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Patentanwälte

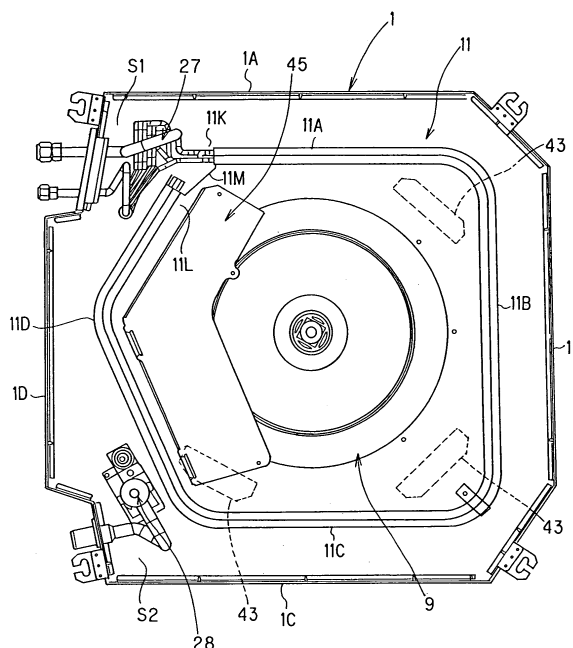
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(54) **CEILING EMBEDDED-TYPE AIR CONDITIONING APPARATUS**

(57) In an in-ceiling type air conditioner containing an air blower 9 and a heat exchanger 11 surrounding the air blower which are mounted in a housing 1, the heat exchanger 11 is bent in a polygonal shape, and a part 11D of the heat exchanger 11 protrudes to the housing 1 side at least at the position corresponding to the one side 1D of the housing 1. A drain pan 13 formed by integrally molding a resin frame for a drain pan sheet and foamed styrol is disposed below the heat exchanger 11, and a suction hole is formed substantially at the center of the drain pan so as to face a suction port of the air blower. A boss 61 which penetrates through the foamed styrol 53 is formed in the resin frame so as to face the surface of the resin frame at the opposite side to the foamed styrol 53, and a bell mouth 14 of the air blower is fixed to the boss 61.

FIG. 2



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Description

Field of the Invention

[0001] The present invention relates to an in-ceiling type air conditioner having a heat exchanger disposed so as to surround an air blower, and particularly to an in-ceiling type air conditioner in which a space for accommodating various kinds of equipment such as a pipe group, a train pump, an electrical part box, etc. therein can be effectively used, and further these kinds of equipment can be easily secured.

Background Art

[0002] There has been generally known an in-ceiling type air conditioner in which a heat exchanger is disposed so as to surround an air blower provided in the main body (housing) of the air conditioner, blow-out ports for air-conditioned air are disposed so as to face the outside space of the heat exchanger, air from the air blower is heat-exchanged through the heat exchanger and the air-conditioned air thus heat-exchanged is blown out from the blow-out ports into a room.

[0003] This type of air conditioner is designed so that various kinds of equipment such as a pipe group of the heat exchanger, an electrical part box, a drain pump, etc. are accommodated in a narrow space in the housing, and thus some determinate restriction is imposed on a bending shape of the heat exchanger. On the other hand, it has been required to achieve the largest power possible in the heat exchanger by increasing the heat transfer area of the heat exchanger as much as possible.

[0004] A drain pan formed by integrally molding a resin frame for a drain pan sheet and foamed styrol is disposed below the heat exchanger of this type of in-ceiling air conditioner, and an air suction hole is formed substantially at the center of the drain pan so as to face an air suction port of an air blower. In this type of air conditioner, it is general that insert fittings are embedded in the foamed styrol face at the opposite side to the resin frame and a resin bell mouth of the air blower, the electrical part box, etc. are fixed to the insert fittings by screws.

[0005] However, the construction as described above has a problem that the insert fittings must be embedded in the foamed styrol face and thus workability is low. Furthermore, the suction hole is formed in the foamed styrol, and such a construction causes the foamed styrol to expose to the surrounding of the suction hole. Therefore, there is also a problem that a corner portion of the foamed styrol is liable to be chipped while the air conditioner is carried.

[0006] Therefore, a first object of the present invention is to provide a heat exchanger which can be efficiently accommodated in a narrow space of a housing to thereby increase a heat-transfer area, and an in-ceil-

ing type air conditioner using the heat exchanger.

[0007] Furthermore, a second object of the present invention is to solve the above problem, and provide a train pan to which equipment such as a bell mouth of an air blower, an electrical part box, etc. can be simply secured, and an in-ceiling type air conditioner using the drain pan.

Summary of the Invention

[0008] In order to attain the above objects, according to a first aspect of the present invention, there is provided an in-ceiling type air conditioner having an air blower and a heat exchanger surrounding the air blower which are mounted in a housing, wherein the heat exchanger is bent in a polygonal shape, and a part of the heat exchanger protrudes to the housing side.

[0009] According to a second aspect of the present invention, in the above in-ceiling type air conditioner, the part of the heat exchanger protrudes to the housing side at least at the position corresponding to one side of the housing, whereby at least two equipment accommodating spaces are formed by the one side of the housing and the part of the heat exchanger.

[0010] According to a third aspect of the present invention, in the above in-ceiling type air conditioner, a pipe group of the heat exchanger and a drain pump are respectively disposed in the two equipment accommodating spaces.

[0011] According to a fourth aspect of the present invention, in the above in-ceiling type air conditioner, the heat exchanger is bent in a substantially pentagonal shape so as to contain the part of the heat exchanger which protrudes to the housing side.

[0012] According to a fifth aspect of the presents invention, in the above in-ceiling type air conditioner, bending start and end positions of the heat exchanger bent in the polygonal shape are joined to each other by a width-narrow pipe plate.

[0013] According to a sixth aspect of the present invention, in the above in-ceiling type air conditioner, an auxiliary heater is disposed between the heat exchanger and the air blower is further disposed, and electrical parts of the auxiliary heater are mounted on the pipe plate for joining the bending start and end positions of the polygonal heat exchanger.

[0014] According to a seventh aspect of the present invention, in the above in-ceiling type air conditioner, the respective corner portions of the polygonal heat exchanger are bent by using a common bending roller jig.

[0015] According to an eighth aspect of the present invention, in the above in-ceiling type air conditioner, the part of the heat exchanger protruding to the housing side is overlapped with an air blow-out port disposed so as to face an outer space of the heat exchanger.

[0016] According to a ninth aspect of the present invention, in the above in-ceiling type air conditioner, a drain pan formed by integrally molding a resin frame for

a drain pan sheet and foamed styrol is disposed below the heat exchanger, a suction hole facing a suction port of the air blower is formed substantially at the center of the drain pan, a boss which penetrates through the foamed styrol is formed in the resin frame so as to face the surface of the resin frame at the opposite side to the foamed styrol, and a bell mouth of the air blower is fixable to the boss.

[0017] According to a tenth aspect of the present invention, in the above in-ceiling type air conditioner, an electrical part box is fixable to the boss.

[0018] According to an eleventh aspect of the present invention, in the above in-ceiling type air conditioner, a reinforcing rib is formed so as to surround the boss.

[0019] According to a twelfth aspect of the present invention, in the above in-ceiling type air conditioner, a suction hole reinforcing rib is formed in the resin frame so as to surround a suction hole formed in the foamed styrol.

[0020] According to a thirteenth aspect of the present invention, in the above in-ceiling type air conditioner, the suction hole reinforcing rib extends around a lead wire guide recess hole formed around the suction hole.

[0021] According to a fourteenth aspect of the present invention, there is provided a heat exchanger disposed so as to surround an air blower in a housing and bent in a polygonal shape, wherein a part thereof protrudes to the housing side at the position corresponding to at least one side of the housing.

[0022] According to a fifteenth aspect of the present invention, in the above heat exchanger, the heat exchanger is bent in a pentagonal shape so as to contain the part protruding to the housing side.

[0023] According to a sixteenth aspect of the present invention, in the above heat exchanger, bending start and end positions of the heat exchanger bent in the polygonal shape are joined to each other by a width-narrow pipe plate.

[0024] According to a seventeenth aspect of the present invention, in the above heat exchanger, the respective corner portions of the polygonal heat exchanger are bent by using a common bending roller jig.

[0025] According to an eighteenth aspect of the present invention, there is provided a drain pan disposed below a heat exchanger of an air conditioner and formed by integrally molding a resin frame for a drain pan sheet and foamed styrol, wherein a boss which penetrates through the foamed styrol is formed in the resin frame so as to face the surface of the resin frame at the opposite side to the foamed styrol, and appending parts are fixable to the boss.

[0026] According to a nineteenth aspect of the present invention, in the above drain pan, a reinforcing rib is formed around the boss.

[0027] According to a twentieth aspect of the present invention, in the above drain pan, a suction hole reinforcing rib is formed in the resin frame so as to surround a suction hole formed in the foamed styrol.

[0028] According to a twenty first aspect of the present invention, in the above in-ceiling type air conditioner, the suction hole reinforcing rib extends around a lead wire guide recess hole formed around the suction hole.

Brief Description of the Drawings

[0029]

Fig. 1 is a cross-sectional view showing an embodiment of an in-ceiling type air conditioner and a heat exchanger according to the present invention.

Fig. 2 is a plan view showing the main body of the air conditioner from which a drain pan is detached. Fig. 3 is a perspective view showing a heat exchanger.

Fig. 4 is a plan view showing the main body of the air conditioner in which the drain pan is mounted.

Fig. 5 is a cross-sectional view of Fig. 4 which is taken along V-V.

Fig. 6A is a plan view of a resin frame, and Fig. 6B is a cross-sectional view of Fig. 6A which is taken along B-B.

Best Modes for carrying out the Invention

[0030] An embodiment according to the present invention will be described hereunder with reference to the accompanying drawings.

[0031] As shown in Fig. 1, an in-ceiling type air conditioner according to this embodiment has a box-shaped main body formed of sheet metal and hung from the ceiling by hanging bolts 2. The air conditioner main body 1 is opened downwardly, and when it is embedded in the ceiling, this opening side faces a room to be air-conditioned. A motor 5 is fixed in the air conditioner main body 1, and a vane wheel 7 is secured to the shaft of the motor 5, thereby constituting an air blower 9. A polygonally-bent heat exchanger 11 is disposed so as to surround the air blower 9, and a drain pan 13 is disposed at the lower side of the heat exchanger 11. A bell mouth 14 is secured to the drain pan 13.

[0032] A decorative panel 21 is secured to the lower surface of the air conditioner main body 1, an air suction port 22 and an air blow-out port 23 are formed in the decorative panel, and a filter 25 is mounted at the inside of the suction port 22.

[0033] Fig. 2 is a plan view showing the air conditioner main body 1 when the drain pan 13 is removed. In this embodiment, the heat exchanger 11 is designed to be bent in a substantially pentagonal (polygonal) shape and disposed in the air conditioner main body 1.

[0034] Three sides 11A, 11B and 11C of the heat exchanger 11 extend substantially in parallel to three sides 1A, 1B, 1C of the air conditioner main body (housing), and the remaining part 11D of the heat exchanger 11 is disposed so as to face one side 1D of the housing 1 and

designed so as to protrude in a triangular shape toward the one side 1D of the housing 1. As shown in Fig. 3, the heat exchanger 11 is constructed by doubly stacking fin-and-tube type heat exchangers in the air flow directions of solid-line arrows. Each of the corner portions A, B, C, D of the heat exchanger is bent by the same roller (not shown) having a radius R which is set in a bending roller jig to thereby complete the pentagonal (polygonal) heat exchanger. In the heat exchanger 11, a bending start position (one end of the heat exchanger) 11K and a bending end position (the other end of the heat exchanger) 11L are joined to each other through a width-narrow tube plate.

[0035] Referring to Fig. 2, a space in which a pipe group 27 of the heat exchanger and a drain pump 28 are disposed is required to be secured in the outer space of the heat exchanger 11, and also a space in which a bell mouth 14 and an electrical part box 45 are disposed is required to be secured in the inner space of the heat exchanger 11. In addition, when the heat exchanger 11 is disposed in a narrow space inside the housing 1, some determinate restriction is imposed on the bending shape of the heat exchanger 11, and also it has been required to achieve large heat-exchange power by increasing the heat-transfer area at maximum.

[0036] In this embodiment, the part 11D of the heat exchanger 11 is designed so as to protrude to the housing 1 side (that is, the part 11D is protruded outwardly). Therefore, as compared with the construction that this part is not protruded (that is, all the sides are flat), the heat-transfer area can be increased. In addition, the pipe group 27 and the drain pump 28 are dispersively disposed in the relatively large spaces S1, S2 at both the sides of the protruded portion, so that these equipment can be efficiently accommodated.

[0037] Furthermore, the bending start position 11K and the bending end position 11L of the heat exchanger 11 are approached to each other to reduce the interval therebetween, and joined to each other by the width-narrow pipe plate 11M. Therefore, as compared with the construction that the ends of the heat exchanger 11 are joined to each other by a width-broad pipe plate, the heat-transfer area of this embodiment can be increased more greatly.

[0038] In the above construction, when the heat exchanger 11 is bent, the same roller of R in radius is used to bend the heat exchanger. Therefore, exchange of the roller is not required, and the manufacturing process of the heat exchanger 11 is simplified, so that the manufacturing cost can be reduced.

[0039] Fig. 4 is a plan view showing a state where the drain pan 13 is mounted in the air conditioner main body 1 shown in Fig. 1. The air conditioner main body 1 (indicated by a one-dotted chain line in Fig. 4) has substantially rectangular inner blow-out ports 41 at four sides, and the inner blow-out ports 41 intercommunicate with the blow-out ports 23 of the decorative panel 21 shown in Fig. 1. A projecting portion 13A projecting into

the inner blow-out port 41 is formed integrally with the drain pan 13 at the position corresponding to the part 11D of the heat exchanger 11.

[0040] In this construction, the part 11D of the heat exchanger 11 protruded to the housing 1 side is slightly overlapped with the blow-out port 23 corresponding to the outside space of the heat exchanger 11, and thus the projecting portion 13A of the drain pan 13 which corresponds to the part 11D faces the blow-out port 23. The projecting portion 13A can achieve such a large effect that the heat-transfer area can be increased by protruding the part 11D so as to be overlapped with the blow-out port 23.

[0041] In this embodiment, auxiliary heaters 43 as indicated by broken lines are disposed as shown in Fig. 2 between the heat exchanger 11 and the air blower 9. In this case, the electrical parts of the auxiliary heaters 43 are mounted on the pipe plate 11M for joining the bending start position 11K and the bending end position 11L of the heat exchanger 11. Accordingly, an extra supporting member for supporting the electrical parts of the auxiliary heaters 43 is not needed, and thus the manufacturing cost can be reduced.

[0042] As shown in Figs. 2 and 4, the part 11D of the heat exchanger 11 is protruded in a triangular shape toward the housing 1 side, and thus the shape of the electrical part box 45 is set to be substantially elbowed in conformity with the shape of the part 11D.

[0043] This type of electrical part box 45 is generally linearly designed. This construction makes the electrical part box 45 protrude greatly into the bell mouth 14, and thus reduces the air suction area of the air blower 9. In this embodiment, the electrical part box 45 is designed to be substantially elbowed in conformity with the shape of the part 11D of the heat exchanger 11, so that the electrical part box 45 does not protrude into the bell mouth 14, and thus a large air suction area can be secured for the air blower 9.

[0044] Next, the structure of the drain pan described above will be described.

[0045] Fig. 5 is a cross-sectional view of the drain pan 13 of Fig. 4 which is taken along V-V.

[0046] The drain pan 13 is constructed by integrally molding a resin frame 51 of a drain pan sheet which constitutes the substantially overall upper surface area of the drain pan 13 and is unevenly shaped in a predetermined form to have a thickness of about 2mm, and foamed styrol 53 mainly serving as a heat-insulating member constituting the overall shape of the drain pan 13.

[0047] An air suction hole 55 which the air suction port of the air blower 9 faces is formed substantially at the center of the drain pan 13, and the bell mouth 14 of the air blower 9 is fitted in the suction hole 55. The bell mouth 14 is fixed to the drain pan 13 by using plural screws 56 as shown in Fig. 4. Furthermore, the electrical part box 45 is fixed to the drain pan 13 by using plural screws 58.

[0048] Fig. 6A is a plan view of the resin frame 51 for the drain pan sheet, and Fig. 6B is a cross-sectional view of Fig. 6A which is taken along B-B.

[0049] Screw reception bosses 61 are integrally formed with the resin frame 51 of about 2mm in thickness so that the bosses penetrate through the foamed styrol 53 and the heads thereof face the surface of the resin frame 51 at the opposite side to the foamed styrol 53 as shown in Figs. 5, 6A and 6B, the number of the screw reception bosses 61 being set to be equal to the number of screws 56 and 58. The screws 56 for fixing the bell mouth 14 and the screws 58 for fixing the electrical part box 45 are screw-fixed to the screw reception bosses 61 integrally formed with the resin frame 51 as shown in Fig. 6B, for example.

[0050] With the above construction, it is not needed to carry out the work of embedding in the foamed styrol the insert fittings for screw-fixing the bell mouth 14 and the electrical part box 45, and thus the fixing work efficiency of these elements can be enhanced.

[0051] Furthermore, as shown in Figs. 6A and 6B, reinforcing ribs 63 are formed around the bosses 61 to reinforce the bosses 61 and the resin frame 51. The resin frame 51 is provided with a suction hole reinforcing rib 64 so as to surround the suction hole 55 formed in the foamed styrol 53, thereby reinforcing the suction hole 55 of the foamed styrol. A substantially U-shaped lead wire guide recess hole 65 for drawing out lead wires of the auxiliary heaters 43 (Fig. 2). A recess hole reinforcing rib 67 is formed so as to extend around a recess hole 65, and the recess hole reinforcing rib 67 is integrally formed with the resin frame 51.

[0052] In this construction, the bosses 61, the suction hole reinforcing rib 64, the recess hole reinforcing rib 67, etc. are integrally formed with the resin frame 51, thereby enhancing the mechanical strength of the drain pan 13.

[0053] The present invention is not limited to the above embodiment. For example, in the above embodiment, the shape of the heat exchanger is set to the substantially pentagonal shape. However, the shape of the heat exchanger is not limited to this shape. The shape of the heat exchanger may be arbitrarily selected in accordance with the size of various kinds of equipment to be accommodated, the number of the equipment, etc. insofar as the heat-transfer efficiency is enhanced.

Industrial Applicability

[0054] According to the in-ceiling type air conditioner of the present invention, the heat exchanger can be efficiently accommodated in the narrow space in the housing, and also the heat transfer area can be increased. Furthermore, the space formed between the heat exchanger and the housing and the space formed in the heat exchanger are used to efficiently accommodate various kinds of equipment such as the pipe group, the drain pump, the electrical part box, etc. in compact spaces.

es. Still furthermore, the air blower, the bell mouth, the electrical part box, etc. can be simply secured to the drain pan.

Claims

1. An in-ceiling type air conditioner having an air blower and a heat exchanger surrounding the air blower which are mounted in a housing, wherein the heat exchanger is bent in a polygonal shape, and a part of the heat exchanger protrudes to the housing side.
2. The in-ceiling type air conditioner according to claim 1, wherein the part of the heat exchanger protrudes to the housing side at least at the position corresponding to one side of the housing, whereby at least two equipment accommodating spaces are formed by the one side of the housing and the part of the heat exchanger.
3. The in-ceiling type air conditioner according to claim 2, wherein a pipe group of the heat exchanger and a drain pump are respectively disposed in the two equipment accommodating spaces.
4. The in-ceiling type air conditioner according to claim 1, wherein the heat exchanger is bent in a substantially pentagonal shape so as to contain the part of the heat exchanger which protrudes to the housing side.
5. The in-ceiling type air conditioner according to claim 1, wherein bending start and end positions of the heat exchanger bent in the polygonal shape are joined to each other by a width-narrow pipe plate.
6. The in-ceiling type air conditioner according to claim 5, wherein an auxiliary heater is disposed between the heat exchanger and the air blower is further disposed, and electrical parts of the auxiliary heater are mounted on the pipe plate for joining the bending start and end positions of the polygonal heat exchanger.
7. The in-ceiling type air conditioner according to claim 1, wherein the respective corner portions of the polygonal heat exchanger are bent by using a common bending roller jig.
8. The in-ceiling type air conditioner according to claim 1, wherein the part of the heat exchanger protruding to the housing side is overlapped with an air blow-out port disposed so as to face an outer space of the heat exchanger.
9. The in-ceiling type air conditioner according to claim 1, wherein a drain pan formed by integrally molding

a resin frame for a drain pan sheet and foamed styrol is disposed below the heat exchanger, a suction hole facing a suction port of the air blower is formed substantially at the center of the drain pan, a boss which penetrates through the foamed styrol is formed in the resin frame so as to face the surface of the resin frame at the opposite side to the foamed styrol, and a bell mouth of the air blower is fixable to the boss.

10. The in-ceiling type air conditioner according to claim 9, wherein an electrical part box is fixable to the boss.

11. The in-ceiling type air conditioner according to claim 9, wherein a reinforcing rib is formed so as to surround the boss.

12. The in-ceiling type air conditioner according to claim 9, wherein a suction hole reinforcing rib is formed in the resin frame so as to surround a suction hole formed in the foamed styrol.

13. The in-ceiling type air conditioner according to claim 12, wherein the suction hole reinforcing rib extends around a lead wire guide recess hole formed around the suction hole.

14. A heat exchanger, **characterized in that** the heat exchanger is disposed so as to surround an air blower in a housing and bent in a polygonal shape, and a part thereof protrudes to the housing side at the position corresponding to at least one side of the housing.

15. The heat exchanger according to claim 14, wherein the heat exchanger is bent in a pentagonal shape so as to contain the part protruding to the housing side.

16. The heat exchanger according to claim 14, wherein bending start and end positions of the heat exchanger bent in the polygonal shape are joined to each other by a width-narrow pipe plate.

17. The heat exchanger according to claim 14, wherein the respective corner portions of the polygonal heat exchanger are bent by using a common bending roller jig.

18. A drain pan disposed below a heat exchanger of an air conditioner and formed by integrally molding a resin frame for a drain pan sheet and foamed styrol, wherein a boss which penetrates through the foamed styrol is formed in the resin frame so as to face the surface of the resin frame at the opposite side to the foamed styrol, and appending parts are fixable to the boss.

19. The drain pan according to claim 18, wherein a reinforcing rib is formed around the boss.

20. The drain pan according to claim 18, wherein a suction hole reinforcing rib is formed in the resin frame so as to surround a suction hole formed in the foamed styrol.

21. The in-ceiling type air conditioner according to claim 20, wherein the suction hole reinforcing rib extends around a lead wire guide recess hole formed around the suction hole.

FIG. 1

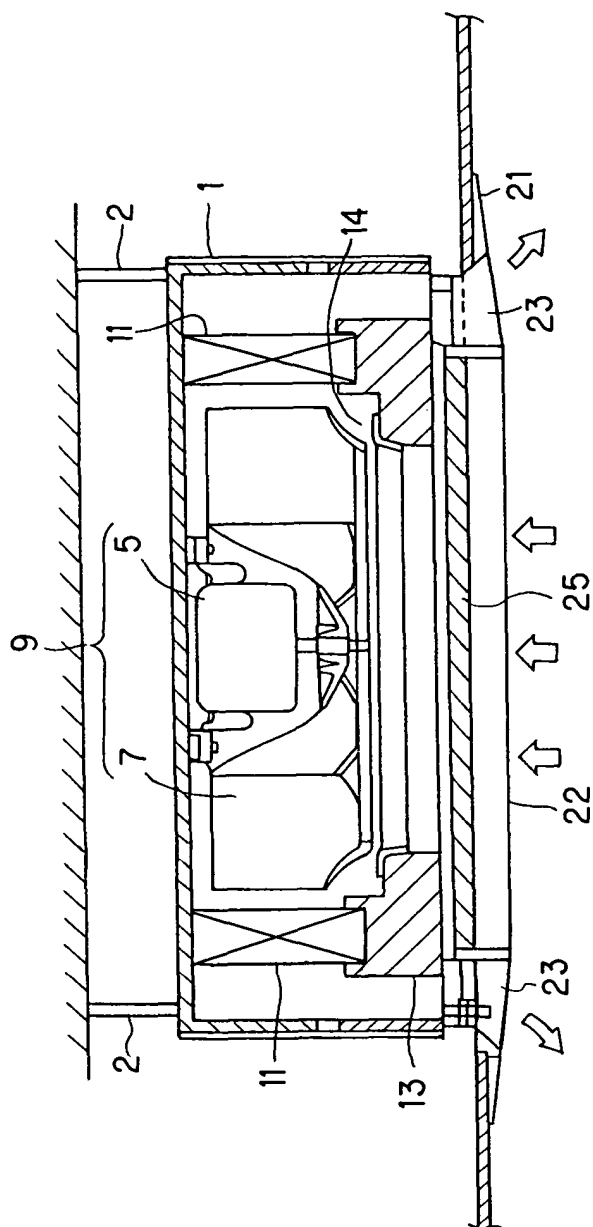


FIG. 2

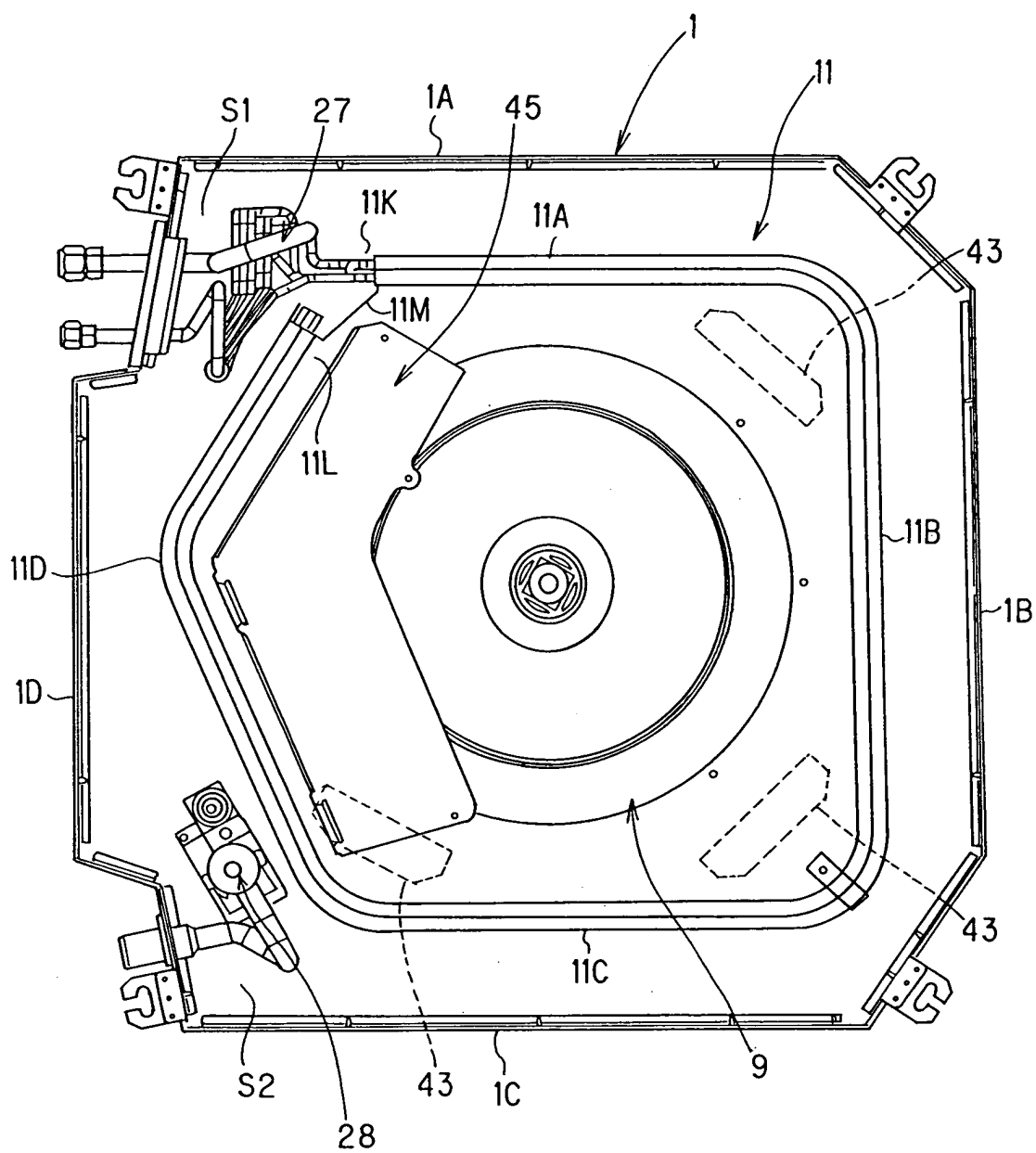


FIG. 3

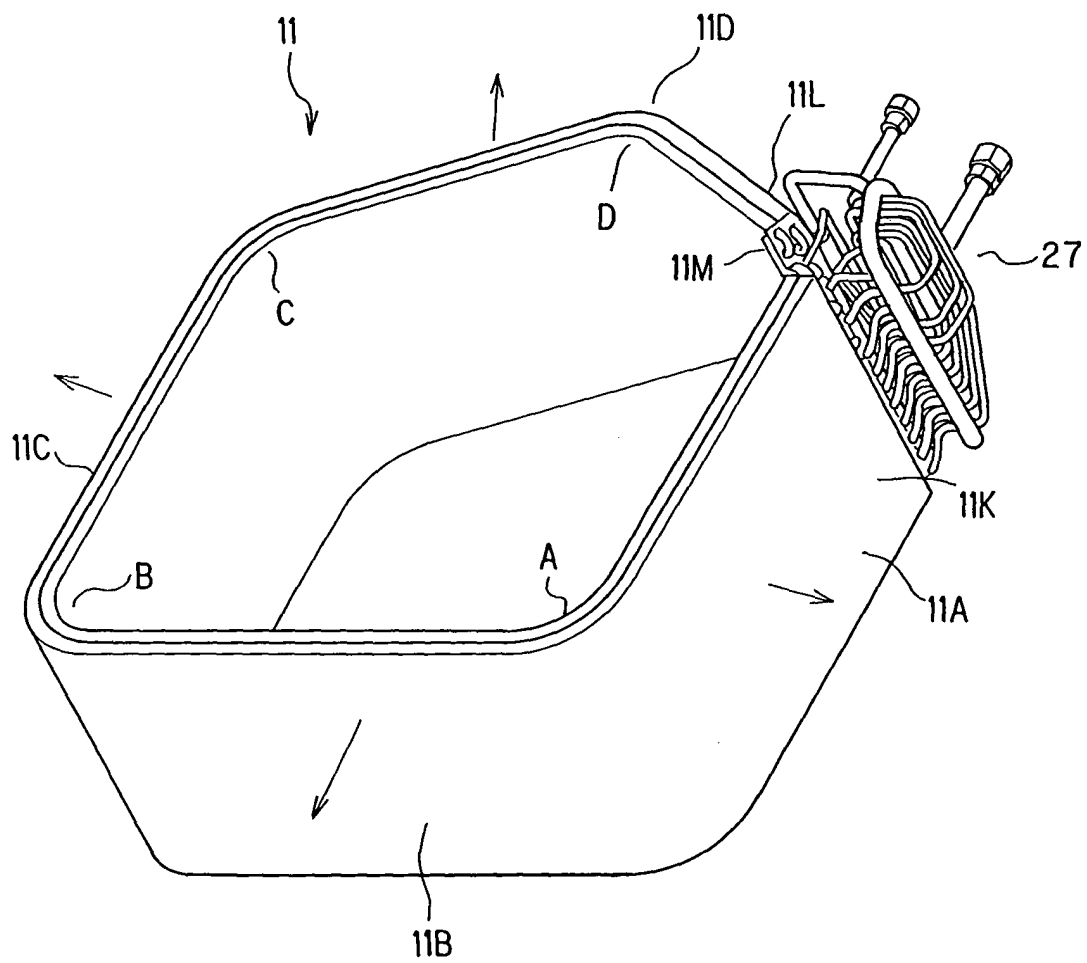


FIG. 4

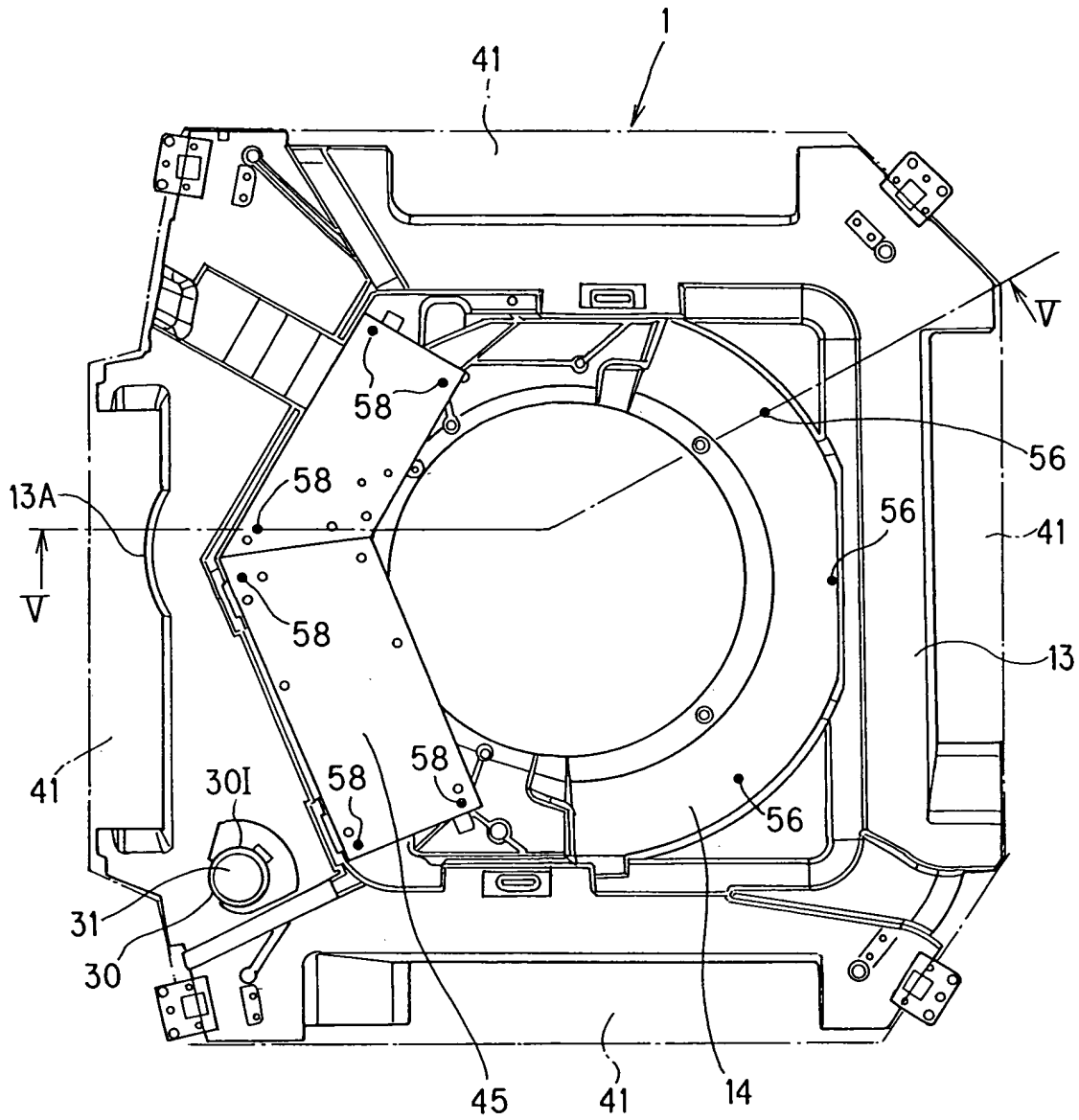


FIG. 5

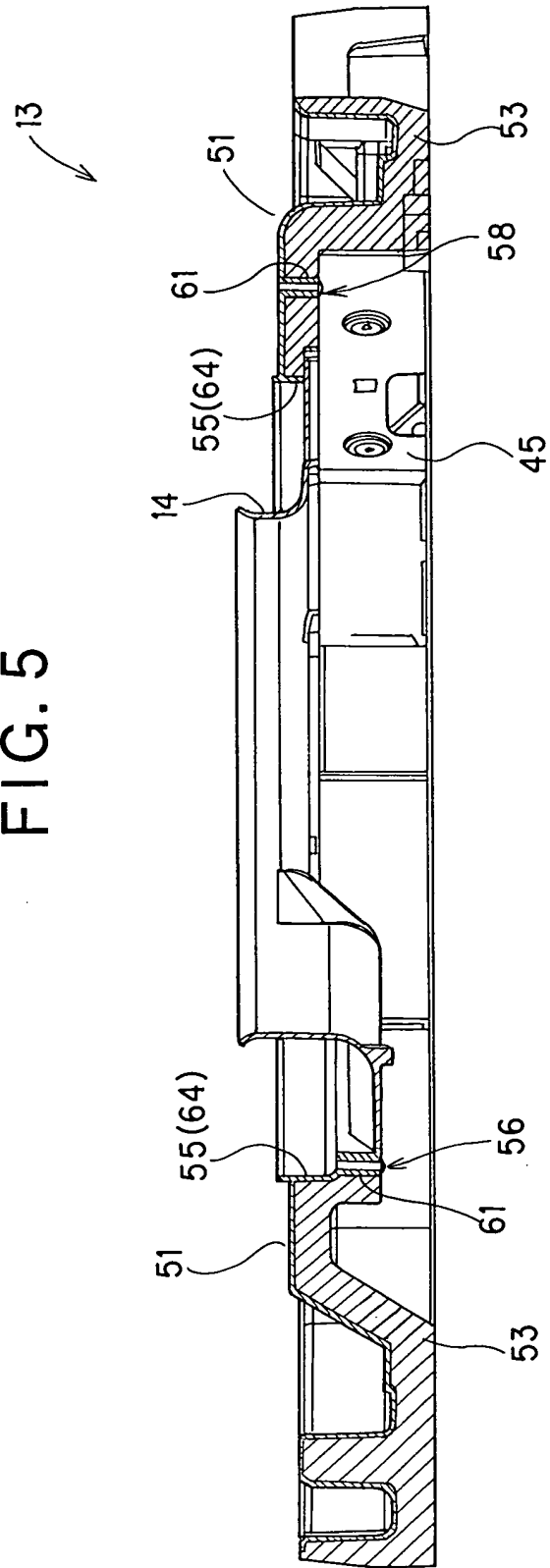


FIG. 6A

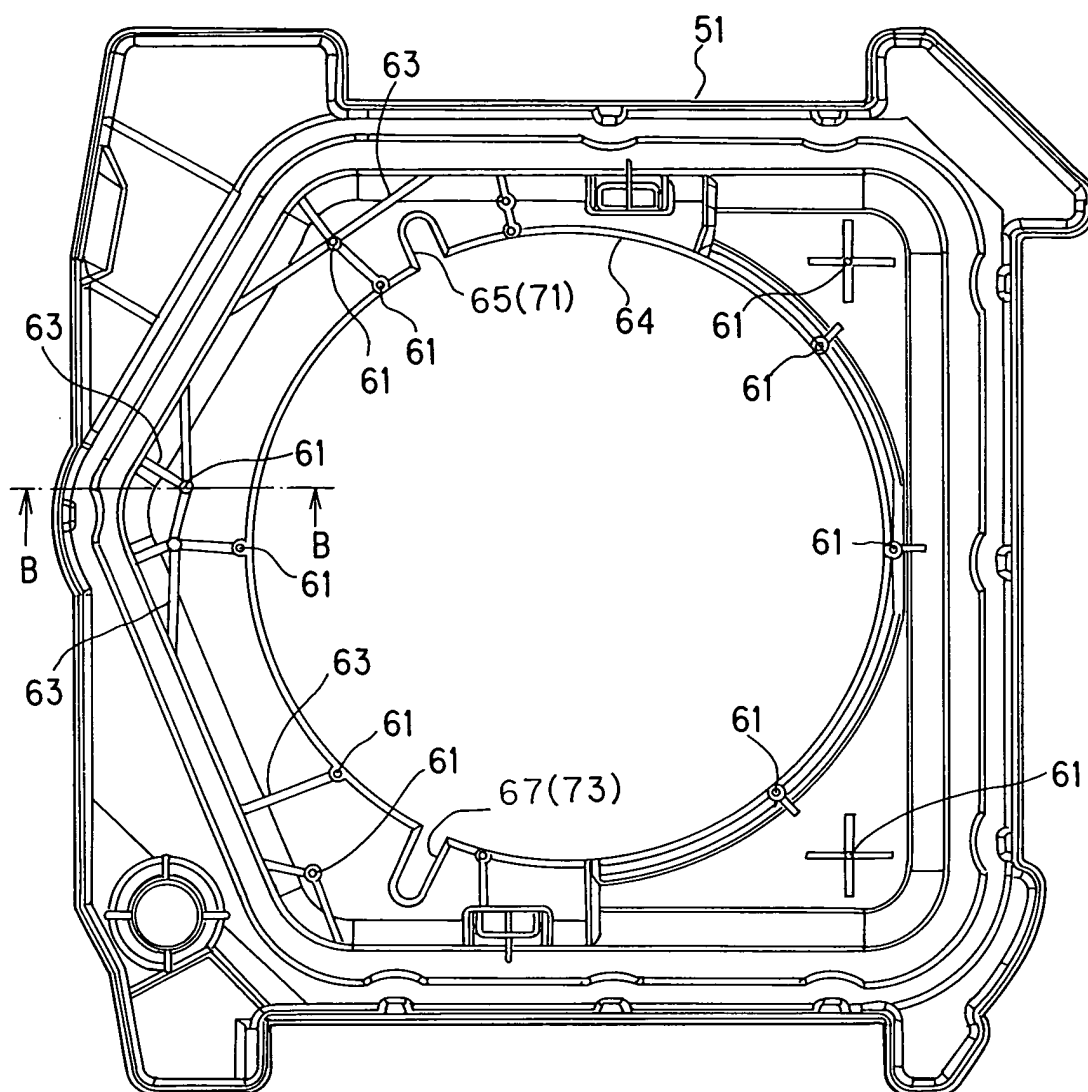
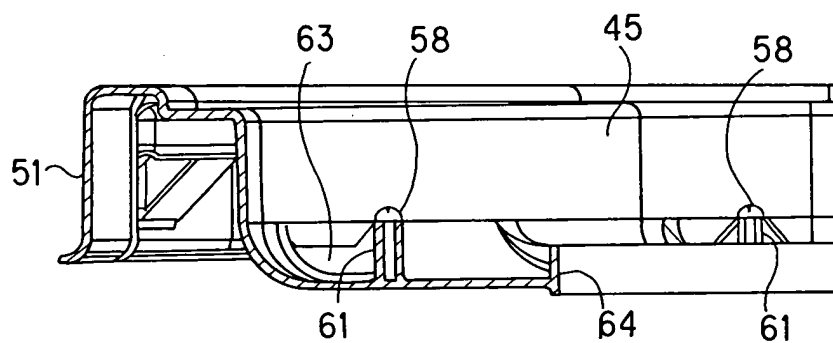


FIG. 6B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/10913

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ F24F1/00		
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) Int.Cl ⁷ F24F1/00		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Toroku Jitsuyo Shinan Koho 1994-2003		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2000-161694 A (Toshiba Corp.), 16 June, 2000 (16.06.00), Par. No. [0023]; Fig. 2 (Family: none)	1-18
X	JP 2001-235177 A (Sanyo Electric Co., Ltd.), 31 August, 2001 (31.08.01), Par. No. [0023]; Fig. 2 (Family: none)	19-21
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "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 26 November, 2003 (26.11.03)		Date of mailing of the international search report 09 December, 2003 (09.12.03)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/10913

Box I Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

"Claims 1-6, 8, 14-16" and "Claims 7, 9-13, 7-21" have different general inventive concepts, and each of them does not have a technical relationship including a "special technical feature." Further, the independent claims in "Claims 1-6, 8, 14-16" do not make any contribution over the prior art. As a result, it is apparent that the application includes more than two inventions.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.