that a device can perform an operation together with another device or parts. For example, the phrase "processor configured (or set) to perform A, B, and C" may mean a generic-purpose processor (such as a CPU or application processor) that may perform the operations by executing one or more software programs stored in a memory device or a dedicated processor (such as an embedded processor) for performing the operations.
- [12] The terms and phrases as used here are provided merely to describe some embodiments of this disclosure but not to limit the scope of other embodiments of this disclosure. It is to be understood that the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. All terms and phrases, including technical and scientific terms and phrases, used here have the same meanings as commonly understood by one of ordinary skill in the art to which the embodiments

of this disclosure belong. It will be further understood that terms and phrases, such as those defined in commonly-used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined here. In some cases, the terms and phrases defined here may be interpreted to exclude embodiments of this disclosure.

- [13] Definitions for other certain words and phrases may be provided throughout this patent document. Those of ordinary skill in the art should understand that in many if not most instances, such definitions apply to prior as well as future uses of such defined words and phrases.

Brief Description of Drawings

- [14] For a more complete understanding of this disclosure and its advantages, reference is now made to the following description, taken in conjunction with the accompanying drawings, in which like reference numerals represent like parts:
- [15] FIGURE 1 illustrates an example wireless network according to this disclosure;
- [16] FIGURE 2 illustrates an example gNB according to this disclosure;
- [17] FIGURE 3 illustrates an example user equipment (UE) according to this disclosure;
- [18] FIGURE 4A illustrates an exemplary embodiment of a split architecture for a gNB according to this disclosure;
- [19] FIGURE 4B illustrates an exemplary DU enabled operation architecture according to this disclosure;
- [20] FIGURE 4C illustrates an exemplary MMU enabled operation architecture according to this disclosure;
- [21] FIGURE 4D illustrates an exemplary MMU enabled feedback operation architecture according to this disclosure;
- [22] FIGURE 5A illustrates an exemplary single interval power determination protocol, according to this disclosure;
- [23] FIGURE 5B illustrates an exemplary multi interval power determination protocol, according to this disclosure;
- [24] FIGURE 6 illustrates an exemplary precoding matrix indicator (PMI) based operation architecture according to this disclosure;
- [25] FIGURE 7 illustrates a simplified flowchart for a DU enabled power estimation and adjustment;
- [26] FIGURE 8 illustrates an exemplary Grid-based Power Estimation grid according to this disclosure;
- [27] FIGURE 9 illustrates an exemplary Radiation Power Table for PMI_j according to this disclosure;

- [28] FIGURE 10 illustrates an exemplary scenario with eight coarse grids, each consisting of four fine grids according to this disclosure;
- [29] FIGURE 11 illustrates an exemplary illustration of the precoder relationship before and after matrix generation and inversion according to this disclosure;
- [30] FIGURE 12A illustrates an exemplary cell dependent grid size implementation according to this disclosure;
- [31] FIGURE 12B illustrates a dynamic change of the grid size and range over time implementation according to this disclosure; and
- [32] FIGURE 13 illustrates an example process flowchart for complying with EMF exposure regulations.
- [33] The above flowcharts illustrate example methods that can be implemented in accordance with the principles of the present disclosure and various changes could be made to the methods illustrated in the flowcharts herein. For example, while shown as a series of steps, various steps in each figure could overlap, occur in parallel, occur in a different order, or occur multiple times. In another example, steps may be omitted or replaced by other steps.

Mode for the Invention

- [34] FIGURES 1 through 13, discussed below, and the various embodiments used to describe the principles of the present disclosure in this patent document are by way of illustration only and should not be construed in any way to limit the scope of the disclosure. Those skilled in the art will understand that the principles of this disclosure may be implemented in any suitably arranged device or system.
- [35] Aspects, features, and advantages of the disclosure are readily apparent from the following detailed description, simply by illustrating a number of particular embodiments and implementations, including the best mode contemplated for carrying out the disclosure. The disclosure is also capable of other and different embodiments, and its several details can be modified in various obvious respects, all without departing from the spirit and scope of the disclosure. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not as restrictive. The disclosure is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings.
- [36] Mobile telecommunication technologies (e.g. mobile phones) transmit and receive radio frequency electromagnetic fields (RF EMFs) in defined ways that allow for communication between devices. As described above, ICNIRP establishes guidelines for limiting EMF exposure. These guidelines are intended to provide protection against known adverse health effects. EMF exposure levels should comply with applicable exposure limits and regulations.

- [37] Under regulation requirements, within a bandwidth, the received power density at any location may need to be less than a given value. The received power density may be the radiated power per unit area (e.g., m²). The received power density may also be averaged over a time period that is dependent on the frequency of the radiation. The constraint of the received power can be expressed as follows (math figure 1). For example, when T = 6 minutes = 3.6*10⁵ ms, RegP = 10 W/m².

- [38] [Math.1]

$$\frac{1}{T} \sum_{t=t_0}^{t_0+T} RxP_{wr} < RegP \text{ for any location within } 1 \text{ m}^2$$

- [39] The constraints mentioned above are contradictory to traditional designs. For example, traditional designs optimize performance with the constraints of the total power, while EMF regulations limit the power usage due to radiation power concerns.
- [40] Certain embodiments of this disclosure provide an architecture for scenarios in which power optimization of the received power may be required.
- [41] Certain embodiments of this disclosure provide the novel algorithms to optimize the radiation power to meet EMF regulation.
- [42] Certain embodiments of this disclosure implement a new function to a base station(s), which monitors the radiation power at the compliance distance, and triggers the power control algorithms when the potential radiation power is larger than the regulation.
- [43] Certain embodiments of this disclosure provide the novel algorithms that achieve the optimal trade-off between the user experience and the received power limitation.
- [44] Certain embodiments of this disclosure propose smart multi-user, multiple-input and multiple output (MU-MIMO) scheduling algorithms which consider the joint optimization of assigned power, modulation coding scheme (MCS), and commonly scheduled layers, without implementing the advanced signal processing of the channel matrix.
- [45] Certain embodiments of this disclosure provide new criterion to switch between MU-MIMO and single-user, multiple-input and multiple output (SU-MIMO) mode for optimizing the throughput performance without violating the received power regulation.
- [46] Certain embodiments of this disclosure provide multiple methods to estimate the radiation power for different MU-MIMO schemes. For example, sounding reference signals (SRS) based zero forcing (ZF) MU-MIMO, SRS based non-ZF MU-MIMO, PMI based ZF MU-MIMO, PMI based non ZF MU-MIMO, and more. The methods include online calculation and online PMI to grid mapping table look up(s).
- [47] Certain embodiments of this disclosure provide power estimation mechanisms that can be performed in the data unit (DU), which may help reduce complexity.

- [48] Certain embodiments of this disclosure illustrate multiple strategies for performing PMI to grid mapping.
- [49] Certain embodiments of this disclosure disclose methods to estimate the radiation power without the final precoder information for ZF MU-MIMO.
- [50] FIGURE 1 illustrates an example wireless network according to embodiments of the present disclosure. The embodiment of the wireless network shown in FIGURE 1 is for illustration only. Other embodiments of the wireless network 100 could be used without departing from the scope of the present disclosure.
- [51] To meet the demand for wireless data traffic having increased since deployment of 4G communication systems and to enable various vertical applications, efforts have been made to develop and deploy an improved 5G/NR or pre-5G/NR communication system. Therefore, the 5G/NR or pre-5G/NR communication system is also called a "beyond 4G network" or a "post LTE system." The 5G/NR communication system is considered to be implemented in higher frequency (mmWave) bands, e.g., 28 GHz or 60GHz bands, so as to accomplish higher data rates or in lower frequency bands, such as 6 GHz, to enable robust coverage and mobility support. To decrease propagation loss of the radio waves and increase the transmission distance, the beamforming, massive multiple-input multiple-output (MIMO), full dimensional MIMO (FD-MIMO), array antenna, an analog beam forming, large scale antenna techniques are discussed in 5G/NR communication systems.
- [52] In addition, in 5G/NR communication systems, development for system network improvement is under way based on advanced small cells, cloud radio access networks (RANs), ultra-dense networks, device-to-device (D2D) communication, wireless backhaul, moving network, cooperative communication, coordinated multi-points (CoMP), reception-end interference cancellation and the like.
- [53] The discussion of 5G systems and frequency bands associated therewith is for reference as certain embodiments of the present disclosure may be implemented in 5G systems. However, the present disclosure is not limited to 5G systems or the frequency bands associated therewith, and embodiments of the present disclosure may be utilized in connection with any frequency band. For example, aspects of the present disclosure may also be applied to deployment of 5G communication systems, 6G or even later releases which may use terahertz (THz) bands.
- [54] As shown in FIGURE 1, the wireless network includes a gNB 101 (e.g., base station (BS)), a gNB 102, and a gNB 103. The gNB 101 communicates with the gNB 102 and the gNB 103. The gNB 101 also communicates with at least one network 130, such as the Internet, a proprietary Internet Protocol (IP) network, or other data network.
- [55] The gNB 102 provides wireless broadband access to the network 130 for a first plurality of user equipments (UEs) within a coverage area 120 of the gNB 102. The

first plurality of UEs includes a UE 111, which may be located in a small business; a UE 112, which may be located in an enterprise (E); a UE 113, which may be located in a WiFi hotspot (HS); a UE 114, which may be located in a first residence (R); a UE 115, which may be located in a second residence (R); and a UE 116, which may be a mobile device (M), such as a cell phone, a wireless laptop, a wireless PDA, or the like. The gNB 103 provides wireless broadband access to the network 130 for a second plurality of UEs within a coverage area 125 of the gNB 103. The second plurality of UEs includes the UE 115 and the UE 116. In some embodiments, one or more of the gNBs 101-103 may communicate with each other and with the UEs 111-116 using 5G, LTE, LTE-A, WiMAX, WiFi, or other wireless communication techniques.

[56] Depending on the network type, the term "base station" or "BS" can refer to any component (or collection of components) configured to provide wireless access to a network, such as transmit point (TP), transmit-receive point (TRP), an enhanced base station (eNodeB or eNB), a 5G base station (gNB), a macrocell, a femtocell, a WiFi access point (AP), or other wirelessly enabled devices. Base stations may provide wireless access in accordance with one or more wireless communication protocols, e.g., 5G 3GPP new radio interface/access (NR), long term evolution (LTE), LTE advanced (LTE-A), high speed packet access (HSPA), Wi-Fi 802.11a/b/g/n/ac, etc. For the sake of convenience, the terms "BS" and "TRP" are used interchangeably in this patent document to refer to network infrastructure components that provide wireless access to remote terminals. Also, depending on the network type, the term "user equipment" or "UE" can refer to any component such as "mobile station," "subscriber station," "remote terminal," "wireless terminal," "receive point," or "user device." For the sake of convenience, the terms "user equipment" and "UE" are used in this patent document to refer to remote wireless equipment that wirelessly accesses a BS, whether the UE is a mobile device (such as a mobile telephone or smartphone) or is normally considered a stationary device (such as a desktop computer or vending machine).

[57] Dotted lines show the approximate extents of the coverage areas 120 and 125, which are shown as approximately circular for the purposes of illustration and explanation only. It should be clearly understood that the coverage areas associated with gNBs, such as the coverage areas 120 and 125, may have other shapes, including irregular shapes, depending upon the configuration of the gNBs and variations in the radio environment associated with natural and man-made obstructions.

[58] As described in more detail below, a new function has been added to the base station(s) (e.g. 101 - 103), which monitors the radiation power at the compliance distance, and triggers the power control algorithms when the potential radiation power is larger than the regulation.

[59] Although FIGURE 1 illustrates one example of a wireless network, various changes

may be made to FIGURE 1. For example, the wireless network could include any number of gNBs and any number of UEs in any suitable arrangement. Also, the gNB 101 could communicate directly with any number of UEs and provide those UEs with wireless broadband access to the network 130. Similarly, each gNB 102-103 could communicate directly with the network 130 and provide UEs with direct wireless broadband access to the network 130. Further, the gNBs 101, 102, and/or 103 could provide access to other or additional external networks, such as external telephone networks or other types of data networks.

[60] FIGURE 2 illustrates an example gNB 102 according to embodiments of the present disclosure. The embodiment of the gNB 102 illustrated in FIGURE 2 is for illustration only, and the gNBs 101 and 103 of FIGURE 1 could have the same or similar configuration. However, gNBs come in a wide variety of configurations, and FIGURE 2 does not limit the scope of the present disclosure to any particular implementation of a gNB.

[61] As shown in FIGURE 2, the gNB 102 includes multiple antennas 205a-205n, multiple RF transceivers 210a-210n, transmit (TX) processing circuitry 215, and receive (RX) processing circuitry 220. The gNB 102 also includes a controller/processor 225, a memory 230, and a backhaul or network interface 235.

[62] The RF transceivers 210a-210n receive, from the antennas 205a-205n, incoming RF signals, such as signals transmitted by UEs in the network 100. The RF transceivers 210a-210n down-convert the incoming RF signals to generate IF or baseband signals. The IF or baseband signals are sent to the RX processing circuitry 220, which generates processed baseband signals by filtering, decoding, and/or digitizing the baseband or IF signals. The RX processing circuitry 220 transmits the processed baseband signals to the controller/processor 225 for further processing.

[63] The TX processing circuitry 215 receives analog or digital data (such as voice data, web data, e-mail, or interactive video game data) from the controller/processor 225. The TX processing circuitry 215 encodes, multiplexes, and/or digitizes the outgoing baseband data to generate processed baseband or IF signals. The RF transceivers 210a-210n receive the outgoing processed baseband or IF signals from the TX processing circuitry 215 and up-converts the baseband or IF signals to RF signals that are transmitted via the antennas 205a-205n.

[64] The controller/processor 225 can include one or more processors or other processing devices that control the overall operation of the gNB 102. For example, the controller/processor 225 could control the reception of forward channel signals and the transmission of reverse channel signals by the RF transceivers 210a-210n, the RX processing circuitry 220, and the TX processing circuitry 215 in accordance with well-known principles. The controller/processor 225 could support additional functions as

well, such as more advanced wireless communication functions.

- [65] For instance, the controller/processor 225 could support beam forming or directional routing operations in which outgoing signals from multiple antennas 205a-205n are weighted differently to effectively steer the outgoing signals in a desired direction. Any of a wide variety of other functions could be supported in the gNB 102 by the controller/processor 225.
- [66] The controller/processor 225 is also capable of executing programs and other processes resident in the memory 230, such as an OS. The controller/processor 225 can move data into or out of the memory 230 as required by an executing process.
- [67] The controller/processor 225 is also coupled to the backhaul or network interface 235. The backhaul or network interface 235 allows the gNB 102 to communicate with other devices or systems over a backhaul connection or over a network. The interface 235 could support communications over any suitable wired or wireless connection(s). For example, when the gNB 102 is implemented as part of a cellular communication system (such as one supporting 5G, LTE, or LTE-A), the interface 235 could allow the gNB 102 to communicate with other gNBs over a wired or wireless backhaul connection. When the gNB 102 is implemented as an access point, the interface 235 could allow the gNB 102 to communicate over a wired or wireless local area network or over a wired or wireless connection to a larger network (such as the Internet). The interface 235 includes any suitable structure supporting communications over a wired or wireless connection, such as an Ethernet or RF transceiver.
- [68] The memory 230 is coupled to the controller/processor 225. Part of the memory 230 could include a RAM, and another part of the memory 230 could include a Flash memory or other ROM.
- [69] As described in more detail below, certain embodiments of this disclosure provide multiple methods to estimate the radiation power for different MU-MIMO schemes. For example, SRS based ZF MU-MIMO, SRS based non-ZF MU-MIMO, PMI based ZF MU-MIMO, PMI based non ZF MU-MIMO, and more. The methods include online calculation and online PMI to grid mapping table look up.
- [70] Although FIGURE 2 illustrates one example of gNB 102, various changes may be made to FIGURE 2. For example, the gNB 102 could include any number of each component shown in FIGURE 2. As a particular example, an access point could include a number of interfaces 235, and the controller/processor 225 could support routing functions to route data between different network addresses. As another particular example, while shown as including a single instance of TX processing circuitry 215 and a single instance of RX processing circuitry 220, the gNB 102 could include multiple instances of each (such as one per RF transceiver). Also, various components in FIGURE 2 could be combined, further subdivided, or omitted and ad-

ditional components could be added according to particular needs.

[71] FIGURE 3 illustrates an example UE 116 according to embodiments of the present disclosure. The embodiment of the UE 116 illustrated in FIGURE 3 is for illustration only, and the UEs 111-115 of FIGURE 1 could have the same or similar configuration. However, UEs come in a wide variety of configurations, and FIGURE 3 does not limit the scope of the present disclosure to any particular implementation of a UE.

[72] As shown in FIGURE 3, the UE 116 includes an antenna 305, a radio frequency (RF) transceiver 310, TX processing circuitry 315, a microphone 320, and receive (RX) processing circuitry 325. The UE 116 also includes a speaker 330, a processor 340, an input/output (I/O) interface (IF) 345, input 350, a display 355, a memory 360, and sensor(s) 365. The memory 360 includes an operating system (OS) 361 and one or more applications 362.

[73] The RF transceiver 310 receives, from the antenna 305, an incoming RF signal transmitted by a gNB of the network 100. The RF transceiver 310 down-converts the incoming RF signal to generate an intermediate frequency (IF) or baseband signal. The IF or baseband signal is sent to the RX processing circuitry 325, which generates a processed baseband signal by filtering, decoding, and/or digitizing the baseband or IF signal. The RX processing circuitry 325 transmits the processed baseband signal to the speaker 330 (such as for voice data) or to the processor 340 for further processing (such as for web browsing data).

[74] The TX processing circuitry 315 receives analog or digital voice data from the microphone 320 or other outgoing baseband data (such as web data, e-mail, or interactive video game data) from the processor 340. The TX processing circuitry 315 encodes, multiplexes, and/or digitizes the outgoing baseband data to generate a processed baseband or IF signal. The RF transceiver 310 receives the outgoing processed baseband or IF signal from the TX processing circuitry 315 and up-converts the baseband or IF signal to an RF signal that is transmitted via the antenna 305.

[75] The processor 340 can include one or more processors or other processing devices and execute the OS 361 stored in the memory 360 in order to control the overall operation of the UE 116. For example, the processor 340 could control the reception of forward channel signals and the transmission of reverse channel signals by the RF transceiver 310, the RX processing circuitry 325, and the TX processing circuitry 315 in accordance with well-known principles. In some embodiments, the processor 340 includes at least one microprocessor or microcontroller.

[76] The processor 340 is also capable of executing other processes and programs resident in the memory 360. The processor 340 can move data into or out of the memory 360 as required by an executing process. In some embodiments, the processor 340 is configured to execute the applications 362 based on the OS 361 or in response to

signals received from gNBs or an operator. The processor 340 is also coupled to the I/O interface 345, which provides the UE 116 with the ability to connect to other devices, such as laptop computers and handheld computers. The I/O interface 345 is the communication path between these accessories and the processor 340.

[77] The processor 340 is also coupled to the input 350 and the display 355. The operator of the UE 116 can use the input 350 to enter data into the UE 116. The input 350 can be a keyboard, touchscreen, mouse, track ball, voice input, or other device capable of acting as a user interface to allow a user to interact with the UE 116. For example, the input 350 can include voice recognition processing, thereby allowing a user to input a voice command. In another example, the input 350 can include a touch panel, a (digital) pen sensor, a key, or an ultrasonic input device. The touch panel can recognize, for example, a touch input in at least one scheme, such as a capacitive scheme, a pressure sensitive scheme, an infrared scheme, or an ultrasonic scheme. The input 350 can be associated with the sensor(s) 365 and/or a camera by providing additional input to the processor 340. In certain embodiments, the sensor 365 includes one or more inertial measurement units (IMUs) (such as accelerometers, gyroscope, and magnetometer), motion sensors, optical sensors, cameras, pressure sensors, heart rate sensors, altimeter, and the like. The input 350 can also include a control circuit. In the capacitive scheme, the input 350 can recognize touch or proximity. In certain embodiments, the input 350 includes the antenna 305 which can emit and receive radar signals for authenticating a user.

[78] The display 355 may be a liquid crystal display, light emitting diode display, or other display capable of rendering text and/or at least limited graphics, such as from web sites, videos, games, images, and the like. The display 255 can be sized to fit within an HMD. The display 355 can be a singular display screen or multiple display screens capable of creating a stereoscopic display. In certain embodiments, the display 255 is a heads-up display (HUD).

[79] The memory 360 is coupled to the processor 340. Part of the memory 360 could include a random-access memory (RAM), and another part of the memory 360 could include a Flash memory or other read-only memory (ROM). The memory 360 can include persistent storage (not shown) that represents any structure(s) capable of storing and facilitating retrieval of information (such as data, program code, and/or other suitable information). The memory 360 can contain one or more components or devices supporting longer-term storage of data, such as a read only memory, hard drive, Flash memory, or optical disc. The memory 360 also can store sensitive and confidential information, which require user authentication prior to accessing.

[80] UE 116 may further include one or more sensors 365 that can meter a physical quantity or detect an activation state of the UE 116 and convert metered or detected in-

formation into an electrical signal. For example, the sensor 365 can include one or more buttons for touch input, a camera, a gesture sensor, an IMU sensors (such as a gyroscope or gyro sensor and an accelerometer), an eye tracking sensor, an air pressure sensor, a magnetic sensor or magnetometer, a grip sensor, a proximity sensor, a color sensor, a bio-physical sensor, a temperature/humidity sensor, an illumination sensor, an Ultraviolet (UV) sensor, an Electromyography (EMG) sensor, an Electroencephalogram (EEG) sensor, an Electrocardiogram (ECG) sensor, an IR sensor, an ultrasound sensor, an iris sensor, a fingerprint sensor, a color sensor (such as a Red Green Blue (RGB) sensor), and the like. The sensor 365 can further include control circuits for controlling any of the sensors included therein. Any of these sensor(s) 365 may be located within UE 116, within a secondary device operably connected to UE 116, within a headset configured to hold the UE 116, or in a singular device where UE 116 includes a headset.

- [81] As described in more detail below, some approaches are UE 116 dependent. For example, UEs 116 may be classified into multiple groups, and different power reduction levels may be applied to different groups of UEs based on classification criteria.
- [82] Although FIGURE 3 illustrates one example of UE 116, various changes may be made to FIGURE 3. For example, various components in FIGURE 3 could be combined, further subdivided, or omitted and additional components could be added according to particular needs. As a particular example, the processor 340 could be divided into multiple processors, such as one or more central processing units (CPUs) and one or more graphics processing units (GPUs). Also, while FIGURE 3 illustrates the UE 116 configured as a mobile telephone or smartphone, UEs could be configured to operate as other types of mobile or stationary devices.
- [83] Systems and methods that are configurable to meet EMF related regulations are disclosed herein. To implement these solutions, it is important to have an accurate and efficient algorithm that estimates the radiation power at any distance so that the country specific EMF regulation(s) can be met.
- [84] Current base stations may contain two separate units. One may be a DU while the other is a massive MIMO (MMU). Modern MMU base stations (e.g., 101 - 103) often use a split architecture with certain functionalities being performed in the MMU while others are performed in the data/distributed unit DU.
- [85] FIGURE 4A illustrates an example of a split architecture for a gNB according to this disclosure. FIGURE 4A includes DU 410, MMU 420, and transceiver(s) (TRX) 430. DU 410 performs prescheduling based on multi-user (MU) list 441, received UE feedback 442, and relevant data received from data center 443. DU 410 transmits the determined scheduling data to MMU 420. MMU 420 performs advanced signal

processing 450 and generates a final precoder 460.

[86] While the above described architectural separation, as illustrated in FIGURE 4A has its advantages in terms of load sharing, multi-tenant hosting, power management etc., this architecture may also impose restrictions in terms of information localization. For example, DU 410 performs pre-scheduling 440, which determines the scheduled UEs (e.g., UE 116) with the assigned MCS, power, layer, etc. Due to complexity restrictions, DU 410 may not be able to access multiple final transmission decisions 460, which are calculated in the MMU 420. For example, the final scheduled UEs, final transmission power, scheduled precoder in each sub-band for each UE 116, scheduled MCS for each UE 116, etc. The limitations mentioned above may cause the radiation power estimation and tracking to be more challenging for DU 410.

[87] For example, the scheduling and various (radio resource management) RRM decisions may be made solely at the DU 410 and only pertinent information may be shared with the MMU 420. A number of advanced signal processing operations 450 are performed only at MMU 420. For example, the number of users and the layers paired at any transmission time interval (TTI) may be decided at DU 410, but the final precoding vectors 460 for actual transmission may only be known at MMU 420. MMU 420 may not be able to influence a DU 410 in its decision-making process, and the final transmitted precoder information 460 may not be known by DU 410.

[88] To comply with additional EMF regulations, certain added functionalities are needed. Systems and methods illustrating an eNB/gNB using a power estimation to determine a resource adjustment are disclosed. In the following examples, several alternative locations to host these added functionalities are provided.

[89] The following architectural proposals illustrate examples of the procedures in which an eNB/gNB may implement EMF algorithms in different ways.

[90] In accordance with certain embodiments in this disclosure, an EMF controller 470 may be added to the eNB/gNB environment. FIGURE 4B illustrates a DU 410 enabled operation architecture according to this disclosure. In this embodiment, DU 410 may estimate the impact of transmission at different azimuth and elevation directions through EMF controller 470. EMF controller 470 may perform, R_x power estimation and T_x power control, irrespective of whether a UE 116 is present at that location. DU 410 may also maintain a running average of the two-dimensional (2-d) heat map in the azimuth and elevation directions. This constraint may be used by the pre-scheduler 440 at each TTI to select UEs, number of layers, power at each layer, and the appropriate MCS to assign.

[91] Advantages to this configuration may include the ability to reuse the existing functionality of MMU technology, joint optimization of transmitted power, a number of layers, and MCS assignment based on the estimate of the peak received power by DU

410. While this design is more simplified, the design may not provide accurate estimation of the received power of any location within the cell. Further, with the configuration of FIGURE 4B, a more conservative scheduling decision from the DU 410 may need to be implemented.

[92] FIGURE 4C illustrates an MMU 420 enabled operation architecture according to this disclosure. In this architecture configuration, MMU 420 may have the complete information regarding the final transmit steering vectors for all users per resource block (RB) through the generation of the final precoder 460. The MMU 420 may compute and maintain an accurate temporal average of radiated energy patterns along different azimuth-elevation directions through R_x power estimation and T_x power control, as performed by EMF controller 470. By computing and maintaining an accurate temporal average in this manner, the difference between the physical antenna pattern and the antenna's datasheet may be ignored. Any potential violation of an EMF regulated power constraint, in any direction, at any scheduling time, may be mitigated by reducing the overall transmit power envelope and/or not transmitting the offending layer(s).

[93] Advantages to this configuration may include the ability of reusing existing functionality of the current MMU 420 without a significant change to the architecture. However, this embodiment may add additional computational complexity in MMU 420. Further, potential MCS and power override information may not be propagated to the pre-scheduler 440.

[94] FIGURE 4D illustrates an MMU 420 enabled feedback operation architecture according to this disclosure. In this configuration, in addition to computing and maintaining a running average of radiated power in each direction, the MMU 420 may periodically, via EMF controller 470, share the heat-map with DU 410, as indicated by 480. The pre-scheduler 440 may use this periodic information to update its decision on the user, layer, power, and/or MCS selection.

[95] Advantages to this configuration may include the ability of reusing the existing functionality of the MMU. Further, potential MCS, layer, and power override decisions may be made at the pre-scheduler 440. However, this embodiment may also add additional computational complexity in the MMU 420. This embodiment may also require periodic feedback from the MMU 420 to the DU 410.

[96] In accordance with certain embodiments of this disclosure, a new function in the eNB/gNB environment is disclosed. This new functionality may allow the eNB/gNB the ability to keep track of the (estimated) radiation power at a compliance distance and trigger certain actions when the received power may potentially become higher than regulation power limitations.

[97] As described above, an EMF controller 470 may be added to the eNB/gNB (e.g. gNB

102) environment. The base station may keep track of the radiation power at the given compliance distance. For example, the EMF controller 470 may maintain a two-dimensional (2-d) heat map in the azimuth and elevation directions. The heat map may record the accumulated power in all directions. If the maximum power (among all defined grids) on the 2-d heat map is higher than the regulation power, the eNB/gNB 102 may begin taking actions. The actions may include, but are not limited to, actions relating to transmission power control, resource block group (RBG) allocation, and rescheduling some of the UEs. For example, UEs with certain PMI values may be rescheduled.

[98] The received power level in all azimuth and elevation dimensions, at required compliance distance and/or direction of the maximum power over azimuth and elevation dimensions may be measured by estimation of a regulation threshold breach. In simple terms, the framework described below may include three components: gather, measure, and react (GMR). For example, relevant statistics/counters such as selecting PMIs for transmission on a per TTB bases, transmit power, and/or network load/RB utilization may be gathered.

[99] The EMF controller 470 may react to the potential threshold breach by adjusting one or more parameters. Parameters may be adjusted using a variety of methods described below. a uniform power adjustment, selective power adjustment, uniform resource adjustment, selective resource adjustment, direction EMF control (DEC), and/or rescheduling UEs with certain PMIs.

[100] RRM algorithms that can be implemented to follow the received power regulation with different performance requirements are also disclosed herein. For example, non-degraded average user throughput, improved cell-edge throughput performance, etc. Multiple exemplary embodiments for reducing the radiated power in response to the EMF controller 470 indicating that the radiated power could be potentially higher than the regulation are disclosed herein.

[101] In the following examples, various configurations of applying a power reduction or a resource reduction are enclosed. These include: a uniform power adjustment, selective power adjustment, automatic dynamic power reduction, uniform resource adjustment, selective resource adjustment, and adaptive RB reduction.

[102] In accordance with certain embodiments in this disclosure, a uniform power reduction may be applied in response to the EMF controller 470 indicating that the radiated power could be potentially higher than the regulation threshold. In this embodiment, the transmit power for all UEs 116 may be reduced by the same amount, for example, by a certain percentage.

[103] In accordance with certain embodiments in this disclosure, a selective power reduction may be applied in response to the EMF controller 470 indicating the radiated

power could be potentially higher than the regulation threshold. The selective power reduction is a UE 116 dependent power allocation. This option may classify UEs 116 into multiple groups. Different power reduction levels may be applied to different groups of UEs 116. Classification criteria may be based on, for example, the UE's 116 current performance. The UE's 116 current performance may depend on, for example, offered traffic size, the initial block error rate (iBLER), the data rate, the reported channel quality indication (CQI) and/or the reference signal received power (RSRP), and/or any other applicable performance criteria.

[104] In the selective power configuration, UEs 116 may be classified into multiple groups. For example, UEs 116 may be classified into two groups. In this example, no reduction of power may be applied to a first group of UE's (Group 1) while a second group of UEs' (Group 2) power may be reduced by a pre-determined percentage. When the first group of UEs 116 are commonly scheduled, the transmit power may be set to the original value or to a previous value. That is, the transmit power (TxP), measured in Watts, may be set to the original transmit power (TxP_orig), and equally distributed over all UEs 116 in the group (i.e., Group 1). When the second group of UEs 116 are commonly scheduled, the transmit power may be reduced by a percentage (x%) of the previous value(s); i.e., $TxP = TxP_orig * (1 - x\%)$, and equally distributed over all users.

[105] The example described above of classifying the UEs into two groups is for explanatory purposes, and this disclosure is not in any way limited to two groups. For example, number of groups may be extended to N, where $N > 2$ groups. In each group, the transmit power may be reduced by x1%, x2%, ..., xN% of the previous value supplied.

[106] Multiple options may be available based on the number of users (N) in each group. In a first example, N1 Group1 users and N2 Group2 users are commonly scheduled. For example, the total transmit power allocated to each user may be set to the original value, i.e. TxP_orig, and distributed over all users. That is, the total transmit power (in Watts) allocated to each user = $TxP_orig / (N1 + N2)$.

[107] In a second example, the total transmit power may be set to the reduced power; i.e., $TxP_orig(1 - x\%)$ and equally distributed over all users. In other words, $TxP_orig(1 - x\%) / (N1 + N2)$ Watts may be allocated to each user.

[108] In a third example, an unequal power allocation over Group 1 users and Group 2 users may be applied. For example, each Group 1 user may be allocated with $TxP_orig / (N1 + N2)$ Watts of power and each Group 2 user may be allocated with $TxP_orig * (1 - x\%) / (N1 + N2)$ Watts of power. The total transmit power will be $(N1 + N2 - N2 * x\%)TxP_orig$ Watts.

[109] In accordance with certain embodiments in this disclosure, an automatic dynamic power reduction may be applied in response to the EMF controller 470 indicating the

radiated power could be potentially higher than the regulation threshold. In this example, the power reduction may be dynamically changed over time based on predefined criteria. For example, the following algorithm (table 1) may be applied to automatically find power set point for all users.

[110] [Table 1]

Init()
S1 = set of all users in the system
P1 = full power for all users
Run()
Iterate till regulation criteria met
Reduce power by δ_p dB for all users in set S1
$P1 = P1 - \delta_p$ (in dB)
S2 = set of users identified to be in "No-power reduction" group
Reset user power for S2 back to P1
$S1 = S1 \setminus S2$;

[111] In accordance with certain embodiments in this disclosure, a uniform RBG reduction may be applied in response to the EMF controller 470 indicating the radiated power could be potentially higher than the regulation threshold. That is, RBG usage for all UEs 116 and TTL's may be reduced.

[112] In accordance with certain embodiments in this disclosure, a selective RBG reduction may be applied in response to the EMF controller indicating the radiated power could be potentially higher than the regulation threshold. That is, non-traffic based RBG allocation may be applied to selective UEs.

[113] In selective RBG reduction configuration, UEs 116 may be classified into multiple groups. For example, UEs 116 may be classified into two groups, Group 1 and Group 2. For the Group 1 UEs, reduced RBG usage for the required traffic may be applied at certain TTIs, or whenever they are scheduled, i.e., the number of allocated RBGs is x% of the required RBGs. For the Group 2 UEs, full RBG allocation may be applied in all transmissions; i.e., the RBG allocation is based on the offered traffic.

[114] Similar to the selective power adjustment configuration, the classification criteria of UE 116 groups for RBG reduction may be iBLER, reported CQI or RSRP, etc.

[115] The example described above is based on classifying the UEs 116 into groups for explanatory purposes, and this disclosure is not in any way limited to two groups. The number of groups may be extended to N, where $N > 2$ groups. In each group, the allocation may be x1%, x2%, ..., xN% of the RBGs required by the offered traffic, respectively.

- [116] In accordance with certain embodiments in this disclosure, an adaptive RB reduction may be applied in response to the EMF controller indicating the radiated power could be potentially higher than the regulation threshold. In this embodiment, less than required RBGs are allocated to commonly scheduled UEs at certain TTIs.
- [117] In the adaptive RB reduction configuration, preconfigured conditions may be set to trigger an RB reduction. For example, when the number of times that a group of UEs are commonly scheduled is larger than a threshold, the RB reduction may be triggered when this group of UEs are commonly scheduled. When this condition or another pre-configured condition is met, a restricted RB allocation algorithm for commonly scheduled UEs may be applied.
- [118] For example, the RBs for all commonly scheduled UEs whenever the preconfigured condition is met may be applied. Another option may be to apply unequal RB allocations to commonly scheduled UEs when a preconfigured condition is met. One example of an unequal RB allocation configuration may be to only restrict RB usage for some of the commonly scheduled UEs while allocating the full RBs required by the traffic to other commonly scheduled UEs.
- [119] In addition to the power/resource reduction examples provided above, other configurations are also available. These include direction specific and resource specific reduction options, dynamic numerology change, traffic specific dynamic power and resource reduction, and load balancing options.
- [120] In accordance with certain embodiments in this disclosure, direction specific power and/or direction specific resource reduction may be applied in response to the EMF controller indicating the radiated power could be potentially higher than the regulation threshold. In this configuration, the DU 410 may be able to predict the maximum received power and its direction without performing the channel matrix inversion. When the estimated maximum received power is larger than the regulation, any combination of the following alternatives action may be applied: directional power reduction, directional RB reduction, re-selecting commonly scheduled UEs, or switching from MU-MIMO to SU-MIMO.
- [121] One example of a directional power reduction may be to reduce power of the UEs with certain PMIs or channel conditions. One example of the directional RB reduction may be reducing the RB assignment for the UEs with certain PMIs or channel conditions. One example of re-selecting commonly scheduled UEs may be avoiding scheduling UEs with certain PMIs or channel conditionals.
- [122] In accordance with certain embodiments in this disclosure, a dynamic numerology change configuration may be applied in response to the EMF controller 470 indicating the radiated power could be potentially higher than the regulation threshold. In this method, the slot length or slot format can be adapted to the determined power as-

sumption.

- [123] In accordance with certain embodiments in this disclosure, a traffic specific dynamic power and resource reduction configuration may be applied in response to the EMF controller indicating the radiated power could be potentially higher than the regulation threshold. In this configuration, the transmission power may be reduced, based on the offered traffic size. For example, to minimize degradation of the UE experience, no RB/power reduction is allowed for a small packet(s).
- [124] In accordance with certain embodiments in this disclosure, a load balancing configuration may be applied in response to the EMF controller indicating the radiated power could be potentially higher than the regulation threshold. In this configuration, the transmission power may be reduced, based on the offered traffic size. Improved load-balancing across sectors and carriers may be realized in order to harmonize user distribution. To minimize the coverage hole due to the reduced transmission power, eNB/gNB may trigger the load-balancing algorithm to move users to other carriers or to other sectors.
- [125] In the following section, procedures regarding how eNB/gNB uses the measurement to determine whether the power adjustment follows the regulation are disclosed. For example, a regulation requirement may be that the power density (averaged over 6 mins) should be lower than a threshold. This procedure may be extended to other resource adjustment to meet any power constraint, e.g., RBG adjustment.
- [126] One method is a single interval power determination. In this method, the maximum grid power (across the elevation and azimuth direction) in the checking period $i-1$ to determine the backoff factor for the checking period i . For example, there are $N+1$ checking periods within the defined averaged time window, e.g., 6 minutes. This method is to make sure that the power density within each checking period, N , complies with the regulation, as shown in FIGURE 5A.
- [127] With reference to FIGURE 5A, one implementation of a single interval power back off determination method is illustrated below. This illustration assumes that the entire sector is divided into M grid points (in elevation and azimuth domain). If the maximum grid beam gain is:
- [128] [Math.2]
- $$G_{\max}(i-1) = \max_m G_m(i-1)$$
- [129] Where
- $$G_m(i-1)$$
- is the average beam gain over the checking period $i-1$ on grid m ; and P_{reg} is the regulation power density required at distance d . The backoff factor can be computed as:

[130] [Math.3]

$$\gamma_i = \frac{P_{reg}}{P^*} = \frac{P_{reg}}{\frac{G_{max}(i-1) * P_{tx}(i-1)}{4 * \Pi * d^2 * \gamma_{i-1}}} \gamma_B$$

[131] γ_B

is the additional backoff parameter, which compensates the inaccurate prediction of the beam gain in period i using the beam gain in the period i-1.

$$P_{tx}(i-1)$$

is the transmit power in the check period i-1. One checking period may contain multiple TTIs (e.g., 500 TTIs).

$$\gamma_i$$

is the power adjustment factor applied in the checking period i. In other words, the transmission power in the checking period i is

$$P_{tx} \gamma_i$$

, where

$$P_{tx}$$

is the full transmit power.

[132] Another method illustrating how eNB/gNB 102 uses the measurement to determine whether the power adjustment follows the regulation is through a multi-interval power determination. This method may use multi checking periods to obtain the back-off parameter, as illustrated in FIGURE 5B. Assuming there are N+1 checking periods within the defined averaged time window, (e.g., 6 minutes), average the power from multiple checking periods, (e.g., <= N) to derive the backoff factor gamma.

[133] In one example, the backoff parameter at period T+1 may be derived from previous T periods as follows:

[134] [Math.4]

$$\gamma_{T+1} = \frac{1}{N+1} \sum_{i=T-N}^T \gamma_i \frac{P_{reg}}{P_{max}(i)} \gamma_B$$

[135] [Math.5]

$$P_{max}(i) = \frac{G_{max}(i) P_{tx}(i)}{4 \Pi d^2}$$

[136] In another example, the maximum power P across all dimension m's from the previous T periods and derive the backoff parameter at a period T+1 from the power P as follows:

[137] [Math.6]

$$P = \max_m \left(\frac{1}{N+1} \sum_{i=T-N}^T \frac{P_m(i)}{\gamma(i)} \right)$$

[138] [Math.7]

$$\gamma_{T+1} = \frac{P_{reg}}{P}$$

[139] In addition to the configurations described above, other embodiments and configurations to reduce the radiated power in response to the EMF controller 470 indicating that the radiated power may be potentially higher than the regulation, are also disclosed. As described above, an exemplary architecture for estimating radiation power at DU 410 side is illustrated in FIGURE 4B. FIGURE 6 illustrates an alternative exemplary architecture for estimating radiation power at the DU 410 side. In the exemplary embodiment of FIGURE 6, a PMI based operational architecture 490 is disclosed. Given the feedback of the UE's PMI 442, DU 410 may adjust the selected UEs 116 and layers with assigned MCS and transmitted power. In this example embodiment, the PMI assignments for the selected UEs are determined by DU 410.

[140] For example, based on the embodiment of FIGURE 6, a user specific power reduction configuration may be combined with a modified MU-MIMO scheduling. In the selective power reduction algorithm described, a modified MU-MIMO scheduling to accommodate unequal transmit power for different group of users is disclosed.

[141] The following example illustrates the configuration above by dividing the users into two groups, i.e., Group 1 users and Group 2 users. In this configuration, Group 1 users are commonly scheduled only with other Group 1 users, and Group 2 users may be commonly scheduled only with other Group 2 users. In other words, a user of Group 1 will not be commonly scheduled with a user of Group 2 and vice versa. First, in the MU-MIMO scheduling, a primary user(s) is determined. If the primary user is a Group 1 user, only Group 1 users may be permitted to be commonly scheduled. If the primary user is a Group 2 user, only Group 2 users may be permitted to be commonly scheduled.

[142] The following section describes several solutions for the estimation under this architectural design including: DU enabled simplified power estimation, grid-based power estimation in MU-MIMO systems, and non-grid-based power estimation in MU-MIMO systems.

[143] FIGURE 7 illustrates a simplified flowchart for a DU 410 enabled power estimation and adjustment. The embodiment of steps to obtain the method as shown in FIGURE 6 is for illustration only. One or more of the components illustrated in FIGURE 6 can be implemented in specialized circuitry configured to perform the noted functions or one

or more of the components can be implemented by one or more processors executing instructions to perform the noted functions.

[144] At step 710, DU 410 estimates the radiation power at a configurable distance. For example, the distance may be the compliance distance required by the operator. Next, at step 720, DU 410 compares the estimated power with one or more pre-configured requirements. For example, the regulation power defined by the operator, the maximum target power at certain distance, etc. At step 730, DU 410 determines if the transmission power should be adjusted. Next, at step 740, DU 410 records the adjusted transmission power if the power adjustment is performed. Once step 640 completes, the method returns to step 710. In other words, steps 710-740 are ongoing.

[145] In the following section of this disclosure, several grid-based power estimation methods in MU-MIMO systems are disclosed. These methods include power estimation in MU-MIMO without zero forcing, power estimation in MU-MIMO with zero forcing, and dynamic grid size and dynamic grid change.

[146] FIGURE 8 illustrates an exemplary diagram of a grid-based power estimation that may be used in MU-MIMO systems. In the grid-based power estimation of FIGURE 8, the power radiation in the azimuth and elevation domains are shown. Multiple grids are generated to show the radiation power distribution from the base station. As illustrated in FIGURE 8, the power is recorded in each labeled grid. The power can be an accumulated power over a period of time or the average power over a period of time.

[147] Using the approach described above and depicted in FIGURE 8, the full picture of the power distribution in azimuth and elevation domain may be captured. The grid size can be implementation dependent. For example, a smaller number of grids may lead to less computation but more inaccurate estimation of the power in different directions. A larger number of grids may lead to accurate power estimation but may have a larger storage requirement.

[148] Additionally, the approach described above eases the calculation for directional power adjustment. Once the power distribution is known in different directions, the power adjustment can be directional. In other words, the transmitted power may only need to be adjusted for certain directions. For example, the directions in which the radiation power is higher than the regulation.

[149] The approach described above may also add flexibility to the power adjustment. For example, the power adjustment does not need to target all directions and/or all UEs. Only UEs that contribute to the radiation power in the remarked direction are transmitted with the adjusted power. The above described approach may also minimize the system performance loss due to unnecessary power reduction because there is no need to adjust the transmit power for all UEs and in all directions. Due to potential limitations of DU 410, the number of grids may need to be small.

[150] The following section describes various methods to estimating power in MU-MIMO systems without zero forcing. These approaches include using an online calculation to compute the radiation power, using offline generated PMI to grid mapping table to compute the radiation power, and using multiple PMI to grid mapping strategies.

[151] In this example, an online calculation to compute the radiation power from the DU 410 side is disclosed. This approach may be used in different MU-MIMO systems. For example, in SRS based or PMI based systems.

[152] In the above described approach, precoder w_k is used as an input to calculate the transmit power with aggregated beam gain in one RBG, iRBG. For example:

[153] [Math.8]

$$P(iRBG) = P_t \sum_k G_{\theta, \phi}(w_k, iRBG)$$

[154] where, w_k : scheduled PMI (or scheduled channel conjugate) for UE k in the iRBG

[155] $G_{\theta, \phi}$

: antenna gain in the direction of

(θ, ϕ)

[156] $G_{\theta, \phi}(w_k, iRBG)$

can be expressed in several ways:

[157] [Math.9]

$$G_{\theta, \phi}(w_k, iRBG) = |h_{\theta, \phi}(\cdot, 1; nTx) * w_k(1; nTx, iRBG)|^2$$

[158] [Math.10]

$$\begin{aligned} G_{\theta, \phi}(w_k, iRBG) &= \left| h_{\theta, \phi}\left(\cdot, 1; \frac{nTx}{2}\right) * w_k\left(1; \frac{nTx}{2}, iRBG\right) \right|^2 \\ &+ \left| h_{\theta, \phi}\left(\cdot, \frac{nTx}{2} + 1; nTx\right) * w_k\left(\frac{nTx}{2} + 1; nTx, iRBG\right) \right|^2 \end{aligned}$$

[159] [Math.11]

$$\begin{aligned} G_{\theta, \phi}(w_k, iRBG) &= \left(\left| h_{\theta, \phi}\left(\cdot, 1; \frac{nTx}{2}\right) * w_k\left(1; \frac{nTx}{2}, iRBG\right) \right| \right. \\ &\left. + \left| h_{\theta, \phi}\left(\cdot, \frac{nTx}{2} + 1; nTx\right) * w_k\left(\frac{nTx}{2} + 1; nTx, iRBG\right) \right| \right)^2 \end{aligned}$$

[160] Alternatively, to further reduce the computation complexity of the size of DU 410, an offline generated PMI to grid mapping table to compute the radiation power may be used. This solution computes the transmit power offline first. Once that is done, the radiation power for a given PMI may be mapped to different grids.

[161] FIGURE 9 illustrates an exemplary Radiation Power Table for PMI_j according to this disclosure. For example, if there are 1024 PMIs, there will be 1024 radiation power tables. DU 410 can simply use the radiation power table to find the radiation power on the grid m for a given PMI_j.

[162] Another approach may be to use multiple PMI to grid mapping strategies for power estimation methods in MU-MIMO systems. FIGURE 10 illustrates an exemplary il-

illustration of a precoder relationship before and after matrix generation and inversion. Given the potentially large number of PMIs, in order to reduce both the complexity and storage requirements of the DU side, several PMI to grid mapping strategies, which use a reduced number of coarse grids to compute an estimate of the radiated power, are disclosed.

- [163] This solution requires the offline mapping of every PMI to all antenna directions to be performed once. Once this is completed, multiple antenna directions with fine granularity, which are referred to as the fine grids in this disclosure, are grouped into coarse grids based on their proximity in

(θ, ϕ)

-domain. This will reduce the size of the PMI to grid mapping, due to the reduced number of grids. Next, instead of using the fine-grid PMI to grid mapping as described above with respect to FIGURE 9, the reduced coarse-grid PMI to grid mapping can be used to estimate the radiated power in different antenna directions. An example scenario with four coarse grids, bounded by the thick black border and each having four fine grids, is illustrated in FIGURE 10. For each PMI, the estimated radiated power for a coarse grid can be computed using several different mapping strategies. Several mapping strategies are described below.

- [164] For example, a max mapping strategy may be used. In this approach, given n fine grids in a coarse grid and n corresponding radiated power, the maximum radiated power among n fine grids is selected as the radiated power estimation of the coarse grid. For example, for the left uppermost coarse grid 1010, the estimated radiated power for PMI_j may be expressed as:

- [165] [Math.12]

$$\max(P_{1_j}, P_{2_j}, P_{9_j}, P_{10_j})$$

- [166] An edge grid mapping strategy may also be used. In this approach, given n fine grids in a coarse grid and n corresponding radiated power, the radiated power at the fine grid which is located at the edge of its corresponding coarse grid is selected as the radiated power estimation of the coarse grid. For example, for the left uppermost coarse grid 1010, the estimated radiated power for PMI_jP_{1-j}, assuming that the left uppermost fine grid 1020 represents the radiated power in the coarse grid uppermost fine grid 1020 resides in.

- [167] Another mapping strategy is to use an average mapping strategy. In this approach, given n fine grids in a coarse grid and n corresponding radiated power, the average radiated power across n fine grids may be used as the radiated power estimation of the coarse grid. For example, for the left uppermost coarse grid 1020, the estimated radiated power for PMI_j is:

[168] [Math.13]

$$\sum_{i=1}^4 P_{i_j}$$

[169] Another example of a mapping strategy that may be used is an X percentile mapping strategy. Given n fine grids in a coarse grid and n corresponding radiated power, the Xth percentile of n radiated power values is used as the radiated power estimation of the coarse grid. FIGURE 9 illustrates an exemplary scenario with eight coarse grids, each consisting of four fine grids. For example, for the left uppermost coarse grid 1010, the estimated radiated power for PMI_j with Xth percentile may be computed as follows:

[170] Without loss of generality, assume that $P_{1j} \leq P_{2j} \leq P_{9j} \leq P_{10j}$. Then, P_{1_j} , P_{2_j} , P_{9_j} , P_{10_j} are assigned to 12.5, 37.5, 62.5 and 87.5 percentile.

[171] Then, linear interpolation is used for the percentiles in between.

[172] For example, the 25th percentile is: $(P_{1_j} + P_{2_j})/2$.

[173] The following section describes estimating power in MU-MIMO systems with zero forcing. Due to some potential limitations with computation of power, the DU 410 site may not be able to perform a matrix inversion. In this scenario, the final precoder for MU-MIMO after zero forcing may not be known at the DU 410 site. To overcome this challenge, using a precoder before zero forcing as the input of the radiation power estimation is proposed. As indicated in FIGURE 11, the precoder, before matrix inversion, is used as the input to calculate the radiation power. $v_1, v_2, \dots, v_k$ are the scheduled PMIs or the scheduled UE channel conjugates for the MU-MIMO as described above in the power estimation in MU-MIMO without zero forcing.

[174] The following section of this disclosure describes using a dynamic grid size and/or a dynamic grid change to estimate power in MU-MIMO systems.

[175] FIGURE 12A illustrates an exemplary cell dependent grid size; i.e., the grid size is different from cell to cell. For example, cell 1 has 30 grids for marking the radiation power and cell 2 has 16 grids for marking the radiation power grid.

[176] In a dynamic grid size approach, a non-fixed number of grids may be used in the power estimation. In other words, the number of grids used for power estimation can be changed over time, changed with different cells, or changed in another available way. For example, for a given cell, the number of grids used for the radiation power estimation can be changed over time. At a time, t , the number of grids used for the radiation power estimation can be different from cell to cell.

[177] FIGURE 12B illustrates the exemplary dynamic change of the grid size and range over time. In a dynamic grid range approach, the elevation and azimuth ranges of the grid can be changed over the time, changed with different cells, or changed in another available way. For example, for a given cell, the grid range used for the radiation

power estimation can be changed with the time based on different criteria. The criteria may be UE channel state information (CSI) feedback, UE traffic, cell load, or any other appropriate criteria. At a time, t , the range of grid used for the radiation power estimation can be different from cell to cell. For example, UE traffic, UE feedback, etc.

[178] For example, at a given time, t_1 the cell can have 40 grids with elevation angles (theta) ranging from 80 to 120 degree and azimuth angles (phi) ranging from -45 to 45 degree. At another time, the cell can have 30 grids with a smaller range, which are 90 to 110 degree of elevation and -35 to 30 degree of azimuth.

[179] An alternative to grid-based power control method is to use number of scheduled layers as a proxy to power scaling. The reason is that when L layers are commonly scheduled, the power assigned to each layer would be

$$\frac{1}{L}$$

of the total power. After ZF-precoding the transmit vectors are orthogonal. If they illuminate non-overlapping segments of the sector, it may be presumed that the maximum power received by any direction is maximum beam-gain divided by L . In one incarnation of the solution during power aggregation or averaging at TTI (t), the maximum power per sector may be

$$\frac{P}{L_t} \frac{G_{PDSCH}(\max)}{4\pi d^2}, L_t$$

number of layers are commonly scheduled for SU or MU transmission. The average power over a period of T transmissions may be given by:

$$P_m = \frac{1}{T} \sum_{t=1}^T \frac{P}{L_t} \frac{G_{PDSCH}(\max)}{4\pi d^2}$$

. The final backoff factor would be calculated based on how much P_m is larger than P_{reg} .

[180] FIGURE 13 illustrates an example process flowchart 1300 for complying with EMF exposure regulations. the regulations of exposure to EMFs. The steps that follow may be performed by a base station, such as gNB 102, that can manage electromagnetic field (EMF) radiation in accordance with this disclosure. At step 1302, gNB 102 may determine one or more radiation power related parameters. The one or more radiation power related parameters may include precoding vectors selected for transmission on a transmission time interval (TTI) basis, a transmit power, and resource block (RB) utilization. At step 1304, gNB 102 may estimate, based on one or more radiation power related parameters, a time-averaged radiation power over a predefined time window in azimuth and elevation dimensions. For example, the time-averaged radiation power may be determined based in part on precoding vectors before zero forcing, a number of

scheduled layers as a proxy to power scaling, or the layers in SU-MIMO as a proxy to power scaling. At step 1306, gNB 102 may determine a direction of a maximum time-averaged radiation power among the estimated time-averaged radiation power. At step 1308, gNB 102 may adjust one or more transmission parameters based on determining that the maximum time-averaged radiation power in the direction is higher than a threshold.

[181] While this disclosure focuses on EMF, certain embodiments herein may be applied to any system in which received power optimization is required. For example, any system where received power at certain locations are restrictive. Certain embodiments of this disclosure may be applied in any case where the received power to a certain direction(s) needs to be estimated/predicted at a base station. In other words, this disclosure is not limited to the EMF domain.

[182] This disclosure can be applied to any case that may need to improve the cell edge user performance or to mitigate the coverage hole. The disclosure can be used in places where MU-MIMO/SU-MIMO switch is required. The disclosure can be used for the optimization of MU-MIMO scheduling. The disclosure can also be used in any case that the enhanced scheduling of commonly scheduled layers/MCS/transmission power may be required.

[183] Certain embodiments of this disclosure can also be applied to any case in which interference from the eNB/gNB needs to be controlled.

[184] Certain embodiments of this disclosure may be applied to any case where the power estimation needs to be simplified for MU-MIMO implementations.

[185] Certain embodiments of this disclosure can be applied in any case in which the radiation power restriction is required at any distance.

[186] Certain embodiments of this disclosure can be applied in any case in which PMI to grid mapping is used for radiation power estimation.

[187] Certain embodiments of this disclosure may be applied in the transmission power control for MU-MIMO implementations.

[188] According to various example embodiments, a base station may include: a transceiver; and a processor operably connected to the transceiver; the processor configured to: determine one or more radiation power related parameters, the one or more radiation power related parameters including precoding vectors selected for transmission on a transmission time interval (TTI) basis, a transmit power, and resource block (RB) utilization; estimate, based on the one or more radiation power related parameters, a time-averaged radiation power over a predefined time window in azimuth and elevation dimensions; determine a direction of a maximum time-averaged radiation power among the estimated time-averaged radiation power; and adjust one or more transmission parameters based on determining that the maximum time-averaged

radiation power in the direction is higher than a threshold.

- [189] According to various example embodiments, wherein to adjust the one or more transmission parameters, the processor is further configured to one of: a) reduce a transmit power to a plurality of electronic devices by a percentage that is based on the threshold; or (b) classify the plurality of electronic devices into groups, wherein different power reduction levels are applied to different groups of electronic devices, based on one or more threshold criteria, wherein the one or more threshold criteria includes one or more of offered traffic size, an initial block error rate (iBLER), a data rate, a reported channel quality indication (CQI), and a reference signal received power (RSRP); and reduce the transmit power to a first of the groups of electronic devices by a percentage that is based in part on the threshold while maintaining the transmit power to a second of the groups; or (c) switch from a multi-user, multiple-input and multiple output (MU-MIMO) mode to a single-user, multiple-input and multiple output (SU-MIMO) mode.
- [190] According to various example embodiments, wherein to adjust the one or more transmission parameters, the processor is further configured to: reduce a transmit power in the direction to a first group of electronic devices by a percentage that is based on one or more threshold criteria for a predefined time window; after reducing the transmit power, determine whether the radiation power in the direction is higher than the threshold; and in response to determining that the radiation power in the direction is higher than the threshold, reduce the transmit power in the direction to a second group of electronic devices for the predefined time window.
- [191] According to various example embodiments, wherein to adjust the one or more transmission parameters, the processor is further configured to: (a) reduce resource block group (RBG) utilization to a plurality of electronic devices for TTIs; or (b) classify the plurality of electronic devices into groups based on device performance criteria including at least one of error rate, data rate, reported channel quality, and reported signal power; and reduce RBG utilization at scheduled TTIs for a first of the groups while maintaining RBG allocation to a second of the groups.
- [192] According to various example embodiments, wherein the processor is further configured to: identify a number of electronic devices being commonly scheduled that belong to a first group of electronic devices; and in response to determining that the number of electronic devices belonging to the first group of electronic devices is greater than a threshold: apply a restricted RB allocation or a power reduction to all the electronic devices that are commonly scheduled; or apply the restricted RB allocation or a power reduction to a first group of electronic devices that are commonly scheduled, while maintaining RB allocation or power allocation for a second group, wherein the first group of electronic devices belong to the commonly scheduled group

of electronic devices.

- [193] According to various example embodiments, wherein to adjust the one or more transmission parameters, the processor is further configured to: classify a plurality of electronic devices into groups based on radiation power in the direction; and reduce the transmit power for a first group of electronic devices in the direction while maintaining the transmit power in other directions.
- [194] According to various example embodiments, wherein the processor is further configured to: determine whether the maximum time-averaged radiation power meets the threshold by one of: determine a backoff factor for a time period based on the maximum time-averaged radiation power in the azimuth and elevation dimensions for a plurality of time periods; or determine a backoff parameter for a time period based on determining an average transmit power over multiple time periods.
- [195] According to various example embodiments, wherein to estimate the time-averaged radiation power over a predefined time window in the azimuth and elevation dimensions comprises: determine the transmit power; and map a precoding matrix indicator (PMI) to the radiation power on grids based on a radiation power table, wherein the mapping comprises at least one of: select the maximum radiated power among a plurality of fine grids, select the radiated power at the fine grid located at the of its corresponding course grid, select an average radiated power across a plurality of fine grids; and select a percentile of radiated power values based on a plurality of fine grids.
- [196] According to various example embodiments, wherein a number of grids used for the radiation power estimation changes based on at least one parameter, wherein the at least one parameter comprises one or more of user equipment (UE) channel state information (CSI) feedback, UE traffic, and cell load; or wherein the elevation and azimuth ranges of the grid can be changed based on at least one parameter.
- [197] According to various example embodiments, wherein to estimate the time-averaged radiation power over a predefined time window in the azimuth and elevation dimensions, the processor is further configured to one of: determine the radiation power based in part on precoding vectors before zero forcing; determine the radiation power based on a number of scheduled layers as a proxy to power scaling; or determine the radiation power based on layers in single-user, multiple-input and multiple output (SU-MIMO) as the proxy to power scaling.
- [198] According to various example embodiments, a method for managing electromagnetic field (EMF) radiation, the method comprise: determining one or more radiation power related parameters, the one or more radiation power related parameters including precoding vectors selected for transmission on a transmission time interval (TTI) basis, a transmit power, and resource block (RB) utilization; estimating, based on the one or

more radiation power related parameters, a time-averaged radiation power over a predefined time window in azimuth and elevation dimensions; determining a direction of a maximum time-averaged radiation power among the estimated time-averaged radiation power; and adjusting one or more transmission parameters based on determining that the maximum time-averaged radiation power in the direction is higher than a threshold.

[199] According to various example embodiments, wherein adjusting the one or more transmission parameters comprises one of: (a) reducing a transmit power to a plurality of electronic devices by a percentage that is based on the threshold; or (b) classifying the plurality of electronic devices into groups, wherein different power reduction levels are applied to different groups of electronic devices based on one or more threshold criteria, wherein the one or more threshold criteria includes one or more of offered traffic size, an initial block error rate (iBLER), a data rate, a reported channel quality indication (CQI), and a reference signal received power (RSRP); and reducing the transmit power to a first of the groups of electronic devices by a percentage that is based in part on the threshold while maintaining the transmit power to a second of the groups; or (c) switching from a multi-user, multiple-input and multiple output (MU-MIMO) mode to a single-user, multiple-input and multiple output (SU-MIMO) mode.

[200] According to various example embodiments, wherein adjusting the one or more transmission parameters comprises: reducing a transmit power in the direction to a first group of electronic devices by a percentage that is based on one or more threshold criteria for a predefined time window; after reducing the transmit power, determining whether the radiation power in the direction is higher than the threshold; and in response to determining that the radiation power in the direction is higher than the threshold, reducing the transmit power in the direction to a second group of electronic devices for the predefined time window.

[201] According to various example embodiments, wherein adjusting the one or more transmission parameters comprises: (a) reducing resource block group (RBG) utilization to a plurality of electronic devices for TTIs; or (b) classifying the plurality of electronic devices into groups based on device performance criteria including at least one of error rate, data rate, reported channel quality, and reported signal power; and reducing RBG utilization at scheduled TTIs for a first of the groups while maintaining RBG allocation to a second of the groups.

[202] According to various example embodiments, further comprising: identifying a number of electronic devices being commonly scheduled that belong to a first group of electronic devices; and in response to determining that the number of electronic devices belonging to a first group of electronic devices is greater than a threshold;

applying a restricted RB allocation or a power reduction to all the electronic devices that are commonly scheduled; or apply the restricted RB allocation or a power reduction to a first group of electronic devices that are commonly scheduled, while maintaining RB allocation or power allocation for a second group, wherein the first group of electronic devices belong to the commonly scheduled group of electronic devices.

[203] According to various example embodiments, wherein adjusting the one or more transmission parameters comprises: classifying a plurality of electronic devices into groups based on radiation power in the direction; and reducing the transmit power for a first group of electronic devices in the direction while maintaining the transmit power in other directions.

[204] According to various example embodiments, further comprising: determining whether the maximum time-averaged radiation power meets the threshold by one of: determining a backoff factor for a time period based on the maximum time-averaged radiation power in the azimuth and elevation dimensions for a plurality of time periods; or determining a backoff parameter for a time period based on determining an average transmit power over multiple time periods.

[205] According to various example embodiments, wherein estimating the time-averaged radiation power over a predefined time window in the azimuth and elevation dimensions comprises: determining the transmit power; and mapping a precoding matrix indicator (PMI) to the radiation power on grids based on a radiation power table, wherein the mapping comprises at least one of: selecting the maximum radiated power among a plurality of fine grids, selecting the radiated power at the fine grid located at the of its corresponding course grid, selecting an average radiated power across a plurality of fine grids; and selecting a percentile of radiated power values based on a plurality of fine grids.

[206] According to various example embodiments, wherein a number of grids used for the radiation power estimation changes based on at least one parameter, wherein the at least one parameter comprises one or more of user equipment (UE) channel state information (CSI) feedback, UE traffic, and cell load; or wherein the elevation and azimuth ranges of the grid can be changed based on at least one parameter.

[207] According to various example embodiments, wherein estimating the time-averaged radiation power over a predefined time window in the azimuth and elevation dimensions comprises one of: determining the radiation power based in part on precoding vectors before zero forcing; determining the radiation power based on a number of scheduled layers as a proxy to power scaling; and determining the radiation power based on layers in single-user, multiple-input and multiple output (SU-MIMO) as the proxy to power scaling.

- [208] It should be noted that the illustrated regions of the figures are merely examples. Also, it should be noted that although the above illustrations are shown in two dimensions, the zones are often three dimensional. It also should be noted that for clarity and ease of illustration, the figures are not necessarily made to scale.
- [209] While the above detailed diagrams have shown, described, and pointed out novel features of the present disclosure as applied to various embodiments, it will be understood that various omissions, substitutions, and changes in the form and details of the device or process illustrated may be made by those skilled in the art without departing from the present disclosure. This description is in no way meant to be limiting, but rather should be taken as illustrative of the general principles of the present disclosure.
- [210] Although the present disclosure has been described with exemplary embodiments, various changes and modifications may be suggested to one skilled in the art. It is intended that the present disclosure encompass such changes and modifications as fall within the scope of the appended claims. None of the description in this application should be read as implying that any particular element, step, or function is an essential element that must be included in the claims scope. The scope of patented subject matter is defined by the claims.

Claims

- [Claim 1] A base station for managing electromagnetic field (EMF) radiation in a wireless communication system, the base station comprising:
a transceiver; and
a processor operably connected to the transceiver; the processor configured to:
determine one or more radiation power related parameters, the one or more radiation power related parameters including precoding vectors selected for transmission on a transmission time interval (TTI) basis, a transmit power, and resource block (RB) utilization;
estimate, based on the one or more radiation power related parameters, a time-averaged radiation power over a predefined time window in azimuth and elevation dimensions;
determine a direction of a maximum time-averaged radiation power among the estimated time-averaged radiation power; and
adjust one or more transmission parameters based on determining that the maximum time-averaged radiation power in the direction is higher than a threshold.
- [Claim 2] The base station of Claim 1, wherein to adjust the one or more transmission parameters, the processor is further configured to one of:
(a) reduce a transmit power to a plurality of electronic devices by a percentage that is based on the threshold; or
(b) classify the plurality of electronic devices into groups, wherein different power reduction levels are applied to different groups of electronic devices, based on one or more threshold criteria, wherein the one or more threshold criteria includes one or more of offered traffic size, an initial block error rate (iBLER), a data rate, a reported channel quality indication (CQI), and a reference signal received power (RSRP); and
reduce the transmit power to a first of the groups of electronic devices by a percentage that is based in part on the threshold while maintaining the transmit power to a second of the groups; or
(c) switch from a multi-user, multiple-input and multiple output (MU-MIMO) mode to a single-user, multiple-input and multiple output (SU-MIMO) mode.
- [Claim 3] The base station of Claim 1, wherein to adjust the one or more transmission parameters, the processor is further configured to:

reduce a transmit power in the direction to a first group of electronic devices by a percentage that is based on one or more threshold criteria for a predefined time window;

after reducing the transmit power, determine whether the radiation power in the direction is higher than the threshold; and

in response to determining that the radiation power in the direction is higher than the threshold, reduce the transmit power in the direction to a second group of electronic devices for the predefined time window.

[Claim 4]

The base station of Claim 1, wherein to adjust the one or more transmission parameters, the processor is further configured to:

(a) reduce resource block group (RBG) utilization to a plurality of electronic devices for TTIs; or

(b) classify the plurality of electronic devices into groups based on device performance criteria including at least one of error rate, data rate, reported channel quality, and reported signal power; and

reduce RBG utilization at scheduled TTIs for a first of the groups while maintaining RBG allocation to a second of the groups.

[Claim 5]

The base station of Claim 1, wherein the processor is further configured to:

identify a number of electronic devices being commonly scheduled that belong to a first group of electronic devices; and

in response to determining that the number of electronic devices belonging to the first group of electronic devices is greater than a threshold:

apply a restricted RB allocation or a power reduction to all the electronic devices that are commonly scheduled; or

apply the restricted RB allocation or a power reduction to a first group of electronic devices that are commonly scheduled, while maintaining RB allocation or power allocation for a second group, wherein the first group of electronic devices belong to the commonly scheduled group of electronic devices.

[Claim 6]

The base station of Claim 1, wherein to adjust the one or more transmission parameters, the processor is further configured to:

classify a plurality of electronic devices into groups based on radiation power in the direction; and

reduce the transmit power for a first group of electronic devices in the direction while maintaining the transmit power in other directions.

[Claim 7]

The base station of Claim 1, wherein the processor is further configured

to:

determine whether the maximum time-averaged radiation power meets the threshold by one of:

determine a backoff factor for a time period based on the maximum time-averaged radiation power in the azimuth and elevation dimensions for a plurality of time periods; or

determine a backoff parameter for a time period based on determining an average transmit power over multiple time periods.

[Claim 8]

The base station of Claim 1, wherein to estimate the time-averaged radiation power over a predefined time window in the azimuth and elevation dimensions comprises:

determine the transmit power; and

map a precoding matrix indicator (PMI) to the radiation power on grids based on a radiation power table, wherein the mapping comprises at least one of:

select the maximum radiated power among a plurality of fine grids,

select the radiated power at the fine grid located at the of its corresponding course grid,

select an average radiated power across a plurality of fine grids; and

select a percentile of radiated power values based on a plurality of fine grids.

[Claim 9]

The base station of Claim 8, wherein a number of grids used for the radiation power estimation changes based on at least one parameter, wherein the at least one parameter comprises one or more of user equipment (UE) channel state information (CSI) feedback, UE traffic, and cell load; or

wherein the elevation and azimuth ranges of the grid can be changed based on at least one parameter.

[Claim 10]

The base station of Claim 1, wherein to estimate the time-averaged radiation power over a predefined time window in the azimuth and elevation dimensions, the processor is further configured to one of:

determine the radiation power based in part on precoding vectors before zero forcing;

determine the radiation power based on a number of scheduled layers as a proxy to power scaling; or

determine the radiation power based on layers in single-user, multiple-input and multiple output (SU-MIMO) as the proxy to power scaling.

[Claim 11]

A method for managing electromagnetic field (EMF) radiation, the

method comprising:

determining one or more radiation power related parameters, the one or more radiation power related parameters including precoding vectors selected for transmission on a transmission time interval (TTI) basis, a transmit power, and resource block (RB) utilization;

estimating, based on the one or more radiation power related parameters, a time-averaged radiation power over a predefined time window in azimuth and elevation dimensions;

determining a direction of a maximum time-averaged radiation power among the estimated time-averaged radiation power; and

adjusting one or more transmission parameters based on determining that the maximum time-averaged radiation power in the direction is higher than a threshold.

[Claim 12]

The method of Claim 11, wherein adjusting the one or more transmission parameters comprises one of:

(a) reducing a transmit power to a plurality of electronic devices by a percentage that is based on the threshold; or

(b) classifying the plurality of electronic devices into groups, wherein different power reduction levels are applied to different groups of electronic devices based on one or more threshold criteria, wherein the one or more threshold criteria includes one or more of offered traffic size, an initial block error rate (iBLER), a data rate, a reported channel quality indication (CQI), and a reference signal received power (RSRP); and

reducing the transmit power to a first of the groups of electronic devices by a percentage that is based in part on the threshold while maintaining the transmit power to a second of the groups; or

(c) switching from a multi-user, multiple-input and multiple output (MU-MIMO) mode to a single-user, multiple-input and multiple output (SU-MIMO) mode.

[Claim 13]

The method of Claim 11, wherein adjusting the one or more transmission parameters comprises:

reducing a transmit power in the direction to a first group of electronic devices by a percentage that is based on one or more threshold criteria for a predefined time window;

after reducing the transmit power, determining whether the radiation power in the direction is higher than the threshold; and

in response to determining that the radiation power in the direction is

higher than the threshold, reducing the transmit power in the direction to a second group of electronic devices for the predefined time window.

[Claim 14]

The method of Claim 11, wherein adjusting the one or more transmission parameters comprises:

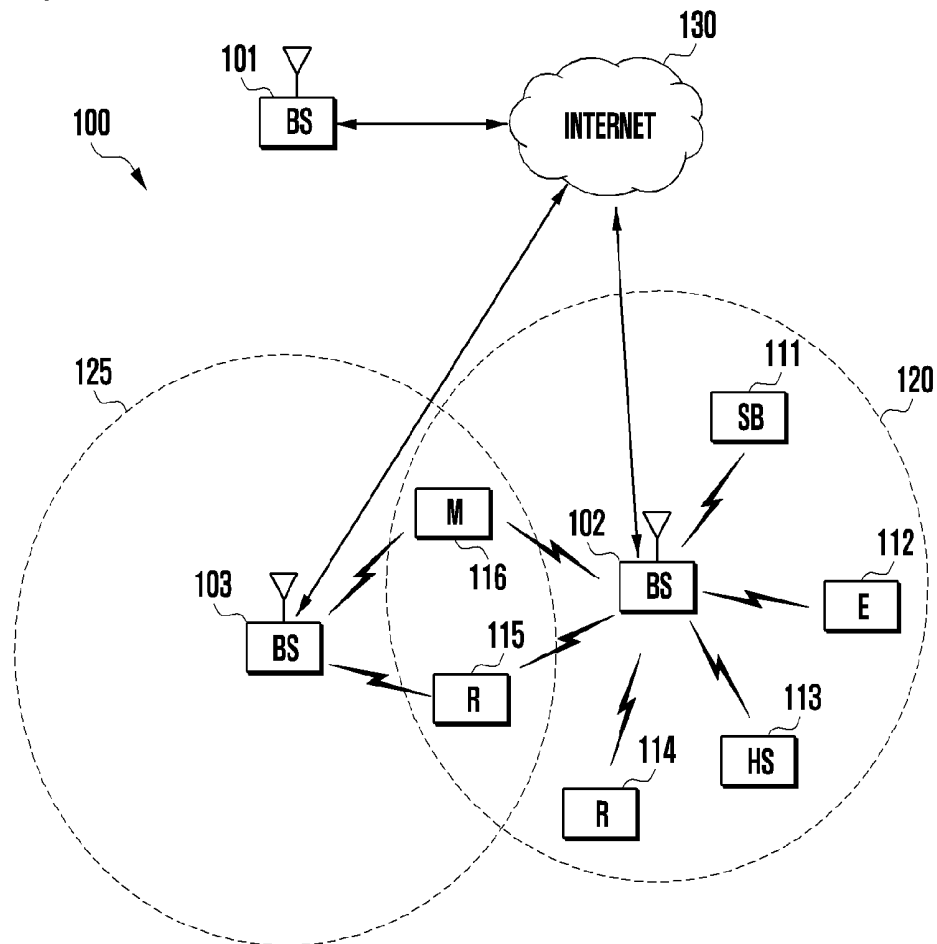
- (a) reducing resource block group (RBG) utilization to a plurality of electronic devices for TTIs; or
- (b) classifying the plurality of electronic devices into groups based on device performance criteria including at least one of error rate, data rate, reported channel quality, and reported signal power; and reducing RBG utilization at scheduled TTIs for a first of the groups while maintaining RBG allocation to a second of the groups.

[Claim 15]

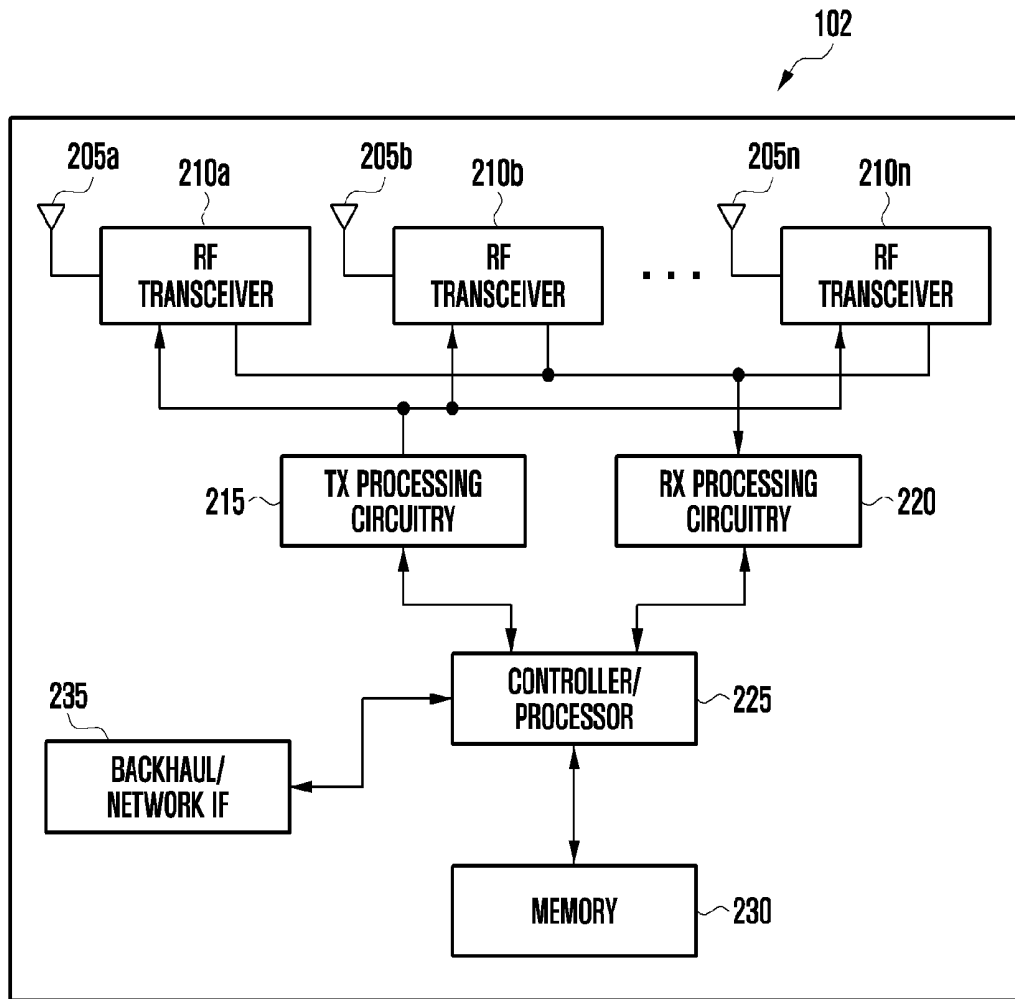
The method of Claim 11, wherein adjusting the one or more transmission parameters comprises:

- classifying a plurality of electronic devices into groups based on radiation power in the direction; and
- reducing the transmit power for a first group of electronic devices in the direction while maintaining the transmit power in other directions.

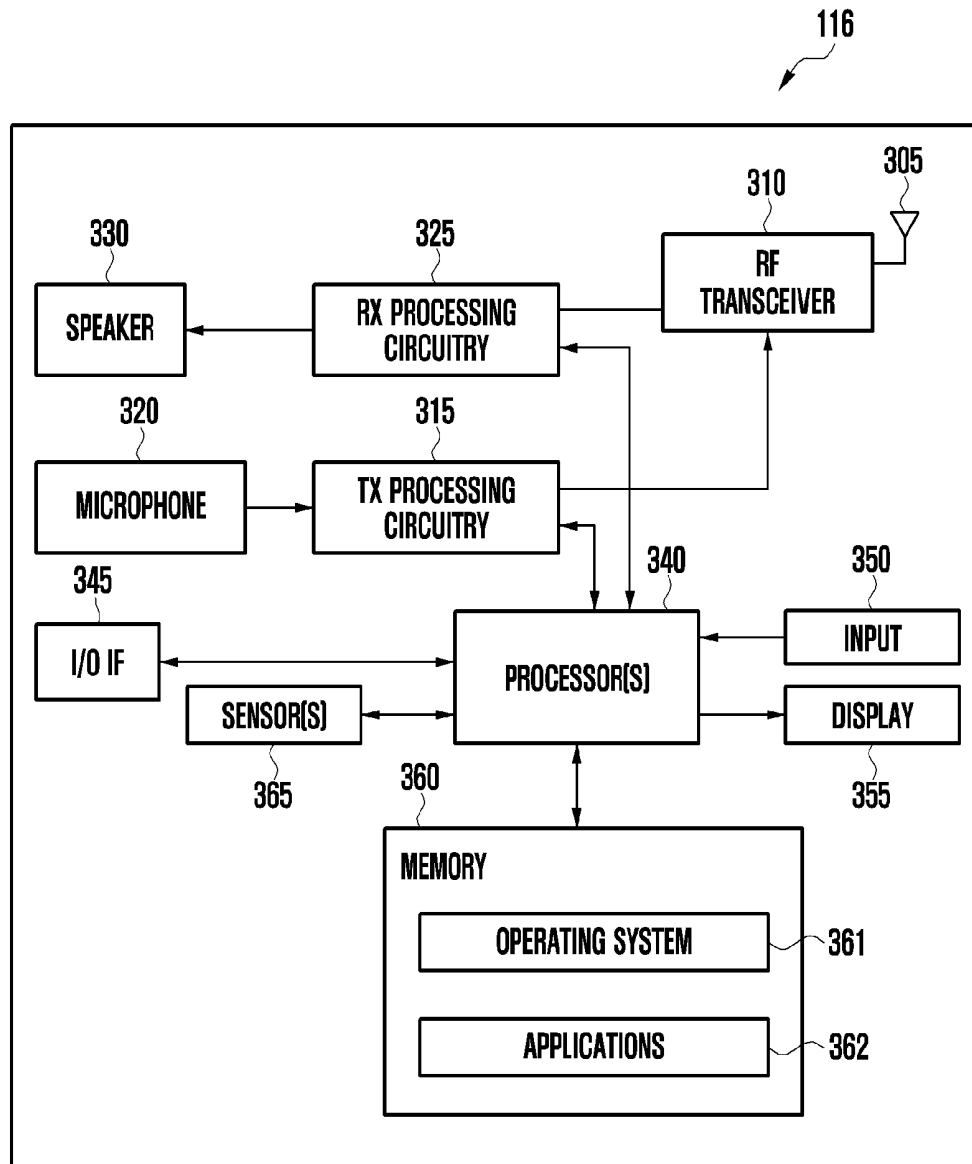
[Fig. 1]



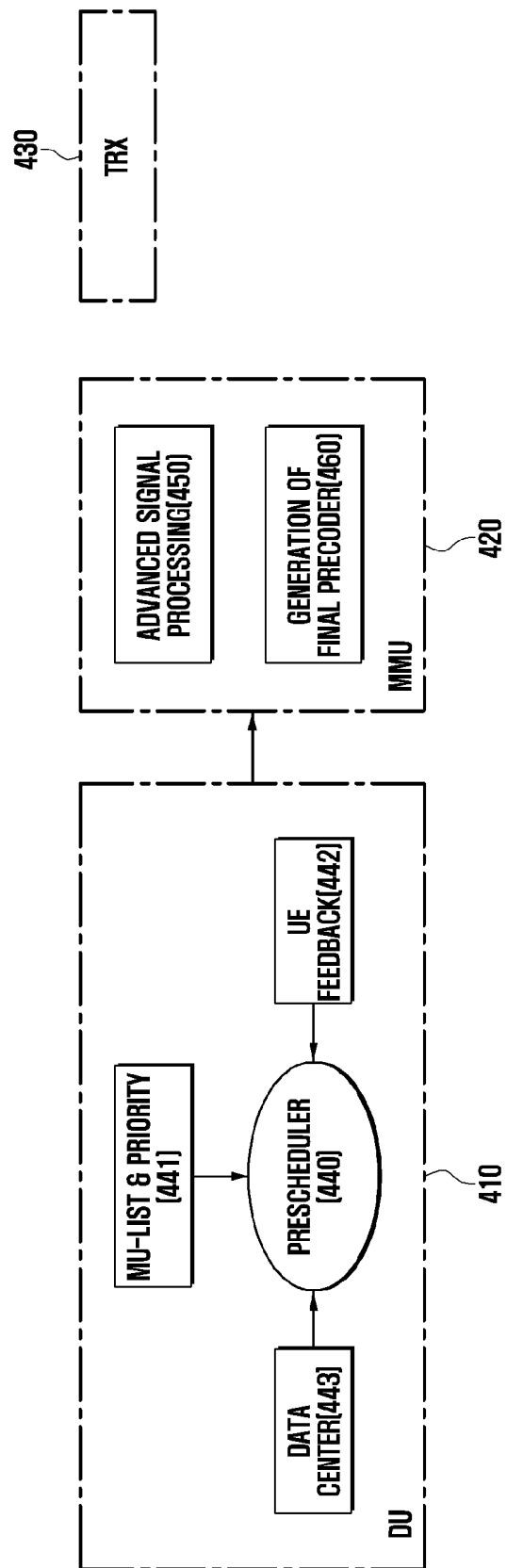
[Fig. 2]



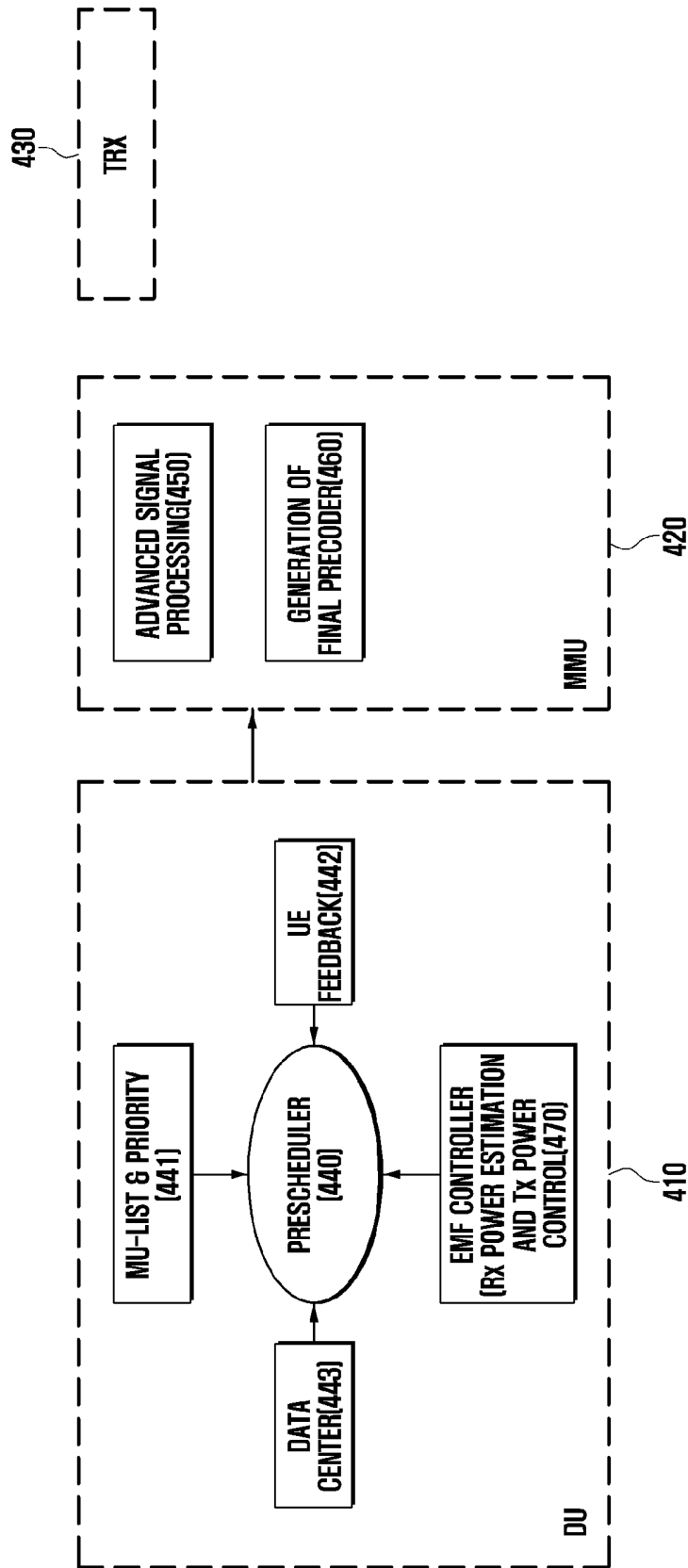
[Fig. 3]



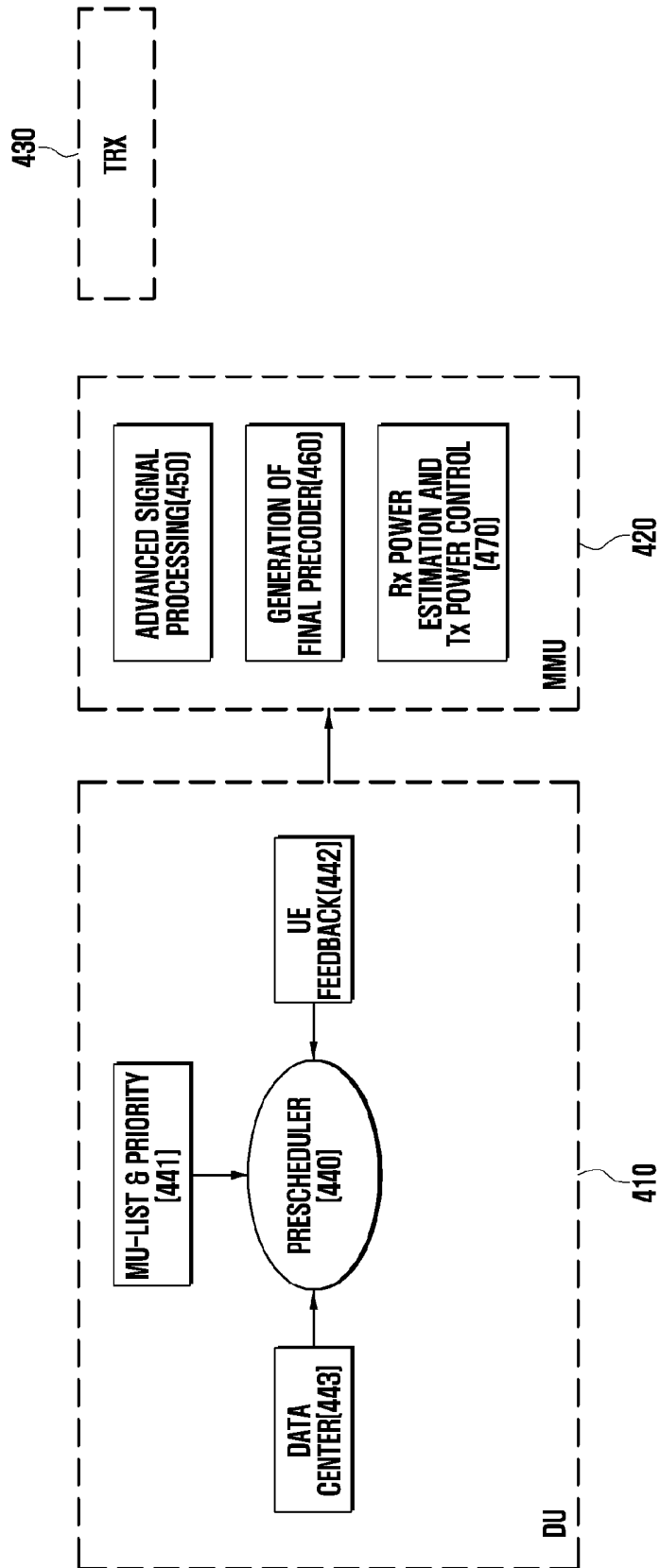
[Fig. 4A]



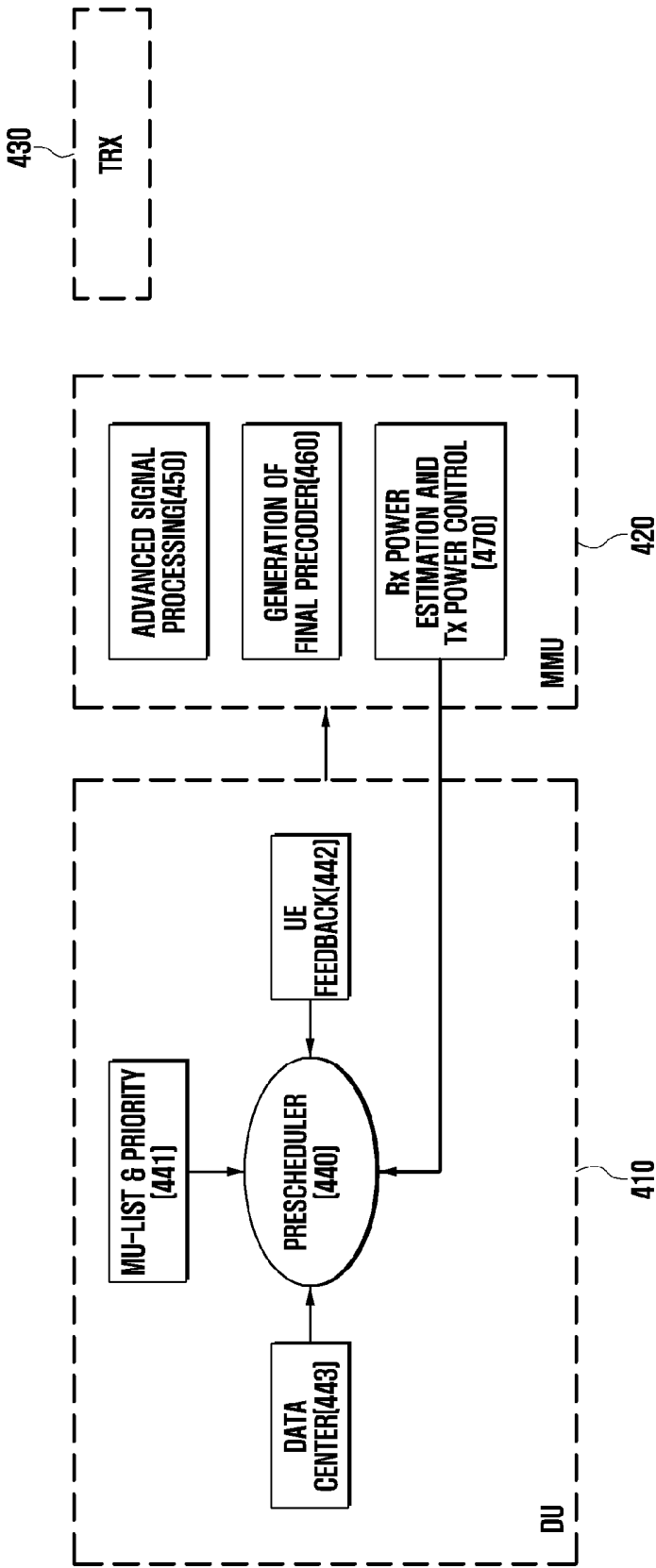
[Fig. 4B]



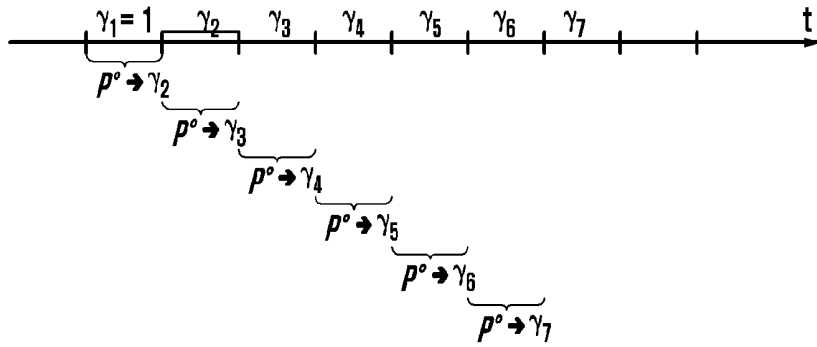
[Fig. 4C]



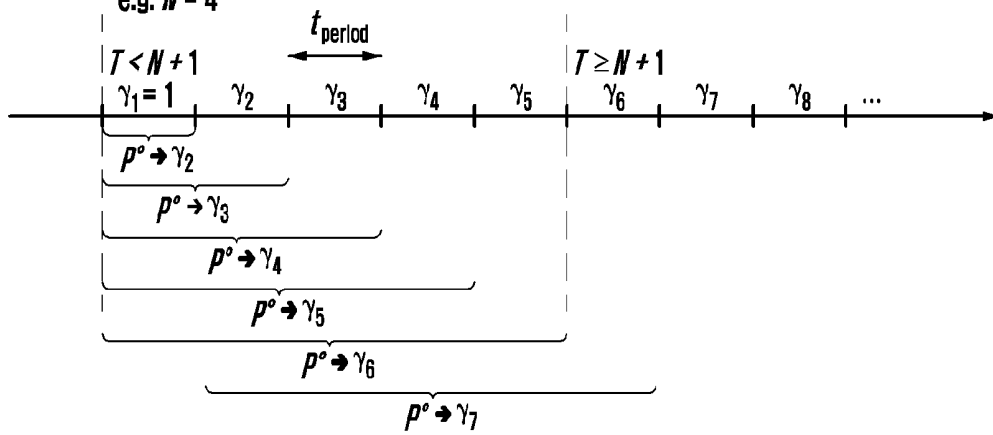
[Fig. 4D]



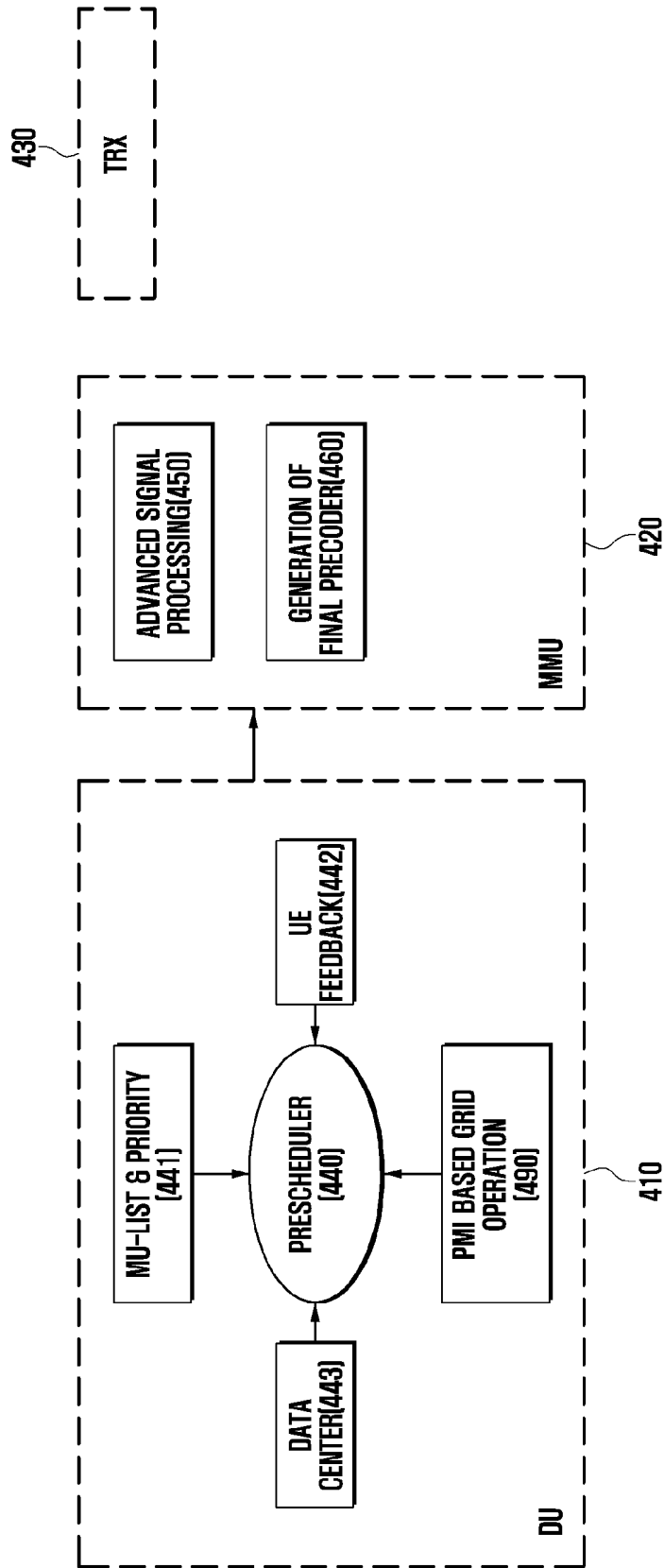
[Fig. 5A]

e.g. $N = 4$ 

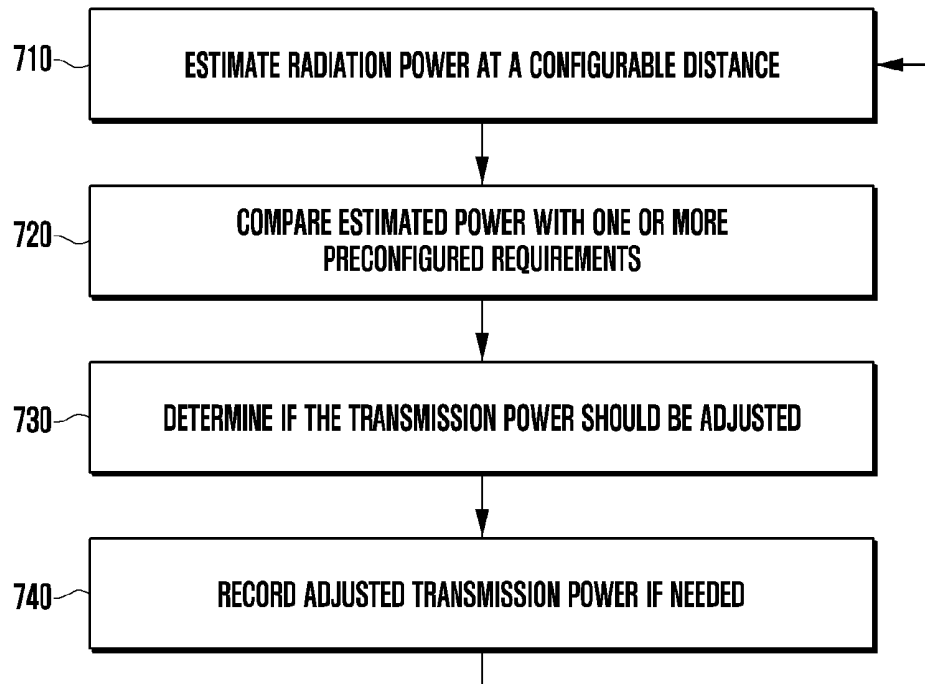
[Fig. 5B]

e.g. $N = 4$ 

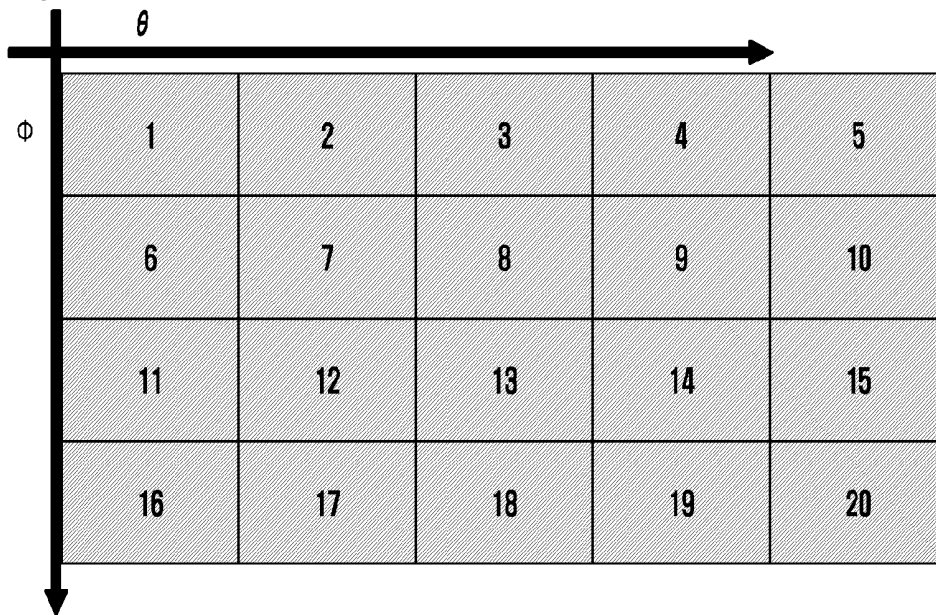
[Fig. 6]



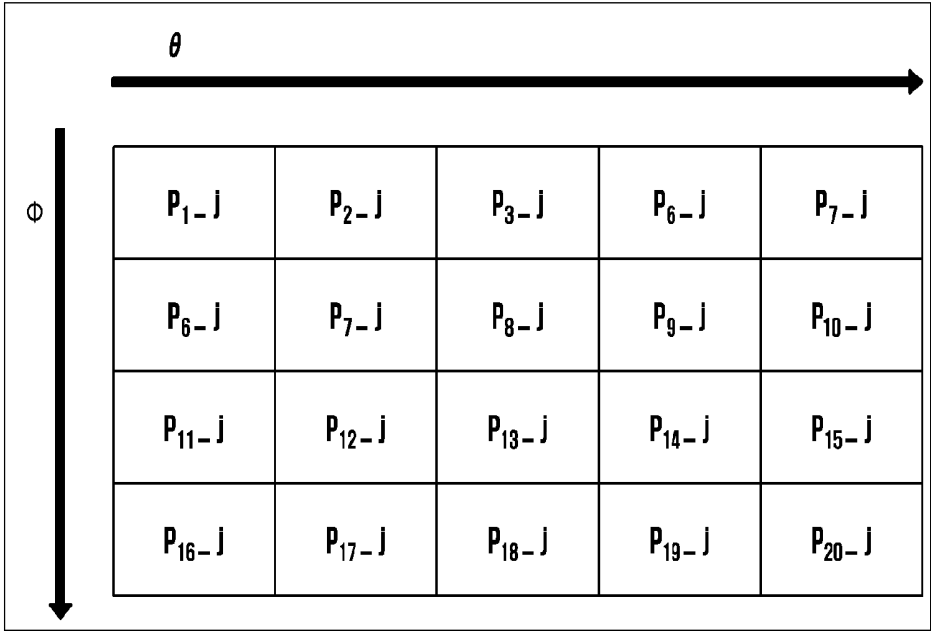
[Fig. 7]



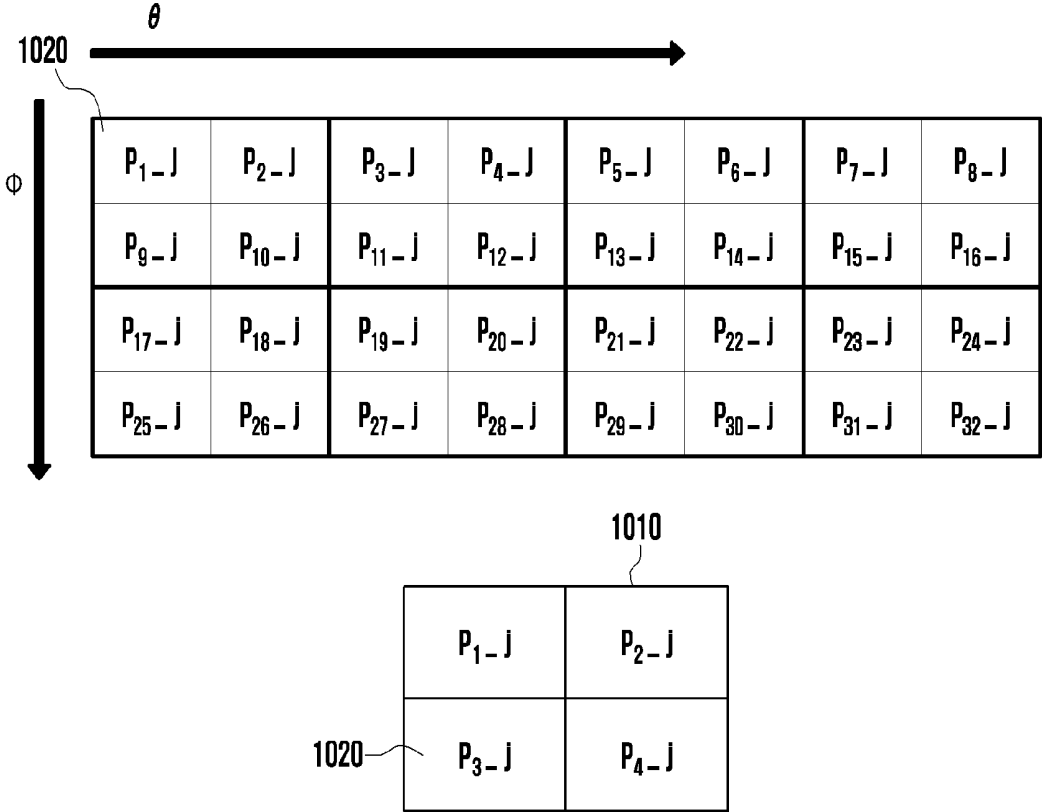
[Fig. 8]



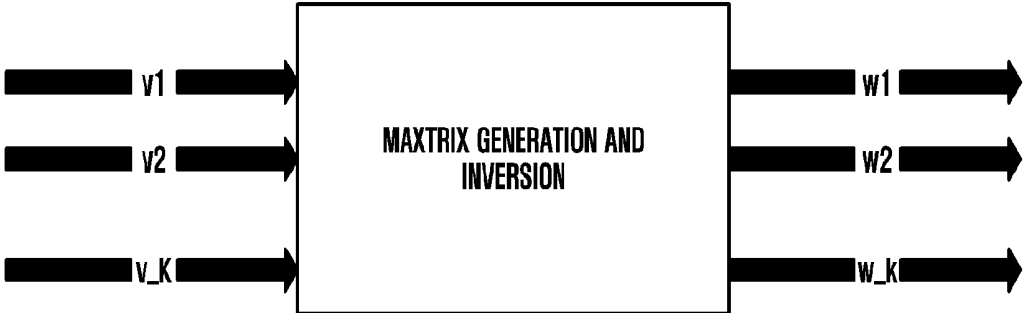
[Fig. 9]



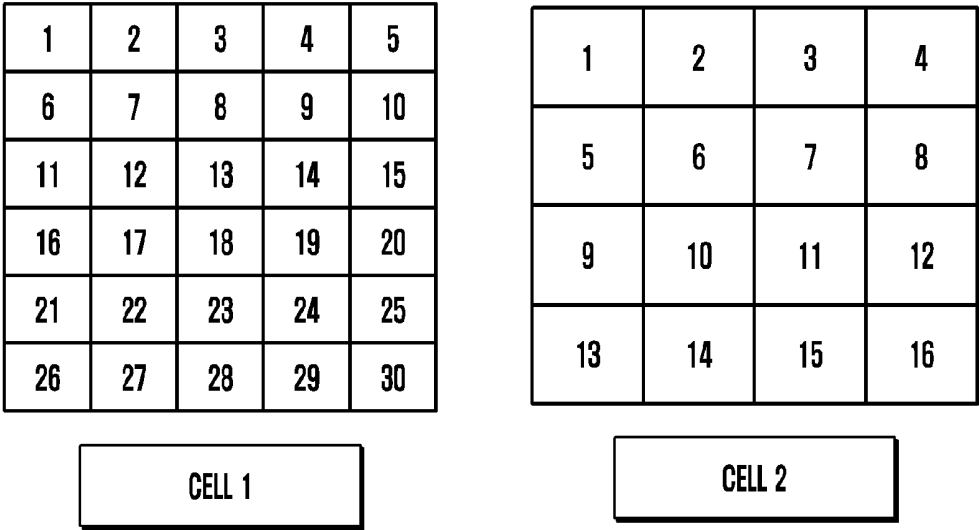
[Fig. 10]



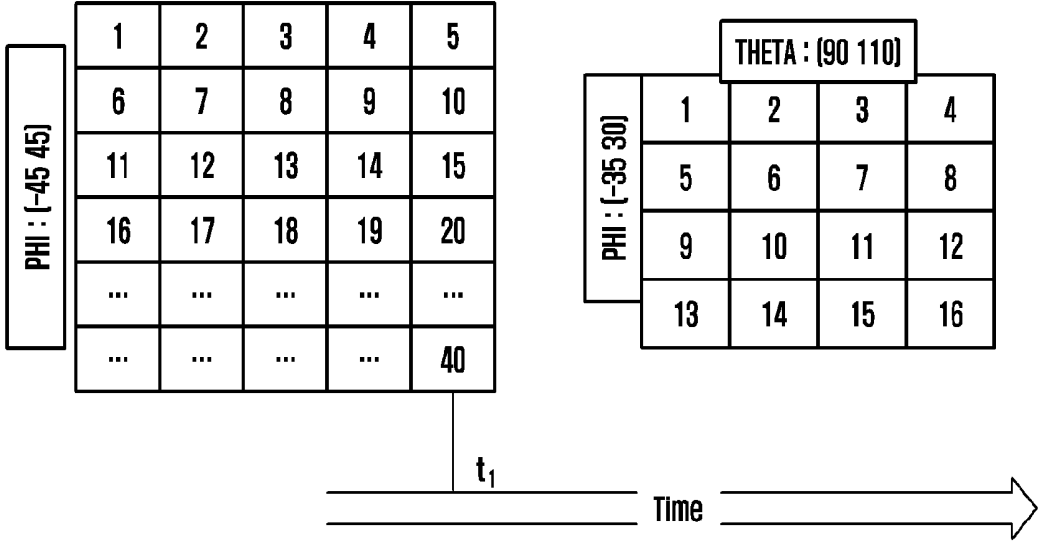
[Fig. 11]



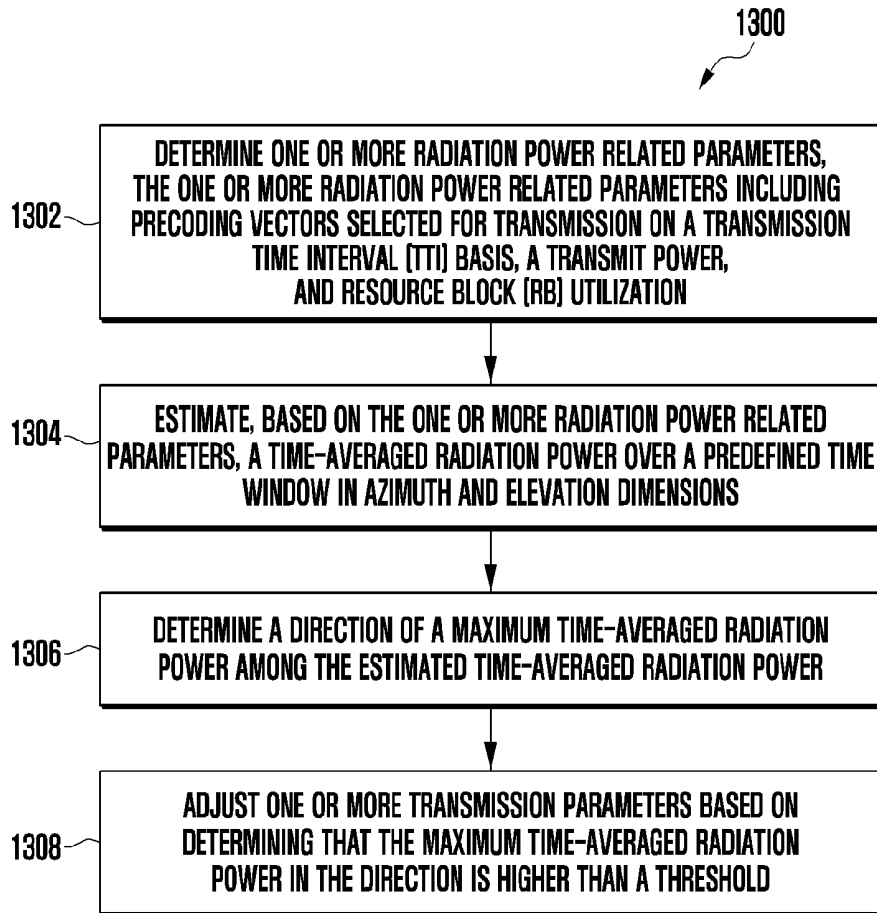
[Fig. 12A]



[Fig. 12B]



[Fig. 13]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2021/008748

A. CLASSIFICATION OF SUBJECT MATTER**H04W 52/22**(2009.01)i; **H04B 7/0426**(2017.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W 52/22(2009.01); H04W 52/04(2009.01); H04W 52/14(2009.01); H04W 52/26(2009.01); H04W 52/34(2009.01);
H04W 52/50(2009.01); H04W 72/08(2009.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & keywords: EMF, radiation power parameter, time-averaged radiation power, maximum time-averaged radiation power, direction, threshold

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2013-0157680 A1 (MOTOKI MORITA et al.) 20 June 2013 (2013-06-20) paragraphs [0045]-[0048]; claims 1, 7; and figure 3	1-15
A	ALFRED BURGI et al., 'Time averaged transmitter power and exposure to electromagnetic fields from mobile phone base stations', International Journal of Environmental Research and Public Health, ISSN 1660-4601, 14 August 2014 pages 8025-8036	1-15
A	US 2016-0066283 A1 (AT&T MOBILITY II LLC) 03 March 2016 (2016-03-03) paragraphs [0032]-[0037]; and figure 2	1-15
A	US 2010-0273518 A1 (HIDETOSHI SUZUKI et al.) 28 October 2010 (2010-10-28) paragraphs [0050]-[0059]; and figure 2	1-15
A	US 2020-0092822 A1 (CHINA ACADEMY OF TELECOMMUNICATIONS TECHNOLOGY) 19 March 2020 (2020-03-19) paragraphs [0028]-[0039]; and figure 1	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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Information on patent family members

International application No.

PCT/KR2021/008748

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				EP	3324685	B1	03 March 2021
				US	10820277	B2	27 October 2020
				WO	2017-020651	A1	09 February 2017

(19)日本国特許庁 (J P)

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(51)Int.Cl.⁶

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H 0 5 K 9/00

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E 0 4 B 1/92

E 0 6 B 5/18

E 0 6 B 5/18

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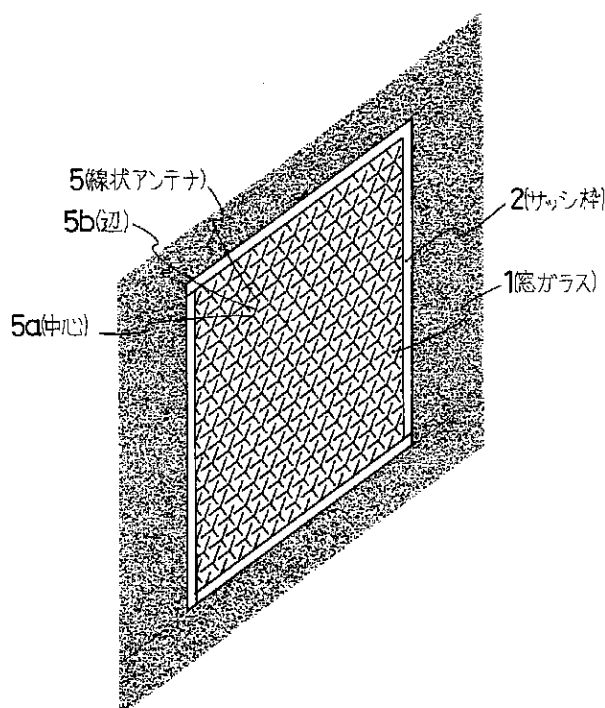
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(54)【発明の名称】 電磁シールド性能を有する窓ガラス

(57)【要約】

【課題】 必要な周波数帯の電波のみを選択して電磁シールドが可能であり、また、周囲の金属サッシ等に導電材等により導電処理させる必要もなく、既設のものに対しても簡単に電磁シールドを施すことができる。

【解決手段】 遮蔽しようとする電波に共振させる長さの線状アンテナ素子5を電磁遮蔽素子として、その素子の電磁界反射等価面積（散乱開口面積）または電磁界反射等価体積（散乱開口体積）を考慮して規則的にガラス表面またはガラス板間に配列させ、この線状アンテナ素子5で電波を散乱させこれにより減衰させる。



【特許請求の範囲】

【請求項1】 遮蔽しようとする電波に共振させる長さの線状アンテナ素子を電磁遮蔽素子として、その素子の電磁界反射等価面積（散乱開口面積）または電磁界反射等価体積（散乱開口体積）を考慮してガラス表面またはガラス板間に配列させ、この線状アンテナ素子で電波を散乱させこれにより減衰させることを特徴とする電磁シールド性能を有する窓ガラス。

【請求項2】 線状アンテナ素子は端部開放形状とし、中心から伸びるその一辺の長さ（電気長）を遮蔽しようとする電波の $1/4$ 波長（一本形状の場合は $1/2$ 波長）とする請求項1記載の電磁シールド性能を有する窓ガラス。

【請求項3】 線状アンテナ素子は環状線路形状であり、その周囲長（電気長）を遮蔽しようとする電波の波長と同じくする請求項1記載の電磁シールド性能を有する窓ガラス。

【請求項4】 線状アンテナ素子は複数の周波数を遮蔽できるように複数種からなり、寸法、形状の異なる2種以上の線状アンテナ素子を組合せて配列させる請求項1ないし請求項3のいずれかに記載の電磁シールド性能を有する窓ガラス。

【請求項5】 線状アンテナ素子は複数の周波数を遮蔽できるように複数種からなり、端部開放形状の線状アンテナ素子と環状線路形状の線状アンテナ素子とを組合わせる請求項4記載の電磁シールド性能を有する窓ガラス。

【請求項6】 線状アンテナ素子は複数の周波数を遮蔽できるように複数種からなり、端部開放形状の線状アンテナ素子同士で、長さが異なるものを組合わせる請求項4記載の電磁シールド性能を有する窓ガラス。

【請求項7】 線状アンテナ素子は複数の周波数を遮蔽できるように複数種からなり、環状線路形状の線状アンテナ素子同士で、長さが異なるものを組合わせる請求項4記載の電磁シールド性能を有する窓ガラス。

【請求項8】 端部開放形状の線状アンテナ素子は、各辺の端を隣接する線状アンテナ素子の中心に近づけて配列する請求項2記載の電磁シールド性能を有する窓ガラス。

【請求項9】 端部開放形状の線状アンテナ素子は、この線状アンテナ素子部分が環状線路形状である請求項2記載の電磁シールド性能を有する窓ガラス。

【請求項10】 線状アンテナ素子相互は、減衰量の関係を考慮して配列間隔を決定する請求項1ないし請求項9のいずれかに記載の電磁シールド性能を有する窓ガラス。

【請求項11】 線状アンテナ素子は、体積抵抗率を少なくとも $5 \times 10^{-8} (\Omega \cdot m)$ 以下とする請求項1ないし請求項10のいずれかに記載の電磁シールド性能を有する窓ガラス。

【請求項12】 線状アンテナ素子は、導電性に優れ、耐久性、耐候性に優れる素材とし、少量のガラス質を混入させる請求項1ないし請求項11のいずれかに記載の電磁シールド性能を有する窓ガラス。

【発明の詳細な説明】**【0001】**

【発明の属する技術分野】本発明は、建物の窓に使用する窓ガラス、その他、自動車や列車等の乗り物の窓ガラスや、間仕切りやボックス等の仕器の窓ガラス等種々の窓ガラスで、電磁シールド性能を持つものに関する。

【0002】

【従来の技術】建築物や建物内部または乗り物内部の電磁シールドの必要性は、無線技術を応用したパーソナルな携帯機器を法に定められた枠内で活用する場合などの周波数の再利用や、電波の干渉妨害対策や、通信のセキュリティ対策の目的から求められる。

【0003】例えば、特定の建物内で、事業所用PHS（自営——屋内専用）やWireless-LAN（無線LAN）を設ける場合、いずれも技術基準に基づいて製造され、その技術内容は公開され、しかも分析する測定機が市販されているので、屋内業務に使われる通信情報は屋外から容易にアクセスされ通信内容の傍受が可能となる。

【0004】公衆使用と兼用されているPHS端末では暗号化等による通信内容漏洩保護は大変に難しいのでセキュリティの維持を行うには一般には通信エリア外への電波の漏洩を防止する電磁シールドしか方法がない。

【0005】また、利用できる周波数チャンネルが制限されているので、可能な限りの使用台数を確保するためには使用エリアに応じて電波を閉じ込めるためのシールドが必要となる。

【0006】さらに、電磁シールドの必要性は、病院等医療分野で電磁波が医療機器や患者へ干渉して障害を発生させる場合や、レストランや車輦内などの公共のエリアで他人に携帯電話の使用で迷惑をかけないようにすること、さらに、コンサートホール等で観客に静寂を求められる場合などに、携帯電話等が作動しないようにすることからも要請される。

【0007】電波に対する電磁シールドは現在でもすでに広く使用されており、金属板や金属メッシュあるいは電波吸収材による研究が多くなされている。例えば、ビル構造の電磁シールドとして、従来は、各床面はデッキプレートその他の鉄板などにより十分な電磁遮蔽が行え、外部壁面並びにテナント間のパーティションには銅箔や金属メッシュをすきまなく貼り付けることによりマイクロ波帯でも有効な電磁遮蔽が行える。

【0008】

【発明が解決しようとする課題】これに対してガラス窓は光の透過性を確保することからも、電磁遮蔽が困難である。そのため、電磁遮蔽を行うにはビルの各室における窓ガラスを全く無くして壁面とし、その壁面を前記電

磁シールド構造とすることがあるが、この場合には視界がなく極めて閉塞感の伴った住環境を強いられる結果となる。

【0009】また、窓ガラスに電磁シールド構造を施すには、内部に金網を入れることも行われているが、例えばPHSで使用する電波（周波数が1.9 GHz帯）の電磁遮蔽では0.1mm程度の非常に細かい網目が必要となつて、電磁遮蔽は行われるものの透明感は損なわれてしまい住環境としては良好のものとは言えない。

【0010】窓ガラスに電磁シールド構造を施す他の例として、タングステン、アルミなどの極めて薄い金属蒸着膜をガラス表面または内部に全面にわたりラミネートすることがあり実用にされている。この方法ではPHS（1.9 GHz）あるいは無線LAN（2.45GHz）に対して最大20～30dB（ $=1/100 \sim 1/1,000$ ）に減衰させることは知られている。これによれば、可視光線に対しては30～35%の減少に留まるので視界制限はない。

【0011】しかし、この方法では採光あるビルの解放感を損なうことなく屋外からの侵入電波を遮蔽することはある程度は可能であるが、全ての範囲の周波数帯にわたり遮蔽するので確かに電波遮蔽は行いが、それでは遮蔽すると困る通常の通信、例えば、公衆携帯電話、ポケベル、各種放送、警察や消防に緊急通信、コードレス電話などの日常通信まで遮蔽されることになる。

【0012】本発明の目的は前記従来例の不都合を解消し、採光性・可視性を損なうことなく、しかも必要な周波数の電波帯のみを選択して電磁シールドが可能であり、また、窓枠の金属サッシ等の電磁シールド部材間の隙間部分の導電材による通電処理や接地処理をする必要もない電磁シールド性能を有する窓ガラスを提供することにある。

【0013】

【課題を解決するための手段】本発明は前記目的を達成するため、第1に、遮蔽しようとする電波に共振させる長さ（電気長）の線状アンテナ素子を電磁遮蔽素子として、その素子の電磁界反射等価面積または体積、すなわち電波の反射領域が、隙間なく重なり合うように考慮して、各アンテナ素子を規則的にガラス表面またはガラス板間に配列させ、この線状アンテナ素子で電波を散乱させこれにより減衰させることを要旨とするものである。

【0014】第2に、線状アンテナ素子は端部開放形状とし、中心から伸びるその一辺の長さ（電気長）を遮蔽しようとする電波の1/4波長（一本形状では1/2波長）とすること、または、線状アンテナ素子は環状線路形状であり、その周囲長（電気長）を遮蔽しようとする電波の波長と同じくすることを要旨とするものである。

【0015】第3に、寸法、形状の異なる2種以上の線状アンテナ素子を組合せて配列させること、および、端部開放形状の線状アンテナ素子と環状線路形状の線状ア

ンテナ素子とを組合わせること、または、端部開放形状の線状アンテナ素子同士で、長さが異なるものを組合わせること、もしくは、環状線路形状の線状アンテナ素子同士で、長さが異なるものを組合わせることを要旨とするものである。

【0016】第4に、端部開放形状の線状アンテナ素子は、各辺の端を隣接する線状アンテナ素子の中心に近づけて配列すること、および、端部開放形状の線状アンテナ素子は、この線状アンテナ素子部分が環状線路形状であることを要旨とするものである。

【0017】第5に、線状アンテナ素子相互は、減衰量の関係を考慮して配列間隔を決定することを要旨とするものである。

【0018】第6に、線状アンテナ素子は、その要求遮蔽性能に応じて体積抵抗率の少ない素材を選定すること、望ましくは $5 \times 10^{-8} (\Omega \cdot m)$ 以下とすること、および、線状アンテナ素子は、導電性に優れ、耐久性、耐候性に優れる素材、例えば銀とし、少量、例えば、5%程度のガラス質を混入させることによりガラスと一体化させることを要旨とするものである。

【0019】請求項1～請求項3記載の本発明によれば、線状アンテナ素子はアンテナの金属部分が占める面積のみが電磁波エネルギーを反射するのではなく、金属部分の近傍のある範囲の電磁界を広い範囲で反射させる。そしてこの線状アンテナ素子をこの電磁界反射等価面積あるいは等価体積を考慮して空間中あるいは非導電性材料上に平面的あるいは立体的に配置することにより電磁シールドができる。また、間隔を存して全面を覆うことがないので、採光性・可視性を損なうことがない。

【0020】しかも、パターン化した小さな線状アンテナ素子はその長さを特定することにより、特定の周波数を遮蔽でき、その結果、他の電波を通過させるので、警察、消防無線などの無線、テレビ電波など、外部からの情報の収集に必要な電波は遮蔽せず、建物内部で使用する特定の電波のみの外部漏れを防ぎ、セキュリティを高めるとともに周波数チャンネルの再利用ができる。

【0021】また、このように線状アンテナ素子はほとんどが反射損失により遮蔽し、一方、吸い取られた（受信した）電力は多くは熱損失として吸収されるので、線状アンテナ素子を窓枠の金属サッシ等に導通させて接地させる必要もなく、導電接続に限定されずに自由な設定ができる。

【0022】さらに、実際の電波では偏波面が一樣ではなく様々な傾きをもっているが、線状アンテナ素子を環状線路形状または方向性をもたせた端部開放形状とすることで、あらゆる偏波面の電波にも対応できる。

【0023】請求項4～請求項7記載の本発明によれば、長さの異なる線状アンテナ素子を組合せて規則的に配列させることで、複数の周波数帯の電波を電磁シールド

ドすることができ、このように、遮蔽する電波を複数の周波数帯のものに特定することで幅広く対応できる。例えば携帯電話に関しては、900 MHz帯、および1.5 GHz帯割り当てられた2つの周波数帯のすべてを対象として電磁シールドをかけることができる。

【0024】請求項8記載の本発明によれば、線状アンテナ素子の電界の高い所と低い所が近接する配置とすることで、電界の高い所同士が近接して素子間の相互干渉が起こることを防止できる。また、素子密度を高くし、減衰度をあげることができる。

【0025】請求項9記載の本発明によれば、端部開放形状の線状アンテナ素子は、この線状アンテナ素子部分が環状線路形状であることにより、反射等価面積を増加させることができ、高帯域化と高減衰化が可能となる。

【0026】高度な減衰量を確保するには線状アンテナ素子を極力近接させて配列することが望ましいが、反面、必要以上に近接させてガラス面に配置すると視覚的に問題（目障り）を発生させる。請求項10記載の本発明によれば、線状アンテナ素子の配列間隔と減衰量の関係に相関関係があることを発見し、必要とされる減衰量から線状アンテナ素子相互の配列間隔を決定することで極力線状アンテナ素子相互間に隙間を大きく確保して、よりよい視覚性をガラス面に確保できる。

【0027】高度な減衰量を確保するには、線状アンテナ素子の損失抵抗を極力低くすることが望ましい。これには線幅を広くすることにより損失抵抗の低減を図ることが望ましい。しかし、線状アンテナ素子の線幅を増すことはこれを配列した場合のガラス面の光学的透過性を損なうことになる。線状アンテナ素子を0.5mm程度の線幅とした場合、請求項11記載の本発明によれば、望ましくは体積抵抗率を $5 \times 10^{-8} (\Omega \cdot m)$ 以下とすることにより十分性能を確保することができる。

【0028】同様に高度な減衰量を確保するため線状アンテナ素子の損失抵抗を極力低くするには電気抵抗の低い素材を採用することが望ましい。線状アンテナ素子の素材としては銅や銀、金が最適であるが、金はコスト高であり、銅は酸化により抵抗値の上昇がある。請求項12によれば、価格がそれほど高くなく、酸化により抵抗値が上昇するおそれのない銀を採用するものであり、少量例えば、5%程度のガラス質を混入させることでガラスと一体化させ線状アンテナ素子の寿命をガラスと同程度とすることができる。

【0029】

【発明の実施の形態】以下、本発明の実施形態を図面について詳細に説明する。図1は本発明の電磁シールド性能を有する窓ガラスの第1実施形態を示す斜視図で、図中1は窓ガラス、2はサッシ枠を示し、遮蔽しようとする電波の周波数に対応した長さの線状アンテナ素子5を電磁界反射等価面積または体積を考慮して窓ガラス1上に規則的に配列させ、この線状アンテナ素子5で電波を

減衰させることとした。

【0030】先に、本発明に関連する基本原理について説明する。導体片が空中にある場合、この面に電波が入射すると、1部は反射、1部は吸収、残りは透過する。この導体片による電波の減衰量は導体片の形状や大きさによって異なる。この導体片を図3に示すように端部が開放の線状アンテナ素子（ダイポール）3としたとすれば、電波を反射するとともに一部は吸収される。

【0031】図4に示すように、平面電磁界に平行に置かれた半波長（ $\lambda/2$ ）のダイポールアンテナ素子3はアンテナ素子の金属部分の面積のみが電磁波エネルギーを受信するのではなく、金属面の近傍の電磁界を吸い取っている。その広がりは一様ではないが等価断面積 A_e は、下記式1で計算値が表示される。

【0032】

【式1】 $A_e \approx 0.13\lambda^2$ （ $\lambda/2 \times \lambda/4$ の面積）

【0033】この等価断面積 A_e の範囲の電磁波の約3/4は反射され、残り約1/4が受信電力となる。これが実効開口である。

【0034】図5に示すように、このような半波長（ $\lambda/2$ ）の線状アンテナの受信入力抵抗をゼロにすると、理想的な損失のないアンテナ素子であれば、空間に電力がすべて反射され、その等価な面積は前記の実効開口の4倍になり（散乱開口）、このような線状アンテナ素子3による素子を前記等価面積 $4 \times A_e$ （散乱開口）に応じて図6に示すように窓ガラス1に配列すれば、あたかも金属膜を貼ったのと同様な電波反射効果を示す。アンテナ素子は一般に周波数依存性をもつが、その特性と受信端抵抗=0がこの線状アンテナ素子3による素子の基本動作であり、もし線状アンテナに損失があれば、電波の一部は電力としてアンテナ損失抵抗に吸い取られる。

【0035】しかも線状アンテナ素子3は散在するもので、窓ガラス1の採光性・可視性を損なうこともない。なお、線状アンテナ素子3をなす導線の太さは視界の妨げにならないように細く、かつ損失の少ないものを選択する。

【0036】ところで1885～1950MHzは、現行のパーソナル通信（PHS-JAPAN, PCS-US, DECT-Europe）および西暦2000年から実用になるFPLMTS（Future Public Land Mobile Telephone System）の周波数帯であり、2420～2480MHzはITUで定めるISM（Industrial-Scientific-Medical — 工業、科学、医療）用の周波数帯でビル内では無線LANに割り当てられているほか電子レンジや大電力の非破壊検査用線形加速機にも使われている。

【0037】PHSの場合は周波数が1.90GHzであるとする、波長が $\lambda \approx 158$ mm、無線LANの場合は周波数が2.45GHzであるとする、波長が $\lambda \approx 122$ mmだから、それぞれの線状アンテナ素子3は面積 $4 \times A_e = 12,980 \text{ mm}^2$ （PHS）、 $4 \times A_e = 7,740 \text{ mm}^2$ （LA

N)に相当し、これをガラス表面またはガラス板間に前記電磁界反射等価面積 $4 \times A_e$ を考慮して規則的に配列、すなわち点在させればよい。

【0038】しかし、図6に示すように線状アンテナ素子3を横一列に配置するのでは、実際の電波の偏波面がこのように横一列でなく、様々な偏波面には対応できない。そこで線状アンテナ素子3はこれを後述のような方向性をもつ端部開放形状か、環状線路形状とする。このようにすることであらゆる面の傾きの異なる電波にも対応できる。

【0039】図1、図2は本発明の第1実施形態を示すもので、線状アンテナ5は端部開放形状とし、遮蔽しようとする電磁波の波長を λ 、ガラス面に線状アンテナ素子を配列した時の等価比誘電率を ϵ_q とした場合、一辺の長さが $\lambda / (4\sqrt{\epsilon_q})$ の逆Y字形素子であるとした。すなわち、空気中では ϵ_q が1であるので、線状アンテナ5は中心5aから伸びる一辺の長さが遮蔽しようとする電波の $1/4$ 波長となる。しかしこの線状アンテナ5をガラス上に配置するとガラスや境界面の誘導率により一辺の長さは変わる。

【0040】なお、前記線状アンテナ素子3や線状アンテナ素子5を設ける窓ガラス1としては、フロートガラスまたはグレーペンガラス等がよく、またガラス表面またはガラス板間に線状アンテナ素子3や線状アンテナ素子5をこのアンテナ素子が有する電磁界反射等価面積を考慮して規則的に配列させる方法としては、銀、銅、金などの金属ペーストシルク印刷やフィルム膜の貼り付けによる方法が考えられる。

【0041】このうち、フィルム膜の貼り付けはガラスの破損時の飛散防止や、日射量の調整も可能である。また、建設後から追加施工することもできるし、相対的に安価な方法である。フィルム材として、ポリイミドフィルムやポリエステルフィルム、ポリエチレンフィルム等の合成樹脂フィルムに、線状アンテナ5を回線パターンとしてエッチング法やラミネート法やスクリーン印刷法で設け、これをガラス等に貼ることになる。

【0042】前記エッチング法はフレキシブル基板としてのフィルムに銅箔を張り付けたものを基材として使用し、パターン部にマスキングをして残る部分を溶剤で溶解する一般のプリント基板と同様な手法からなる。これに対してスクリーン印刷法は基材上に銀、金などの金属ペースト印刷を施すことにより回線パターンを構成するものである。

【0043】前記Y字形の線状アンテナ5を配置した電磁波シールドガラスの性能確認を行うためにガラス表面に銀ペーストにより線状アンテナ5を焼成印刷して行った実験結果を図9に示す。

【0044】最大減衰量は35dB（中心周波数1.9GHz）で、目標とした30dBの減衰帯域幅は35MHz程度となりPHS電波使用帯域に対して十分なシールド性能を持つことが確認された。

【0045】下記表-1にこのガラス仕様を、表-2に実験概要を示す。

【0046】

【表1】

項 目	仕 様
基盤ガラス	グレーペンガラス 60cm × 60cm 厚さ8mm
エレメント	銀ペースト焼成印刷 (Ag:95%, その他ガラス質5%) 線長 21mm 線幅 0.5mm

【0047】

【表2】

項 目	概 要
計測方法	電波暗室開口部による挿入損失法 (開口部寸法 110cm × 50cm)
計測器	発信器：シンセサイズドスイーパー 受信器：スペクトラムアナライザ アンテナ：Wリジットガイドホーンアンテナ
計測距離	60cm, 200cm
入射角	0°, 60°
偏波面	垂直, 水平偏波

【0048】図10は線状アンテナ素子5を4角形、すなわち十字形の素子とした場合である。この場合、中心5aが電位の低い所となり、各辺5bの端が電位の高い所となる。図10の場合と比べて図2の場合は、線状アンテナ素子5の電位の高い所と低い所が近接する3角形を配置することで、電位の高い所同士が近接して素子間の相互干渉が起こることを防止できる。また、3角形として配列することで素子密度を高くすることができる。

【0049】図12に端部開放形状の線状アンテナ素子5のさらなる変形例を示す。このうち左側に示す一字形のものは、全長が遮蔽しようとする電波の1/2波長と同じになる。

【0050】また、前記線状アンテナ素子5を配列した窓ガラス1は、ガラスの突き合わせ（ガラス間の隙間）間にパッキン等の配置部分でアンテナ素子5がない部分があっても十分対応できることを実験結果で確認した。これによれば、ガラス間隙サイズ変更によるシールド中心周波数変移がわずかに見られるが、30mm程度までシールド要求性能は満足できる。

【0051】この実験は図21に示すように、開口部（幅51cm×高さ111cm）を有するシールドルームの室内のアンテナより一定出力で電波を発信し、シールドルーム室外のアンテナよりこの電波を受信するもので、開口部に2枚の前記供試体による本発明の窓ガラス1を組込み、この窓ガラス1間の隙間の間隔を変化させた時の受信電界強度をスペクトラムアナライザにて計測したものである。

【0052】ところで、先に線状アンテナ素子5は電磁界反射等価面積または体積を考慮して窓ガラス1上に規則的に配列させ、この線状アンテナ素子5で電波を減衰させることとしたと述べたが、さらに、線状アンテナ素子5同士の最適間隔については必要とする減衰量を考慮し定めることができる。

【0053】高度な減衰量を確保するには線状アンテナ

素子5を極力近接させて配列することが望ましいが、反面、必要以上に近接させて窓ガラスのガラス面に配置すると視覚的に問題（目障り）を発生させる。

【0054】図22、図23はこのような線状アンテナ素子の配列間隔と減衰量の関係を見るための実験装置であるが、銅の棒を線状アンテナ素子に見立てて実験を行なった結果、図24に示すような相関関係を得た。

【0055】そこで、線状アンテナ素子5相互は、減衰量の関係を考慮して配列間隔を決定することとし、必要とされる減衰量から線状アンテナ素子相互の配列間隔を決定することで極力線状アンテナ素子相互間に隙間を大きく確保して、よりよい視覚性をガラス面に確保できる。

【0056】また、前記実験結果で、線状アンテナ素子5の素材は銀ペースト焼成印刷、線幅0.5mmとしたが、線状アンテナ素子5は、体積抵抗率を $5 \times 10^{-8} (\Omega \cdot m)$ 以下とすることが望ましい。

【0057】高度な減衰量を確保するには、線状アンテナ素子の損失抵抗を極力低くすることが望ましい。これには線幅を広くすることにより損失抵抗の低減を図ることあるいは導電性の良い素材を採用することが望ましい。しかし、線状アンテナ素子の線幅を増すことはこれを配列した場合のガラス面の光学的透過性を損なうことになる。前記のごとく、線状アンテナ素子を0.5mm程度の線幅とした場合、請求項11記載の本発明によれば、体積抵抗率が少なくとも $5 \times 10^{-8} (\Omega \cdot m)$ 以下であれば十分に性能を確保することができる。

【0058】また、線状アンテナ素子の素材としては銅や銀、金が電気抵抗の低い素材として最適であるが、金はコスト高であり、銅は酸化により抵抗値の上昇がある。前記のごとく、銀を採用することにより、価格がそれほど高くなり、酸化により抵抗値が上昇するおそれのないものとなる。さらに、5%程度のガラス質を混入させることでガラスと一体化させ線状アンテナ素子の寿命

をガラスと同程度とすることができる。

【0059】図7、図8は端部開放形状の線状アンテナ素子5の代わりに、環状線路形状の線状アンテナ素子とした場合で、Y字形の環状線路形状とした例である。さらに、図11に環状線路形状の線状アンテナ素子4の変形例を示す。三角形、四角形、その他の多角形、円形等種々の形状のものが考えられる。

【0060】かかる環状線路形状の線状アンテナ素子4は、その周囲長（電気長）を遮蔽しようとする電波の波長と同じくする。正確には、波長を λ 、等価比誘電率を ϵ とした場合、線状アンテナ素子4は周囲が約 $\lambda/\sqrt{\epsilon}$ のリングとなる。

【0061】この環状線路形状の線状アンテナ素子4は前記端部開放形状の線状アンテナ素子5に比べて線幅が細いものですみ、また、端部開放形状の線状アンテナ素子の $\lambda/4$ より短い素子のキャパシタンス成分を折り返しループのインダクタンスで打ち消して共振条件を得ている。輻射抵抗は低いが折り返し線路の効果で4倍に高めている。

【0062】素子が短いので、電界が低くガラスに誘電率の影響を少なくでき、また、ループ幅を広げるとZ₀b（平行2線の特性インピーダンス）が高くなり、ガラスの影響を低くする効果が得られる。さらに、幅を広げると等価半径が大きくなり細い線で広い帯域が実現できる。

【0063】図13は前記端部開放形状の線状アンテナ素子5のさらなる変形例として、この線状アンテナ素子5の部分が環状線路形状5cであるようにした。いわば、端部開放形状の線状アンテナ素子の部分に環状線路形状の線状アンテナ素子を組み込んだ複合形とする。

【0064】このようにすることで、細い線を多数並列に使うことになり、反射表面積を増加させることができるとともに透視性を劣化させないで高周波損失抵抗値を低下させ、高帯域化と高減衰化が可能となる。

【0065】ところで、例えば、携帯電話では周波数帯は900 MHz 帯と1,500 MHz 帯の2種類がある。同様に、PHSは周波数が1.9 GHzであり、無線LANの場合は周波数が2.45 GHzである。これらの電波帯に電磁シールドを行うには、複数周波数帯に対応することが必要となる。

【0066】図14はこのような複数周波数帯対応を有する電磁シールド方法の実施形態を示す斜視図で、長さの異なる線状アンテナ素子を組合せて規則的に配列させることとする。本実施形態では環状線路形状の線状アンテナ素子4と端部開放形状の線状アンテナ素子5を組合せたものをそれぞれ等価電磁界反射面積（体積）を考慮して規則的に配列させるが、図15に示すように端部開放の線状アンテナ素子5はY字形のもの、環状線路形状の線状アンテナ素子4は正三角形のものとする。なお、線状アンテナ素子3は2重のものとしたが、これを1重の

ものとしてもよい。

【0067】また、線状アンテナ素子5は線状アンテナ素子4の中に非接続で納まる。このようにすることで、素子間の干渉を軽減することができる。図16には図15に示す線状アンテナ素子4、5の電磁シールド効果を示すが、縦軸は減衰量、横軸は周波数である。（DDSは線状アンテナ素子3は2重のものとした場合、SDSは1重のものとした場合である。）

【0068】図17に環状線路形状の線状アンテナ素子4と端部開放形状の線状アンテナ素子5を組合せたものの変形例を示す。図中aは端部を折り曲げた例である。

【0069】さらに、複数周波数帯対応を有する電磁シールド方法として、図18に示すように端部開放形状の線状アンテナ素子5同士で、長さが異なるものを組合せる場合や、図19に示すように環状線路形状の線状アンテナ素子4同士で長さが異なるものを組合せる場合も可能である。

【0070】また、複数周波数帯対応として3つの周波数帯のための線状アンテナ素子の組合せ例を図20に示す。

【0071】なお、前記の実施形態は建物に窓に使用する窓ガラスについて述べたが、その他、自動車や列車等の乗り物の窓ガラスや、パーテーションやボックス等の仕子の窓ガラスにも適用できる。

【0072】

【発明の効果】以上述べたように本発明の窓ガラスは、アンテナ素子長に応じた周波数帯の電波のみシールドし、これ以外の電波は透過できるので必要な周波数の電波帯のみを選択して電磁シールドが可能なのである。

【0073】また、最大40 dB程度のシールドが可能で、アンテナ素子周囲に反射領域ができるため、ある程度隙間が存在してもシールド性能は確保でき、アンテナ素子の細線化が可能なので、採光性・可視性を損なうことがない。

【0074】さらに、これを施した部材間の隙間部分の処理や接地のための導電材による通電処理をする必要もないものである。

【図面の簡単な説明】

【図1】本発明の窓ガラスの第1実施形態を示す斜視図である。

【図2】本発明の窓ガラスの第1実施形態を示す要部の正面図である。

【図3】線状アンテナ素子を短絡型ダイポールとした場合の説明図である。

【図4】本発明窓ガラスにおける電磁シールド方法の原理を示すその1の説明図である。

【図5】本発明窓ガラスにおける電磁シールド方法の原理を示すその2の説明図である。

【図6】線状アンテナ素子を配置した窓ガラスの正面図である。

【図7】本発明の窓ガラスの第2実施形態を示す斜視図である。

【図8】第2実施形態での線状アンテナ素子の正面図である。

【図9】Y字形の線状アンテナ素子を配置した本発明の窓ガラスの性能確認を行った実験結果のグラフである。

【図10】線状アンテナ素子を十字形とした場合の配置を示す説明図である。

【図11】環状線路形状の線状アンテナ素子の変形例を示す説明図である。

【図12】端部開放形状の線状アンテナ素子の変形例を示す説明図である。

【図13】端部開放形状の線状アンテナ素子の変形例を示す正面図である。

【図14】本発明の窓ガラスの第3実施形態を示す斜視図である。

【図15】環状線路形状の線状アンテナ素子と端部開放形状の線状アンテナ素子の組合せの一例を示す平面図である。

【図16】図13に示す線状アンテナ素子の電磁シールド効果を示すグラフである。

【図17】環状線路形状の線状アンテナ素子と端部開放形状の線状アンテナ素子を組合せたものの変形例を示

す説明図である。

【図18】端部開放形状の線状アンテナ素子同士で、長さが異なるものを組合わせ例を示す説明図である。

【図19】環状線路形状の線状アンテナ素子同士で長さが異なるものを組合わせ例を示す説明図である。

【図20】3つの周波数帯のための線状アンテナ素子の組合せ例を示す説明図である。

【図21】窓ガラス相互に隙間の遮蔽性能を確認する実験設備の説明図である。

【図22】線状アンテナ素子の配列間隔と減衰量の関係を見るための実験装置の正面図である。

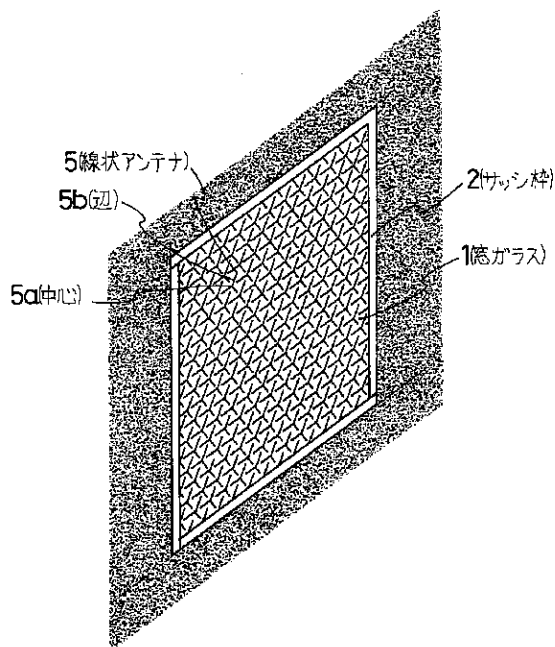
【図23】線状アンテナ素子の配列間隔と減衰量の関係を見るための実験装置の縦断側面図である。

【図24】線状アンテナ素子の配列間隔と減衰量の実験結果のグラフである。

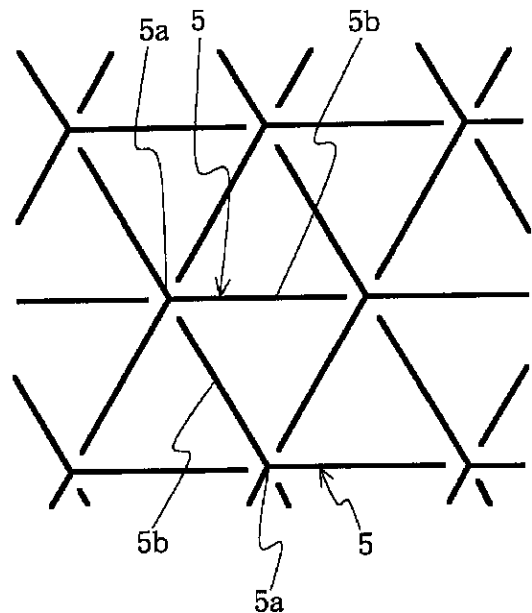
【符号の説明】

- | | |
|------------|------------|
| 1…窓ガラス | 2…サッシ枠 |
| 3…線状アンテナ素子 | 4…線状アンテナ素子 |
| 5…線状アンテナ素子 | 5a…中心 |
| 5b…辺 | 5c…環状線路形状 |

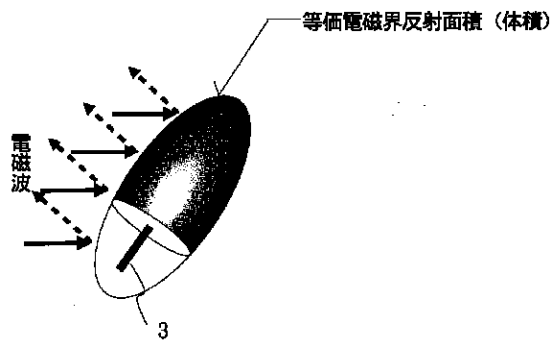
【図1】



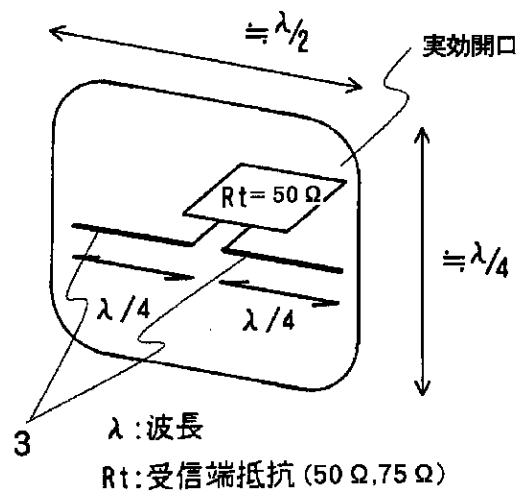
【図2】



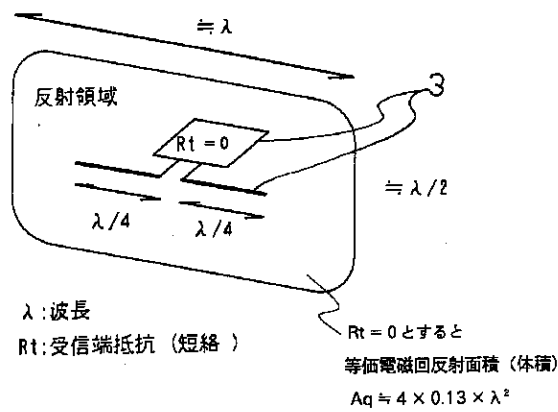
【図3】



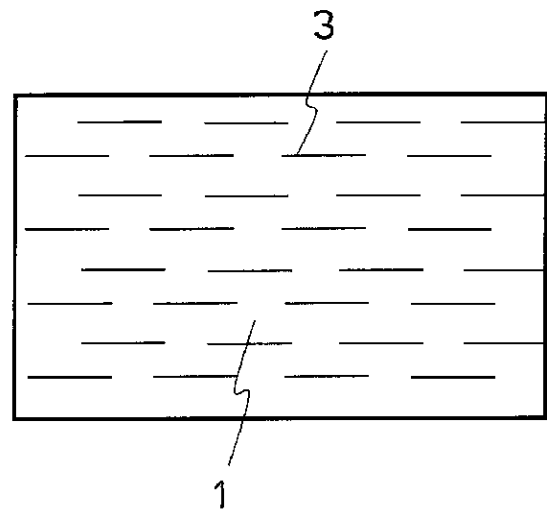
【図4】



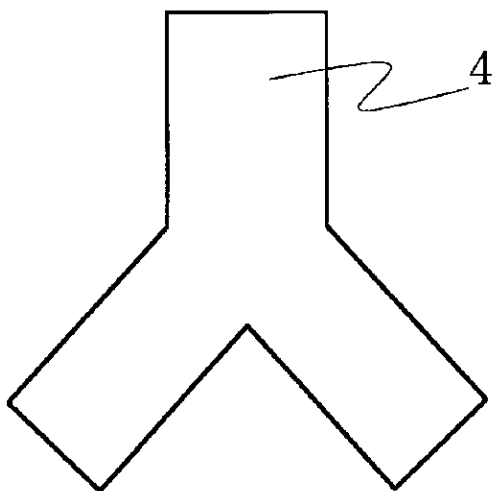
【図5】



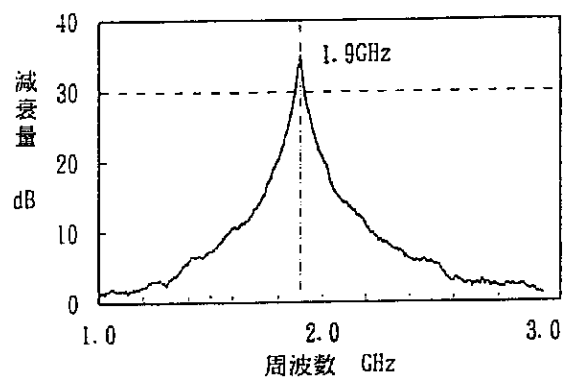
【図6】



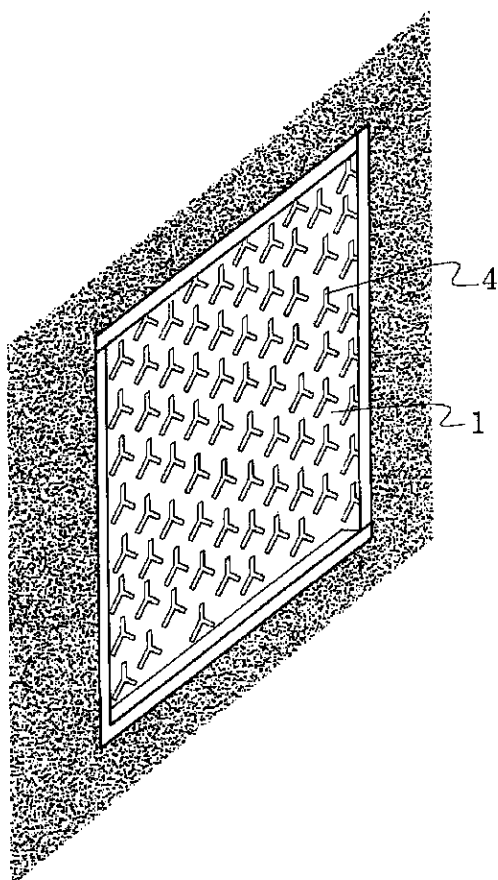
【図8】



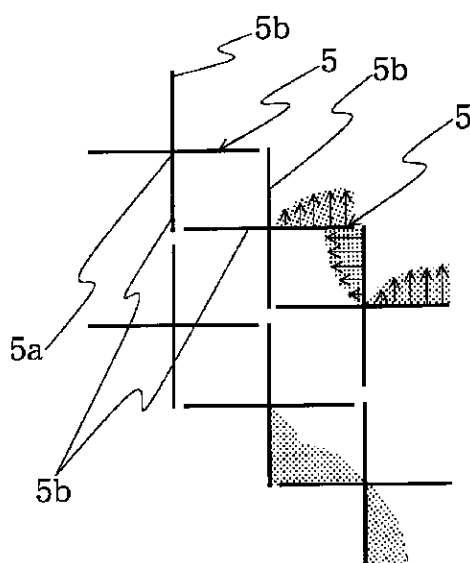
【図9】



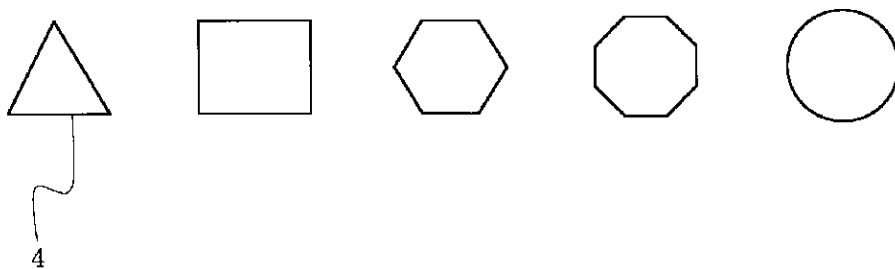
【図7】



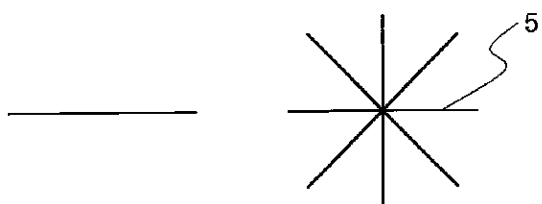
【図10】



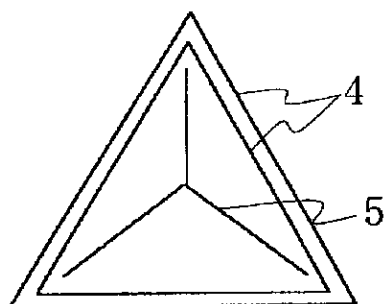
【図11】



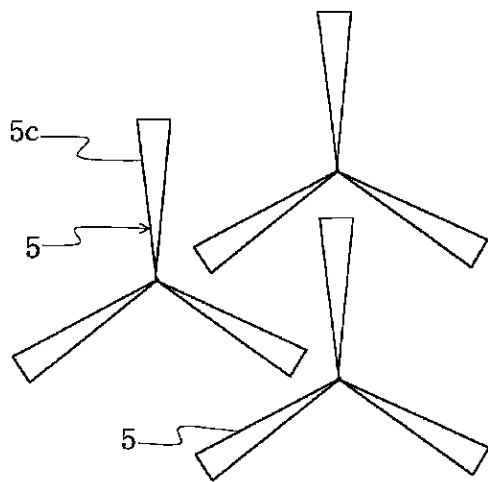
【図12】



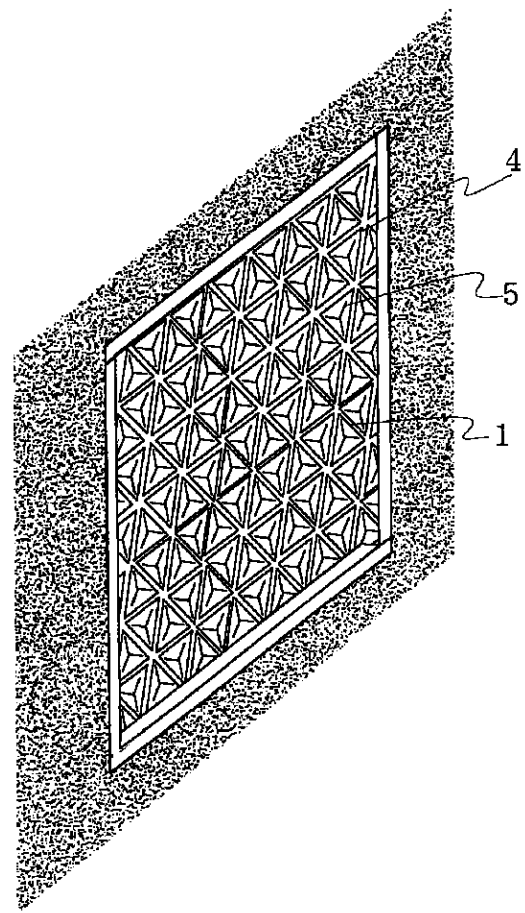
【図15】



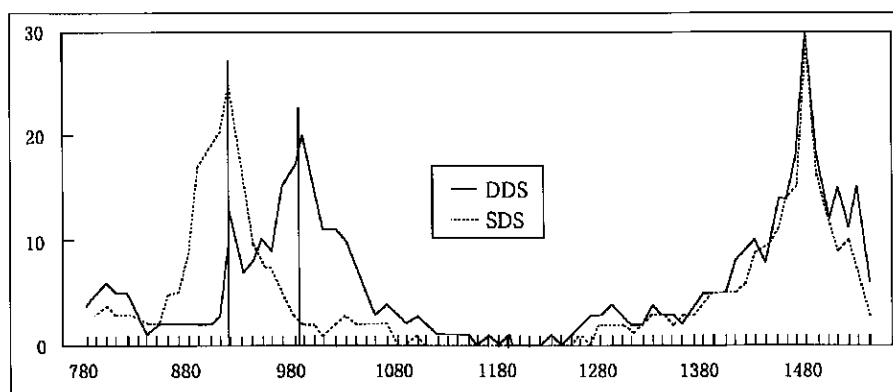
【図13】



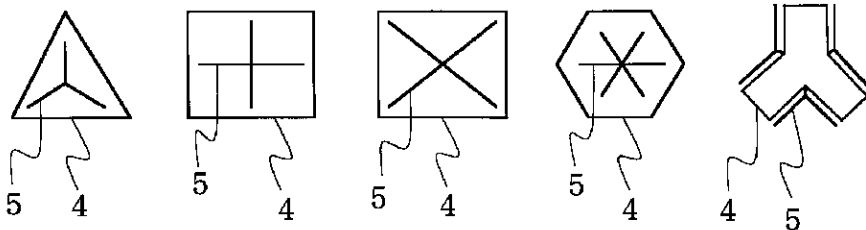
【図14】



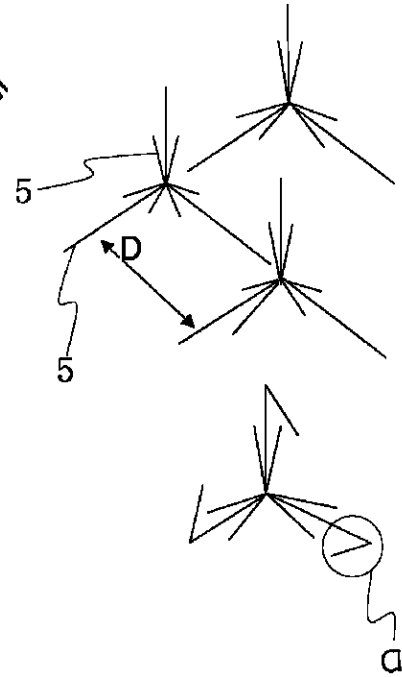
【図16】



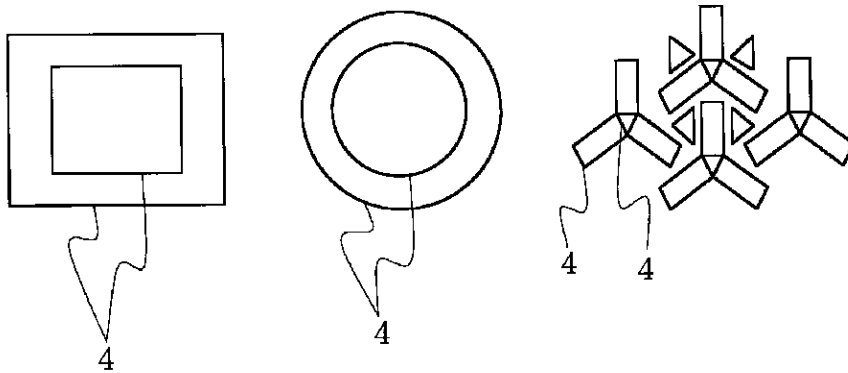
【図17】



【図18】

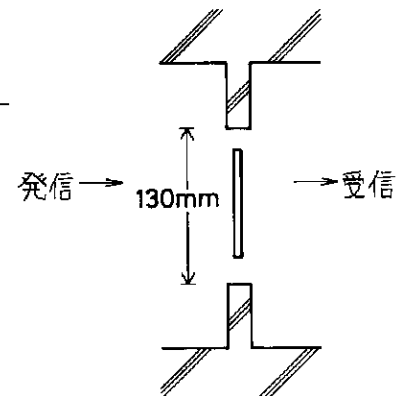
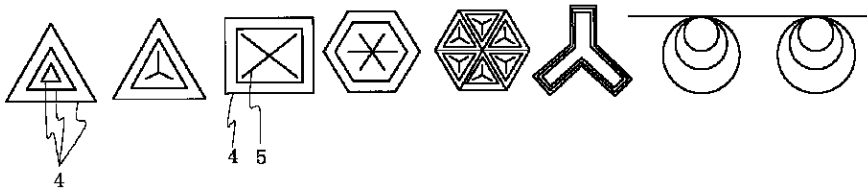


【図19】

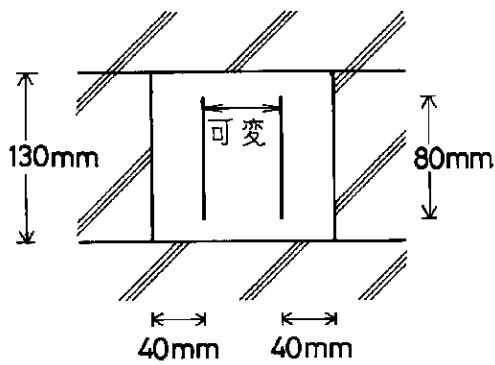


【図23】

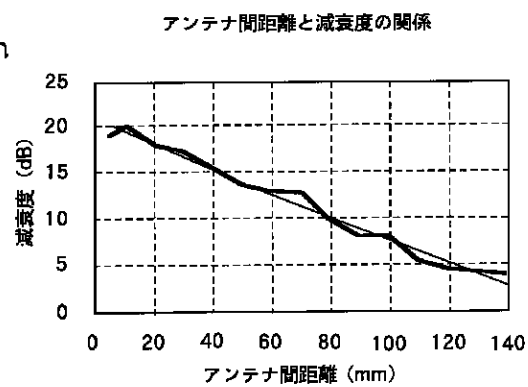
【図20】



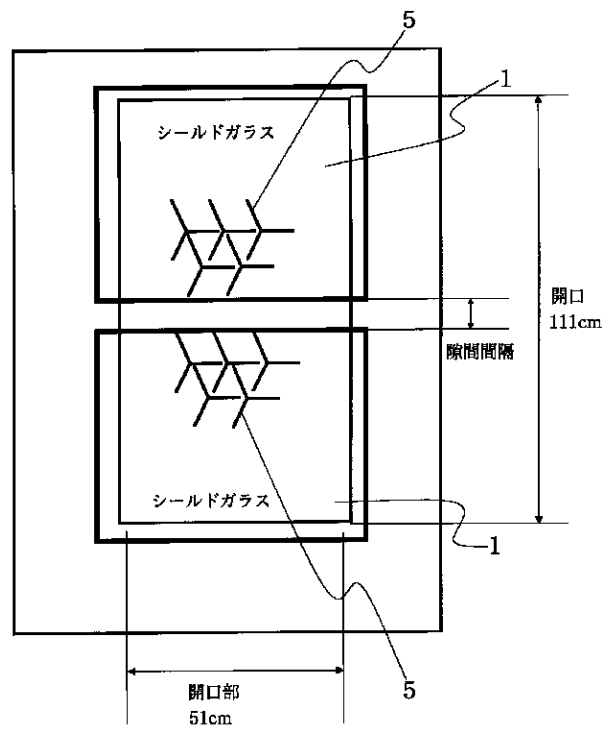
【図22】



【図24】



【図21】



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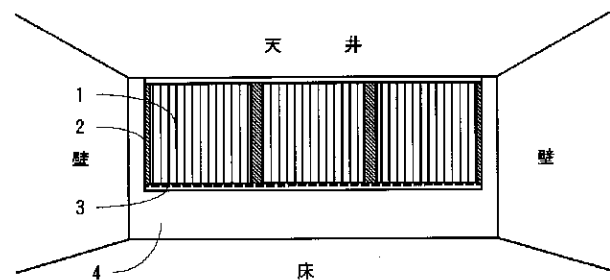
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(54)【発明の名称】 ブラインド遮蔽による電磁遮蔽ビル

(57)【要約】

【目的】 窓開口部の電磁遮蔽を簡便に行うことができる。

【構成】 天井や床、壁4からなる周囲を電磁遮蔽材からなる電磁遮蔽層で覆ってビル内空間を外部からの独立した電磁遮蔽空間として構成する電磁遮蔽ビルにおいて、ブレードの表裏面に導電体と磁性体を用いたブラインド1で窓開口部の内側を塞ぐことによって、窓開口部の電磁遮蔽を行う。



【特許請求の範囲】

【請求項1】 周囲を電磁遮蔽材からなる電磁遮蔽層で覆ってビル内空間を外部からの独立した電磁遮蔽空間として構成する電磁遮蔽ビルにおいて、ブレードの表裏面に導電体と磁性体を用いたブラインドで窓開口部の内側を塞ぐことによって、窓開口部の電磁遮蔽を行うことを特徴とするブラインド遮蔽による電磁遮蔽ビル。

【発明の詳細な説明】**【0001】**

【発明の属する技術分野】本発明は、周囲を電磁遮蔽材からなる電磁遮蔽層で覆ってビル内空間を外部からの独立した電磁遮蔽空間として構成する電磁遮蔽ビルに関する。

【0002】

【従来の技術】ビルの室内で通信用電波を使って無線通信を行う方式について、本出願人は特開昭62-112427号公報や特開昭62-230230号公報で提案している。通信用電波を使って無線通信を行う場合、電波法上の規制を受けることなく自由に周波数帯域を選択できるようにするため、ビル自体を電磁遮蔽構造にすることが要求される。このような構造の電磁遮蔽ビルに関しても、例えば特公平6-99972号公報や特公平6-99973号公報、特公平7-16118号公報、特公平6-76706号公報では、ビルの躯体や外壁の遮蔽構造について提案し、特公平6-99971号公報や特公平6-33699号公報、特公平6-13822号公報では、ビルの出入口の遮蔽構造について、特公平6-63407号公報や特公平5-79790号公報、特公平3-58557号公報では、窓開口部の遮蔽構造について提案している。また、特公平3-62320号公報や特公平3-45972号公報、特公平3-62318号公報、特公平5-34159号公報では、天井や階層別の遮蔽構造について提案している。

【0003】これらの提案に見られるように、電磁遮蔽ビルは、躯体や壁構造体に電磁遮蔽材を用い、さらに窓や出入口等の開口部にも電磁遮蔽材を用いてビルの外壁に沿って全面を電磁遮蔽材で覆うようにすることにより、ビル内の空間を外部と独立した1つの電磁遮蔽空間として構成することができる。また、ビル内を1つの電磁遮蔽空間としてではなく、各フロア毎に上下の天井や床において電磁遮蔽材で仕切り、或いは各フロアにおいて部屋間の壁を電磁遮蔽材で仕切ることによって、各フロア毎、或いは各部屋毎に独立した複数の電磁遮蔽空間を構成することができる。

【0004】

【発明が解決しようとする課題】上記のような電磁遮蔽ビルにおいて、窓開口部の電磁遮蔽を行う場合には、電磁遮蔽層として、窓ガラスの1面或いは両面に金属等の導電性材料による薄い膜を形成したものが用いられる。このようなガラスは、電磁遮蔽層が導電性材料という限

定した材料となるため、その材料によってガラスの色合いも決まってしまう。そのため問題は、ビルの外壁の色合いとの関係で、デザイン的に色調のバランスをとるのが難しくなることである。

【0005】また、既設のビルを電磁遮蔽ビルとしてリニューアルしようとする場合には、当然、躯体が電磁遮蔽性能を有していないため、壁や床、天井には、金属メッシュや金属箔、導電性繊維を用いたシート、導電性塗料等の電磁遮蔽材をその内面や内装材との間に貼り、窓開口部は、電磁遮蔽層を有するガラスと取り替えることによって実現できるが、一般に電磁遮蔽層付きガラスはコストが高く、また、上記のように色合いを自由に選択することができないという問題もある。

【0006】

【課題を解決するための手段】本発明は、上記の課題を解決するものであって、窓開口部の電磁遮蔽を簡便に行うことができるものである。

【0007】そのために本発明は、周囲を電磁遮蔽材からなる電磁遮蔽層で覆ってビル内空間を外部からの独立した電磁遮蔽空間として構成する電磁遮蔽ビルにおいて、ブレードの表裏面に導電体と磁性体を用いたブラインドの窓開口部の内側を塞ぐことによって、窓開口部の電磁遮蔽を行うことを特徴とするものである。

【0008】

【発明の実施の形態】以下、本発明の実施の形態を図面を参照しつつ説明する。図1は本発明のブラインド遮蔽による電磁遮蔽ビルの実施の形態を示す図、図2は窓開口部遮蔽の詳細断面を示す図である。図中、1はブラインド、2は電波吸収材、3は導電性ガasket、4は壁、5は電磁遮蔽層、6は方立、11はサッシ枠、12はセッティングブロック、13はバックアップ材、14はシーリング材、15はブラインドボックス、16はブラインド吊り具、17は接続蛇腹を示す。

【0009】図1において、壁4は、例えば既設の電磁遮蔽性能を有しない躯体の場合には、その内壁に金属メッシュや金属箔（フィルム）、不織布、その他導電性繊維を用いたシート等を貼ったり、導電性塗料を塗って電磁遮蔽層を設けたものである。これに対して、窓開口部は、ブレードの一方の面を導電性材料や導電性塗料等からなる導電体、他方の面をフェライト等からなる磁性体で構成したブラインド1を配置したものである。また、昇降コードには、スチールを用いることにより、ブレード間を電氣的に接続して重なるようにする。

【0010】電波吸収材2は、ブラインド1を横方向に並べて配置したとき、その両側、つまりブラインド1同士の上に配置し、導電性ガasket3は、ブラインド1の下端と腰壁との間に配置して、ブラインドの左右両端、下端の隙間から電波が漏洩するのを防ぐものである。なお、上端部は、通常、金属製のブラインドボックスの中に納まってしまうので、電波吸収材2や導電性ガ

スケッチ3のようなものがなくてもよいが、ブラインドボックスの形状や取り付け関係に応じて適宜配置してもよいことはいうまでもない。

【0011】一般に使用されている電波は、その用途により周波数帯域が割り当てられるが、電界の偏波方向に縦偏波のものと横偏波のものがある。一般のテレビやラジオの放送等では、500kHz～1GHzの周波数帯域で横偏波の電波が使用されているのに対して、PHS（パーソナル・ハンディホン・システム）や無線LAN等では、1GHz～3GHzの周波数帯域で縦偏波の電波が使用されている。導電体である金属製のブラインドで電磁遮蔽する場合には、縦型のブラインドを用いると、電界が縦偏波の電波を用いたPHSや無線LAN等で一定の遮蔽レベルを達成することはできるのに対し、横偏波の電波に対しては有効に遮蔽効果を得ることはできない。しかし、上記のような本発明のブラインド1によれば、互いに直角な方向の電界と磁界が空間的に同時に存在し伝播する電波に対応して、ブレードの表裏面を導電体と磁性体で構成しているため、電波の電界の偏波方向が縦偏波或いは電界の偏波方向が横偏波のいずれであっても、一定の遮蔽レベルを達成することができ、窓開口部における遮蔽レベルの低下を抑制することができる。何故なら、電界の偏波方向が横偏波の電波は、磁界が縦偏波であり、縦方向に配置された磁性体によって電波が遮蔽されるからである。

【0012】横型ブラインドを配置した例を縦断面図で示したのが図2である。図2において、窓開口部は、壁4に取り付け固定されたサッシ枠11に例えば2層構造の窓ガラス10がセッティングブロック12、バックアップ材13、シーリング材14を用いて嵌め込まれている。ブラインド1は、この窓開口部の内側のブラインドボックス15の中にブラインド吊り具16を取り付けて吊り下げられ、例えばブラインド自体の昇降コードにスチールを用いることにより、ブレード間が電氣的に一体に接続されている。そして、その下端部、腰壁の上に導電性ガasket 3が配置され、壁の内側に電磁遮蔽層5が配置されて、ブラインドボックス15から電磁遮蔽層5まで電氣的に一体に接続されている。接続蛇腹19は、導電性材料を使用したものであり、ブラインドボックス16を例えばスラブのデッキプレート（金属製）に電氣的に接続するものである。また、図2（b）に示すように窓開口部の方立6の部分にブラインド1の横方向の継ぎ目で隙間が生じる場合、この部分に電波吸収材2が配置されている。このように窓ガラス10に電磁遮蔽

ガラスを用いなくても、その内側のブラインド1を用いた窓開口部の電磁遮蔽構造が実現できる。勿論、窓ガラスとして、断熱複層ガラスや熱線反射フィルムガラスを用いた場合には、金属製膜がコーティングされ、一定の遮蔽レベルを有するので、窓開口部としての遮蔽レベルを高める効果があり、電磁遮蔽ガラスを用いればさらにその効果が高まることはいうまでもない。

【0013】なお、本発明は、上記の実施例に限定されるものではなく、種々の変形が可能である。例えば上記の実施例では、躯体が電磁遮蔽性能を有しない既設ビルを電磁遮蔽ビルとしてリニューアルする場合を説明したが、電磁遮蔽材を用いて躯体全体を遮蔽構造体とする新設ビルであっても、同様に窓開口部を構成してもよいことはいうまでもない。また、PHSや無線LANでは、使用電波の偏波面が縦であることから、導電性材料を用いた縦型ブラインド、例えば不織布ブラインド等を配置するだけでもよい。さらには、ロール型やプリーツ型のブラインドを用いるようにしてもよいことはいうまでもない。

【0014】

【発明の効果】以上の説明から明らかなように、本発明によれば、窓開口部の内側にブレードの表裏面を導電体と磁性体で構成したブラインドを配置して偏波方向に関係なく所定の遮蔽レベルを確保できるようにするので、窓ガラスに従来の使用されている断熱複層ガラスや熱線反射フィルムガラスを用いることができる。したがって、既設ビルを電磁遮蔽ビルとしてリニューアルしようとする場合にも、窓開口部の施工費を低減することができる。また、窓ガラスとブラインドとの組み合わせにより、要求にあった遮蔽レベルの達成が容易になる。しかも、ブラインドと組み合わせることにより、窓ガラスの選択範囲が広くとれるので、外壁の色デザインに合わせて窓ガラスを選択することができ柔軟に対応することができる。

【図面の簡単な説明】

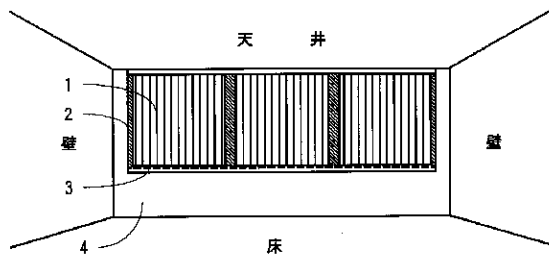
【図1】 本発明のブラインド遮蔽による電磁遮蔽ビルの実施の形態を示す図である

【図2】 窓開口部遮蔽の詳細断面を示す図である。

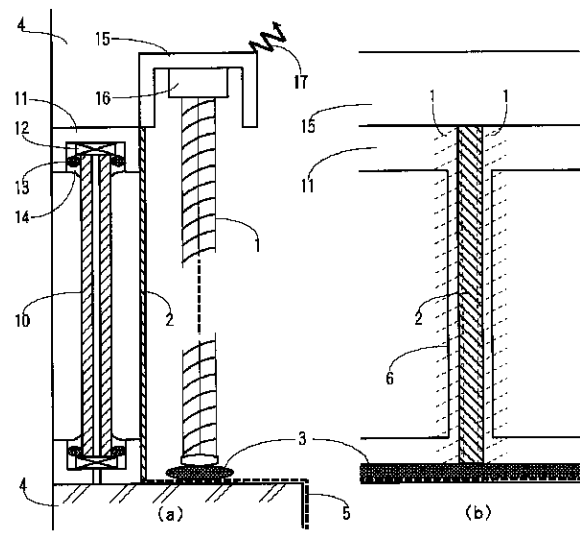
【符号の説明】

1…ブラインド、2…電波吸収材、3…導電性ガasket、4…壁、5…電磁遮蔽層、6…方位、11…サッシ枠、12…セッティングブロック、13…バックアップ材、14…シーリング材、15…ブラインドボックス、16…ブラインド吊り具、17…接続蛇腹

【図1】



【図2】



(19) 日本国特許庁 (J P)

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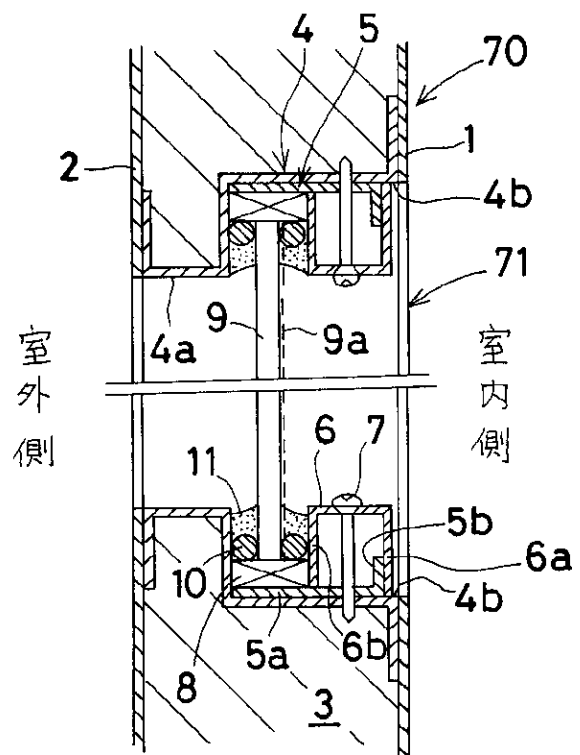
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(54) 【発明の名称】 電磁遮蔽窓

(57) 【要約】

【課題】 窓開口部全体としての電磁遮蔽性能を向上させる。

【解決手段】 窓開口部4a及び該窓開口部より開口面積の大きいガラス装着用開口部4bとを有する窓枠4と、前記ガラス装着用開口部に嵌合される当接片5a及び該当接片から開口部側に屈曲された遮断片5bを有する電磁遮蔽部材5と、前記当接片をガラス装着用開口部に固定する押縁6と、該押縁と前記窓開口部との間に電磁遮蔽材からなるバックアップ材10及びシーリング材11を介して固定された電磁遮蔽ガラス9とを備えた構成。



【特許請求の範囲】

【請求項1】窓開口部及び該窓開口部より開口面積の大きいガラス装着用開口部とを有する窓枠と、前記ガラス装着用開口部に嵌合される当接片及び該当接片から開口部側に屈曲された遮断片を有する電磁遮蔽部材と、前記当接片をガラス装着用開口部に固定する押縁と、該押縁と前記窓開口部との間に電磁遮蔽材からなるバックアップ材及びシーリング材を介して固定された電磁遮蔽ガラスとを備えたことを特徴とする電磁遮蔽窓。

【発明の詳細な説明】**【0001】**

【発明の属する技術分野】本発明は、電磁遮蔽材を用いて床や天井、壁、窓開口部に電磁遮蔽層を形成し電磁遮蔽空間を構成する電磁遮蔽ビルの技術分野に属する。

【0002】

【従来の技術】電波を使った無線通信方式を採用する場合には、使用周波数帯域について電波法の規制が問題になる。そこで、このような電波法による規制を受けることなく、自由に使用周波数帯域を選択、設定して独自の無線による通信方式を採用するためには、ビル内の空間を外部から電磁的に遮蔽した電磁遮蔽ビルの構築が不可欠となる。既に出願人は、このような電磁遮蔽ビルに関し、例えば特公平6-99972号公報や特公平6-99973号公報、特公平7-16118号公報、特公平6-76706号公報に、ビルの躯体や外壁の遮蔽構造について提案し、特公平6-99971号公報や特公平6-33699号公報、特公平6-13822号公報に、ビルの出入口の遮蔽構造について、特公平6-63407号公報や特公平5-79790号公報、特公平3-58557号公報に、窓開口部の遮蔽構造について提案している。また、特公平3-62320号公報や特公平3-45972号公報、特公平3-62318号公報、特公平5-34159号公報に、天井や階層別の遮蔽構造について提案している。

【0003】図2は、本発明に係わる電磁遮蔽ビルの構成概要を示す図であり、壁40は、例えば躯体の内壁に金属メッシュや金属箔（フィルム）、不織布、その他導電性繊維を用いたシート等を貼ったり、導電性塗料を塗って電磁遮蔽層を形成したもの、或いはこのような電磁遮蔽層を片面に形成したボードを用いたものである。天井50、床60も、壁40と同様の施工を行い、或いは電磁遮蔽材を貼り合わせたパネルを用いたものである。窓30は、窓ガラスの片面又は両面に上記と同様に電磁遮蔽材を用いて電磁遮蔽膜を形成し、この電磁遮蔽膜をサッシ枠に接続することにより、壁40と窓30の電磁遮蔽層を電氣的に一体に接続したものである。扉70は、電磁遮蔽材からなるパネルを用い、扉閉時に扉70の周囲が壁40及び床60と電氣的に接続可能にしたものである。扉窓71は窓30と同様に窓ガラスに電磁遮蔽膜を形成し、この電磁遮蔽膜を扉70の電磁遮蔽層と

電氣的に一体に接続したものである。

【0004】このようにして、ビル内を1つの電磁遮蔽空間としてではなく、各フロア毎に上下の天井や床において電磁遮蔽材で仕切り、或いは各フロアにおいて部屋間の壁を電磁遮蔽材で仕切ることによって、各フロア毎、或いは各部屋毎に独立した複数の電磁遮蔽空間を構成することができる。

【0005】

【発明が解決しようとする課題】ところで、高性能の電磁遮蔽を達成する場合、その性能を大きく左右する部位は窓開口部である。特に、現状において電磁遮蔽ガラスは高価であるものの、ガラス自体で所望の性能を達成できるが、ガラスと窓枠との境界部で電磁波が洩れ易く、窓開口部として全体で所望の電磁遮蔽性能を達成することが困難であるという問題を有している。

【0006】本発明は、上記問題を解決するものであって、窓開口部全体としての電磁遮蔽性能を向上させることができる電磁遮蔽窓を提供することを目的とする。

【0007】

【課題を解決するための手段】上記目的を達成するために本発明の電磁遮蔽窓は、窓開口部4a及び該窓開口部より開口面積の大きいガラス装着用開口部4bとを有する窓枠4と、前記ガラス装着用開口部に嵌合される当接片5a及び該当接片から開口部側に屈曲された遮断片5bを有する電磁遮蔽部材5と、前記当接片をガラス装着用開口部に固定する押縁6と、該押縁と前記窓開口部との間に電磁遮蔽材からなるバックアップ材10及びシーリング材11を介して固定された電磁遮蔽ガラス9とを備えたことを特徴とする。なお、上記構成に付加した番号は、本発明の理解を容易にするために図面と対比させるもので、これにより本発明が何ら限定されるものではない。

【0008】

【発明の実施の形態】以下、本発明の実施の形態を図面を参照しつつ説明する。図1は本発明の電磁遮蔽窓の1実施形態を示す断面図である。なお、図1は、図2の扉窓71に適用した例であるが、壁40側の窓30にも無論適用可能である。

【0009】扉70の内壁1と外壁2間には遮音材3が充填され、内壁1と外壁2間には、扉窓71すなわち矩形状開口部を形成するための窓枠4が固定されている。内壁1、外壁2及び窓枠4は金属製であり、窓枠4には、窓開口部4aと、窓開口部4aより開口面積の大きいガラス装着用開口部4bが形成されており、ガラス装着用開口部4b側から後述する電磁遮蔽ガラスの装着を可能にし、ガラス装着用開口部4b側には、押縁6を配設することにより、窓開口部4aと同じ大きさの開口となるようにしている。

【0010】そして、窓枠4のガラス装着用開口部4bに額縁状の電磁遮蔽部材5が嵌合され、電磁遮蔽部材5

は、4つの槌状の押縁6によりボルト7にて開口部4bに固定されている。電磁遮蔽部材5は、ガラス装着用開口部4bの4辺に嵌合当接される当接片5aと当接片5aから開口部側に屈曲された遮断片5bを有し、押縁6の外側片6aを遮断片5bに当接させるようにして固定している。

【0011】押縁6の内側片6bと窓開口部4a間には、遮蔽部材5上に複数のセッティングブロック8が固定され、セッティングブロック8間に電磁遮蔽ガラス9が装着され、電磁遮蔽ガラス9と押縁6の内側片6b及び窓開口部4a間には、バックアップ材10、シーリング材11が充填される。電磁遮蔽ガラス9は、メッシュや導電性フィルム、金属薄膜等からなる電磁遮蔽膜9aを備え、また、押縁6、バックアップ材10、シーリング材11は電磁遮蔽材で構成されている。

【0012】上記構成の電磁遮蔽窓は、電磁遮蔽ガラス9と窓枠4との間にバックアップ材10及びシーリング材11からなる電磁遮蔽材を配設し、これらを介して電磁遮蔽ガラス9の電磁遮蔽膜9aと窓枠4の電気的接続を行い電磁遮蔽を行うものであるが、本発明においては、電磁遮蔽ガラス9と窓枠4との間の極めて微小な隙間からガラス装着用開口部4bにそって突き抜けようとする電磁波を、電磁遮蔽部材5の遮断片5bにより遮蔽するため、電磁遮蔽性能をさらに向上させることができる。

【0013】以上、本発明の実施の形態について説明し

たが、本発明はこれに限定されるものではなく種々の変更が可能である。例えば、上記実施形態では電磁遮蔽ガラスとして単層ガラスの例を示したが複層ガラスを採用してもよい。

【0014】

【発明の効果】以上の説明から明らかなように、本発明によれば、窓開口部及び該窓開口部より開口面積の大きいガラス装着用開口部とを有する窓枠と、前記ガラス装着用開口部に嵌合される当接片及び該当接片から開口部側に屈曲された遮断片を有する電磁遮蔽部材と、前記当接片をガラス装着用開口部に固定する押縁と、該押縁と前記窓開口部との間に電磁遮蔽材からなるバックアップ材及びシーリング材を介して固定された電磁遮蔽ガラスとを備えたので、窓開口部全体としての電磁遮蔽性能を向上させることができる。

【図面の簡単な説明】

【図1】本発明の電磁遮蔽窓の1実施形態を示す断面図である。

【図2】本発明に係わる電磁遮蔽ビルの構成概要を示す図である。

【符号の説明】

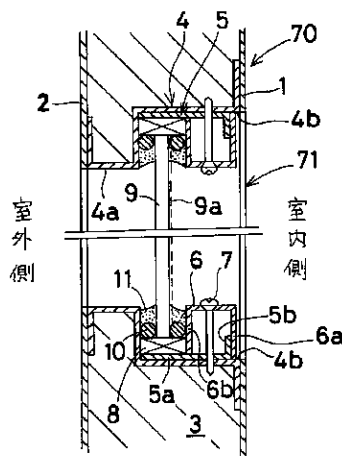
4…窓枠、4a…窓開口部、4b…ガラス装着用開口部、5…電磁遮蔽部材

5a…当接片、5b…遮断片、6…押縁、9…電磁遮蔽ガラス

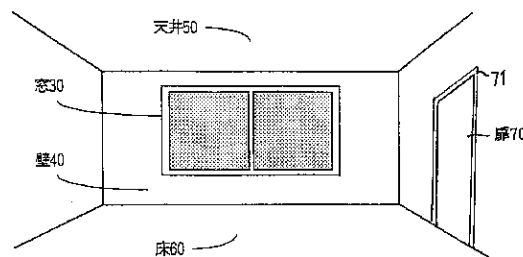
5a…当接片、5b…遮断片、6…押縁、9…電磁遮蔽ガラス

10…バックアップ材、11…シーリング材

【図1】



【図2】



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