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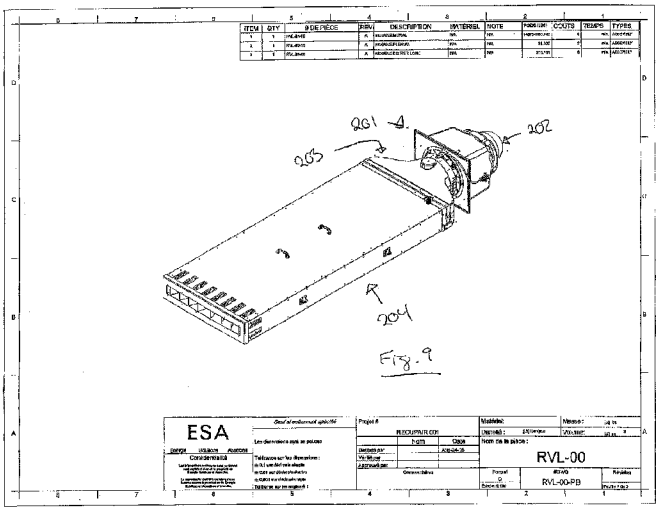


Fig. 9

(57) Abstract: A Heat Exchanger Unit comprising a venting unit, a shutter, a counter flow heat exchanger and a plurality of plenums. The venting unit pulls the fresh air from outdoor air through the shutter while it pushes the contaminated inside air through the counter flow heat exchanger and the plurality of plenums toward outside air.

PUSH-PULL COUNTER FLOW HEAT EXCHANGER

Cross-Reference to Related Applications

[0001] The present patent application claims the benefits of priority of American Patent Application No. 62/069,148, entitled "Push-Pull counter Flow Concentric Heat Exchanger" and filed at the United States Trademark and Patent Office on October 27, 2015.

Field of the Invention

[0002] The present invention relates in the general field of agrifood industry ventilation systems. In particular, the object of the invention is to improve venting capacity of high moisture and contaminated area while reducing energy cost. Precisely, the invention consists of an improved heat exchanger comprising an ingenious combination of 4 modules including a new push-pull axial vane impeller fan.

Background of the Invention

[0003] The typical application of a push-pull impeller is well known in HVAC application since 1935 (US1,672,272) and provide a mean of moving air in opposite direction with a single motor and to concentric cylinder. The anterior art is described in Figure 1 and generally consists of a dual fan with inverted pitch blades located on the inside (1) and the outside (2) of a flow separation annulus (3).

[0004] In agrifood industry, heat, moisture and contaminants such as ammonium must be evacuated from production area to avoid performance lost. This problem is generally solved by high venting flow and high heating costs. Furthermore, most existing heat exchangers can't withstand the dust contaminant or ice formation. Clogging, moisture dripping or absence of good cleaning method compromise the use of heat exchanger in a northern climate.

Summary of the Invention

[0005] The present invention generally addresses the venting problems of agrifood industry by providing a novel heat exchanger assembly. Such heat exchanger assembly comprises an axial vane dual flow impeller in a venting or fan modulus. In some aspect of the invention, the fan assembly is embodied as a counter flow concentric heat exchanger by means of a plenum set. Such an approach aims at providing a safe way to induce heat transfer in the exchanger core, but also aims at providing protection from outside environment since hot air is always surrounding cold air entering the building by the center of the heat exchanger core.

[0006] In an aspect of the invention, the heat exchanger aims at providing improved motor cooling and aims at maximizing the recovery of heat loss from a motor located inside a building. In addition, in an aspect of the present invention, an axial fan dual impeller is designed to benefit from two (2) vane stators which induce better flow swirl recovery when compared to prior art or standard design. Such recovery aims at increasing static pressure and at reducing losses due to swirl friction in the exchanger.

[0007] Supplementary to these advantages, when configured in a concentric design, the heat exchanger exhibits extra heat exchanges from all the venting units. Such potential benefits are unthinkable in a standard heat exchanger venting apparatus.

[0008] In other aspects of the invention, the single stage unit may be easily extended to two or more stages according to the required or needed static pressure.

[0009] Accordingly, the present heat exchanger Unit comprises of a low cost dual flow heat exchanger system for installation in any type of building requiring heat and/or air exchanges, such as but not limited to building in the agricultural or food industries where high moisture environment is typically a major concern. Thus, according to one aspect of the present invention, a heat exchanger assembly uses the concentric counter flow heat exchange to allow the mitigation of the moisture through isolation of the incoming cold air. As such the incoming cold air is contained in the inner most conduit isolated by the outer most conduit containing the inside air projected toward the outside of the building through the shutter.

[0010] The heat exchanger according to an embodiment having a concentric configuration aims at minimizing energy loss in order to optimize energy consumption. Furthermore, the centrally located motor unit aims at improving cooling of the heat exchanger motor through thermal exchange from the inner conduit incoming outside air surrounding the motor. Moreover, the inner motor unit is further insulated from any noise generated therefrom. As such, having the motor is surrounded by a first inner conduit and second outer conduit thus having the ability of rendering the motor virtually soundless or at least quieter of similar motor deprived of such insulation.

[0011] According to yet another aspect of the present invention, the heat exchanger configuration aims at reducing moisture formation compared with conventional systems. The moisture formation is typically reduced on the outside thus minimizing the risk of dripping water in production area. The heat exchanger configuration further aims at reducing the installation time and at reducing the weight of the heat exchange unit. In configurations having in gate and out gate vanes, a greater static pressure performance of the fan is generally observed. In addition, in configurations having both in gate and out gate vanes, an improved swirl recovery aims at generally enhancing overall ventilation performance compared with conventional system. The dual vane unit also works as a supplementary heat exchanger as the vane units isolate cold fluid from peripheral wall, thus aiming at reducing conduction lost and the need of conventional insulation from the fan unit itself. Reduction in the moisture formation on the heat exchanger outside wall and reduced water dripping may also be achieved using the dual impeller fan unit.

[0012] According to yet another embodiment, a push-pull counter flow concentric heat exchanger unit allows for vertical wall installation and allow suspended configuration thus aiming at eliminating production area losses. Airfoil shaped vanes having generally optimal angle and spacing as per know aeronautical blade art is permitting wider range of operation from the selected airfoil shape. Therefore, the incorporation of airfoil similar to airplanes blade improves the behavior of the fan unit and heat exchanger unit as a whole. In addition, concentric counter flow air-air heat exchanger aims at improving counter flow efficiency thus aiming at reducing heat losses from outside wall and reduced outside wall moisture in combination with water dripping.

[0013] In configurations where the heat exchanger is generally shaped as a long flat shape, air distribution may be substantially improved and may reduce impact on occupied space for producer. Flow vanes also, according to some embodiments, generally allow complete shutdown of the heat exchanger thus aiming at reducing infiltration loss. The presence of the fan unit outside a building further aims at reducing the heat lost or ice formation when heat exchanger is offline.

[0014] According to an aspect of the present invention, a heat exchanger assembly having a dual vane configuration is disclosed. The heat exchanger assembly generally comprises an

axial fan (or venting) unit, a heat exchanger; and a plenum module having at least a set of plenums, the plenum module operatively interconnecting the axial fan unit and the heat exchanger. The venting unit further comprises a dual flow impeller typically comprising an outer blade row located about the periphery of the dual flow impeller, an inner blade row located about the center axis of the dual flow impeller. The venting unit further comprises an in gate vane located upstream from at least one of the outer and inner blade row, and/or an out gate vane located downstream from at least one of the outer and inner blade row. According to yet another aspect of the present invention, the inner blade row forces exterior air, such as cold or fresh air, in the heat exchanger assembly generating a cold air flow and wherein the outer blade row forces inside air out of the heat exchanger assembly generating a hot air flow.

[0015] According to yet another aspect of the present invention, the heat exchanger assembly has at least one, some or each of the in gate vane and/or out gate vane that are stator vanes. Furthermore, according to an aspect of the present invention the heat exchanger may be a counter flow heat exchanger. The heat exchanger assembly may comprise a fan unit wherein the in gate vane is a straight or curved vane. The heat exchanger assembly of claim 1, wherein the out gate vane is a curved stator vane.

[0016] According to yet another aspect of the present invention, the heat exchanger assembly has a dual flow impelled located between at in gate vanes and out gate vanes.

[0017] According to a further aspect of the present invention, the plenums of the heat exchanger assembly are concentric for limiting flow separations and reducing the static pressure loss.

[0018] According to yet another aspect of the present invention, the heat exchanger assembly has a concentric counter flow heat exchanger for limiting heat lost and water dripping.

[0019] According to yet another aspect of the present invention, the heat exchanger assembly comprises a dual impeller housing and wherein the cold air flow is isolated by the hot air flow.

[0020] According to a further aspect of the present invention, the heat exchanger assembly comprises a counter flow heat exchanger having a thermoformed exchanger core. According to yet another aspect of the present invention, the heat exchanger assembly comprises a supplementary splitter and a heating device operatively mounted to the supplementary splitter.

[0021] According to yet another aspect of the present invention, the heat exchanger assembly further comprises a shutter system operatively mounted to the axial fan unit.

[0022] According to a further aspect of the present invention, the heat exchanger assembly has an inner blade row and an outer blade row with angles of attack to propel air in opposite directions.

[0023] According to yet another aspect of the present invention, the heat exchanger assembly comprises a distribution baffle.

[0024] According to yet another aspect of the present invention, the heat exchanger assembly comprises a fan unit wherein both the inner blade row and outer blade row have in gate vanes and out gate vanes and wherein the in gate vane of the inner blade row and the out gate vane of the outer blade row form an outside stator and where the outside stator comprises a fixation aperture mounting the shutter system.

[0025] According to yet another aspect of the present invention, the heat exchanger assembly comprises a fan unit wherein the inner blade row and outer blade row have in gate vanes and out gate vanes and wherein the in gate vane of the outer blade row and the out gate vane of the inner blade row form an inside stator. According to an aspect of the present invention, the inside stator comprises a rotation clip.

[0026] According to yet another aspect of the present invention, the heat exchanger assembly has a concentric heat exchanger comprising a core section and a shell section and wherein the core section may be ice resistant and dimensioned to be larger than half an inch.

[0027] Other and further aspects and advantages of the present invention will be obvious upon an understanding of the illustrative embodiments about to be described or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

Brief Description of the Drawings

[0028] The above and other aspects, features and advantages of the invention will become more readily apparent from the following description, reference being made to the accompanying drawings in which:

[0029] Figure 1 describes one of the prior art inventions of the field of the invention.

[0030] Figure 2 is a perspective view of a heat exchanger in accordance with the principles of the present invention.

[0031] Figure 3 is a perspective view of a venting unit of a heat exchanger in accordance with the principles of the present invention.

[0032] Figure 4 is an exploded perspective view of a venting unit of a heat exchanger in accordance with the principles of the present invention.

[0033] Figure 5 is a side cut view, front view and side view a venting unit of a heat exchanger in accordance with the principles of the present invention.

[0034] Figure 6 is an exploded view of a concentric heat exchanger unit in accordance with the principles of the present invention.

[0035] Figure 7 is an exploded view of a plenum unit in accordance with the principles of the present invention.

[0036] Figure 8 is a side cut view of the stacking of a plurality of venting units in accordance with the principles of the present invention.

[0037] Figure 9 is a perspective view of a second embodiment of a heat exchanger assembly in accordance with the principles of the present invention.

[0038] Figure 10 is a perspective view of the venting unit of the heat exchanger of Fig. 9.

[0039] Figure 11 is an exploded perspective view of the venting unit of the heat exchanger of Fig. 9.

[0040] Figure 12 is a cross sectional view along a plan from a vertical axis and a longitudinal central axis.

[0041] Figure 13 is a cross sectional view along a plan from a vertical axis and a longitudinal central axis.

[0042] Figure 14 is a perspective view of an embodiment of a fan having brushed mounted thereto in accordance with the principles of the present invention.

[0043] Figure 15 is an exploded view of the fan of Fig. 14

[0044] Figure 16 is a side view of the fan of Fig. 14

[0045] Figure 17 is a cross sectional view of the fan of Fig. 14.

[0046] Figure 18 is a perspective view of an embodiment of a fan having brushed mounted thereto in accordance with the principles of the present invention.

[0047] Figure 19 is an exploded view of the fan of Fig. 18

[0048] Figure 20 is a side view of the fan of Fig. 18

[0049] Figure 21 is a cross sectional view of the fan of Fig. 18.

[0050] Figure 22 is a cross sectional view of an embodiment of a venting and shutting units in accordance with the principles of the present invention, the shutting unit being in the open configuration.

[0051] Figure 23 is a perspective view of the venting and shutting units of Fig. 22.

[0052] Figure 24 is a cross sectional view of the venting and shutting units of Fig. 22, the shutting unit being in closed configuration.

[0053] Figure 25 is a perspective view of the venting and shutting units of Fig. 24.

Detailed Description of the Preferred Embodiment

[0054] A novel heat exchanger will be described hereinafter. Although the invention is described in terms of specific illustrative embodiments, it is to be understood that the embodiments described herein are by way of example only and that the scope of the invention is not intended to be limited thereby.

[0055] The heat exchanger assembly in accordance with the principle of the present invention aims at exchanging heat between indoor air, typically warm and/or contaminated air, and exterior air, typically colder air or cleaner/fresher air. Now referring to Figure 2, the Heat Exchanger Unit comprises a venting unit (1), a shutter (2), a counter flow heat exchanger (4) and a plurality of plenums (3). The venting or fan unit (1) pulls air from outside through the shutter (2) and pushes the inside air through the counter flow heat exchanger (4) and the plurality of plenums (3) toward outside air. One of the functions of the shutter (2) is to stop the outside air from entering the unit while the venting unit (1) is turned off. The shutter (2) also helps reducing the air contamination when the venting unit (1) is turned on. One of the plenums (3) functions is to transfer the air from the venting unit (1) to the counter flow heat exchanger (4) in a way that reduces the energy loss and limits the flow separations. Finally, one of the functions of the counter flow heat exchanger (4) is to transfer the energy from the inside air to the clean outside air. In some embodiment, a concentric configuration aims at reducing the loss of energy inside of the building due to poor insulation since the energy filled exhausted air is surrounding the new air.

[0056] Now referring to Figures 3 and 4, the dual flow impeller (101) is located between at least two stator vane parts (102) and (103). The impeller (101) comprises at least one row of inner blades (104) and outer blades (105). The angles of attack of the blades are such as the air is propelled in opposite direction as indicated by the air flow arrow shown in Figure 5. The black arrows of Figure 5 represent outside air flowing in the building while the white arrows

represent the inside air typically evacuated from a building or area. The venting unit (1) in accordance with the principle of the present invention has the desirable effect of having higher potential increase of air pressure in the air flow and therefore may allow the use of a heat exchanger module.

[0057] In some embodiments, the stator vane (102) and/or (103) comprises a straight vane (106) located before or in front of the fan assembly (1) entrance and a curved stator vane (107) located after the fan output according to the air flow direction. The stator vanes (102) and/or (103) may also be configured to allow different pressure increases depending on the application of the heat exchanger unit. Therefore, the entrance portion or output portion stator (102) and/or (103) may be straight when use for different applications.

[0058] Now referring to the Figure 8, a different embodiment of the heat exchanger is shown. One skilled in the art shall understand that such embodiment of the heat exchanger in accordance with the principles of the present invention may be configured to allow different configurations comprising a variable number of push-pull blades and/or stator rows which may increase the total system pressure increase in different applications.

[0059] Referring back to Figures 3 and 4, the impeller is typically propelled by a motor (108) which is supported by a frame (109) typically configured to mount the different components of the venting module. Such embodiment allows lower costs of assembly while allowing an easy access to the components for maintenance or cleaning purposes.

[0060] In a preferred embodiment, the different components of the unit are typically assembled using bolts (110) or any other fastening or securing method. In another embodiment, a hinge incorporated or mounted on plastic stator parts (102, 103) is used to assemble the unit. Such an assembly typically reduces the assembly cost and increase the life of the unit. Also, an assembly comprising a hinge may also be particularly fit for smaller unit were material resistance is less critical.

[0061] Still referring to Figure 4, the plenum module (3) allows the air to circulate between the counter flow heat exchanger (4) and the venting unit (1) and vice versa. In a preferred embodiment, the inside stator (102) may comprise a rotation clip (111). The rotation clip (111) typically reduces the installation or removal duration of the plenum module (3) (as shown in Figure 2).

[0062] Still in a preferred embodiment, the outside stator (103) may comprise fixation aperture configured to allow the installation of a shutter system (2). The second stator may be shaped to create one or more air flow deflectors. Such configuration typically reduces the mix

of air flow happening outside of the building or the area. The unit may comprise a plurality of seals (112,113) which are typically located between the stators (102,103) and the frame (109) to further reduce possible water or air leak in the unit.

[0063] Now referring to Figure 6, a concentric heat exchanger (4) in accordance with the principles of the present invention is shown. The concentric heat exchanger (4) comprises a core section (401) and a shell section (402). The concentric heat exchanger (4) may also include a distribution baffle (403). The core (401) is typically configured to be ice resistant. In order to be ice resistant, of the core is typically dimensioned to be larger than half an inch. The core may also be shaped as irregular winding patterns to increase the exchange of heat.

[0064] In a preferred embodiment, the core (401) may be slid outside of the shell (402). Such configuration eases the cleaning and the maintenance of the heat exchanger (4).

[0065] During operation of the unit, the outside air circulates inwardly through the core (401) while the exhausted or outside air, typically coming from the inside of a building or of a concealed area, circulates outwardly in the shell (402). One of the shell (402) functions is to isolate the inside of the building from the air inside of the core (401). In other embodiments, the heat exchanger may be thermoformed in order to reduce the costs and to increase the efficiency of the unit.

[0066] In embodiments comprising a distrusting baffle (403), the distribution of the air flow inside of the building is optimized while the infiltration of the new/fresh air in the shell (402) is reduced.

[0067] Now referring to Figure 7, the plenums unit (3) in accordance with the principle of the present invention is shown. The plenum unit (3) typically comprise an inside plenum section (301), an outside plenum section (303), one or more support elements (302) and a piping system (304). The inside plenum (301) limits the flow of cold/fresh air. The outside plenum (303) directs the exhausted/contaminated air from the counter flow heat exchanger (4) to the venting or fan unit (1). In another embodiment, the outside plenum (303) may be constructed with two identical parts or with more than two different parts in order to reduce cost and to ease the assembling. The inside plenum (301) shall be of smaller dimension compared to the outside plenum (303) as the inside plenum (301) is installed within the outside plenum (303).

[0068] The plenum unit (3) may comprise two identical shells allowing simple assembly and reducing the overall costs. The plenum unit (3) may further comprise supplementary support (302) in order to ease the assembly of the plenum unit (3). Such support (302) is used according to material and thickness selections of the plenum unit (3) components.

[0069] The plenum unit (3) may further comprise one or more water elimination mean, such as a hole/aperture and a piping system (304). Such water elimination means allows the elimination of condensation out of the plenum unit (3). The water elimination mean (304) is typically located the top side of the outside plenum (303) and may be used as an aperture for cables or other means to connect electrical component. The plenum units (3) may further comprise quick connect pins (305) allowing a fast connection of the heat exchanger core to the plenum unit (3) for maintenance and cleaning purposes.

[0070] According to embodiments, now referring to Fig. 9-13, a heat exchanger assembly in accordance with the principle of the present invention aims at exchanging indoor air, typically warm and/or contaminated, and exterior air, typically purer and colder. Now referring to Figure 9, the heat exchanger assembly comprises a venting or axial fan unit (201), a shutter (202), a heat exchanger (204), preferably a counter flow heat exchanger and at least a set of interior and exterior plenums comprised in a plenum unit (203), preferably a plurality of plenums. The venting unit 201 pulls the fresh air from outdoor air through the shutter (202) using a central inner blade fan and pushes the contaminated inside air through the counter flow heat exchanger (204) using a peripheral outer blade fan and the plurality of plenums contained in the plenum unit (203) toward exterior. Notably, the shutter unit (202) is used to stop or at least to limit outside air from entering the unit while the venting unit (201) is turned off. The shutter unit (202) also aims at reducing the air contamination when the venting unit (201) is turned on. One of the plenums unit (203) functions is to transfer the air from the venting unit (201) to the counter flow heat exchanger (204) while reducing energy loss and limiting flow separations. Yet, one of the functions of the counter flow heat exchanger (204) is to use the transfer of energy from the inside air to the outside air. In embodiment having a concentric configuration, the loss of energy inside of the building due to poor insulation is further reduced since the energy filled exhausted air is surrounding the new air.

[0071] Now referring to Figures 10 and 11, the dual flow impeller (501) is located between at least two stator vane parts (502) and (503). The dual flow impeller (501) comprises at least one row of inner blades (504) generally located about the central axis of the fan and a row of outer blades (505) located about the periphery of the fan. The angles of attack of the blades are such as the air is propelled by the airfoil blades of the inner blade row and outer blade row in opposite direction. Outside air flow is preferably directed in the building using the inner blade row while the inside air is generally evacuated from a building or area through the outer blade row. The venting unit (201) in accordance with the principle of the present invention has the desirable effect of having higher potential increase of air pressure in the air

flow due to the use of in gate and out gate vanes and therefore allow the use of a heat exchanger module thus increasing the efficiency of the overall heat exchanger assembly. Understandably, though preferred, the heat exchanger assembly may function with at least one of the in gate and/or out gate vane. Likewise, though counter flow heat exchanger is preferred, the heat exchanger unit may comprise known heat exchanger.

[0072] In some embodiments, the in gate vanes referred as stator vanes (502) and/or (503) comprises a straight vanes (506) located before or in front of the fan entrance and a curved stator vane (507) located after the fan output according to the air flow direction. The stator vanes (502) and/or (503) may also be configured to allow different pressure increases depending on the application of the heat exchanger unit. Therefore, the entrance portion or output portion stator (502) and/or (503) may be straight or curved depending on its intended use for different applications.

[0073] According to the present invention, all elements controlling the airflow of the system, such as in-gate or out-gate vanes, impellers and blades are designed using efficiency principles found in the aeronautical industry, such as plane wings, in order to optimize the airflow before entering the fan unit or the plenum unit. Such optimized airflow ensures low energy consumption of the motor by reducing turbulences of the entering and exiting airflow. Thus, all principles of reduction of turbulences in an airflow found in modern aeronautics may be used to designs the vanes and the impeller to provide improved airflow and are incorporated in the present patent application.

[0074] Referring back to Figures 10 and 11, the impeller is typically propelled by a motor (508) which is supported by a frame (509) typically configured to mount the different components of the venting module. Such embodiment allows lower costs of assembly while allowing an easy access to the components for maintenance or cleaning purposes.

[0075] As described in the previous embodiments, the different components of the unit are typically assembled using bolts (510) or any other fastening or securing method. In another embodiment, a hinge incorporated or mounted on plastic stator parts (502, 503) is used to assemble the unit.

[0076] Still referring to Figure 11, the plenum module (203) allows the air to circulate between the counter flow heat exchanger (204) and the venting unit (201) and vice versa. In a preferred embodiment, the inside stator (502) may comprise a rotation clip (511). The rotation clip (511) typically reduces the installation or removal duration of the plenum module (203) (as shown in Figure 8).

[0077] Likewise, in a preferred embodiment, the outside stator (503) may comprise fixation aperture configured to allow the installation of a shutter system (202).

[0078] Now referring to Figures 10 and 11, the dual flow impeller (501) is located between at least two stator vane parts (502) and (503). The impeller (501) comprises at least one row of inner blades (504) and outer blades (505). The angles of attack of the blades are such as the air is propelled in opposite direction as indicated by the air flow arrow shown in Figure 5.

[0079] Now referring to Figs. 12-13 a concentric counter flow heat exchanger (204) in accordance with the principles of the present invention is shown. The concentric heat exchanger (204) comprises a core section (601) and a shell section (602). The concentric heat exchanger (204) may also include a distribution baffle (603). The core (601) is typically configured to be resistant to ice. In order to be ice resistant, of the core is typically dimensioned to be larger than half an inch. The core may also be shaped as irregular winding patterns to increase the exchange of heat.

[0080] Now referring to Figs. 14-21, according to an embodiment of the present invention, the heat exchanger assembly further comprises brushes to improve the fan efficiency and mitigate losses or air contamination arising from the air opening at the junction of the inner and outer blade of the axial fan. According to one embodiment, brushes may be vertical 604 or horizontal 602. The brushes may be positioned on the inner side, outer side of the blade or both. Understandably optimal efficiency will be achieved using both outer and inner fan brushes. The brushes 604 and 602 are respectively in contact with annulus 608 and 606 bridging the inner and outer conduits.

[0081] Now referring to Fig. 8, according to another embodiment, the geometry of the concentric heat exchange in combination with the dual flow fan allow to synergistically improving efficiency of the heat exchanger assembly allowing better energy efficiency. Additionally, the configuration of the fan unit allows for quick replacement of existing fan units in building without substantial retrofitting. As such, the heat exchanger assembly may replace simple ventilation fan of similar dimension the heat exchanger assembly thus substantially improving the ventilation of the building. For instance, the heat exchanger assembly may replace an existing ventilation unit of a farming building and thus improve the ventilation of the installations.

[0082] Now referring to Fig. 22-2, according to yet another embodiment of the present invention, , the heat exchanger assembly may comprise a shutter unit 201 having an extending unit 720 extending about the inner conduit 722 removably closing the shutting unit flap

opening 709. Accordingly, the lateral translation of the shutting conduit extending unit 720 allows closing and opening of the shutting unit 202. The lateral translation of the shutting conduit extending unit 720 is generally achieved through a linear actuator thereby expending or retracting the shutting conduit extending unit 720. As such, depending on the level of opening of the shutting conduit extending unit 720, the ventilation of the building may be entirely isolated from the outside allowing only recirculation of the air (the shutting unit in the closed position see Figs. 24-25). Understandably, other mean of lateral translation known in the art may be used.

[0083] Likewise, the building may be partially ventilated, allowing some incoming outside air while having a portion of the inside air being recirculated through the shutting unit. Lastly the building may be totally ventilated when the shutter is entirely open (see Figs. 22-23) in which case no inside air is recirculated in the building. Therefore, in the entirely open configuration (see Figs. 22-23) the shutting conduit inner conduit 705 is entirely isolated from the outer conduit 707 via sealing member 703. In the open configuration, the extending unit 720 is substantially covering the inner conduit 722 allowing the flap opening 709 to freely allow air inflow through inner conduit opening 711. To the opposite, in the closed configuration, the cover portion 701 of the inner conduit 722 is entirely overlapping shutting unit flap opening 709.

[0084] While illustrative and presently preferred embodiments of the invention have been described in detail hereinabove, it is to be understood that the inventive concepts may be otherwise variously embodied and employed and that the appended claims are intended to be construed to include such variations except insofar as limited by the prior art.

Claims

1) A heat exchanger assembly having a dual vane configuration, the heat exchanger assembly comprising:

a fan assembly comprising

a dual flow impeller comprising:

an outer blade row about the periphery of the dual flow impeller, the outer blade row being configured to pull airflow out of the heat exchanger assembly to warm air flow.;

an inner blade row between the center axis of the dual flow impeller, the inner blade row being configured to push the airflow in the heat exchanger assembly to lower temperature of the airflow;

an in gate vane, the in-gate vane being upstream from the dual flow impeller;

a heat exchanger unit; and

a plenum module, the plenum module comprising at least one set of plenums and the plenum module being operatively interconnecting the fan assembly and the heat exchanger

2) The heat exchanger assembly of claim 1, the fan assembly further comprising an out gate vane, the out-gate vane being downstream from the dual flow impeller;

3) The heat exchanger assembly of claim 1, wherein at least one of the in gate vane is a stator vane.

4) The heat exchanger assembly of claim 2, wherein at least one of the in gate vane or out gate vane is a stator vane.

5) The heat exchanger assembly of any of claims 1 or 2, wherein the heat exchanger is a counter flow heat exchanger.

6) The heat exchanger assembly of claim 2, wherein the in gate vane and the out gate vane are stator vanes.

7) The heat exchanger assembly of claim 1, wherein the in gate vane is a straight vane.

8) The heat exchanger assembly of claim 2, wherein the out gate vane is a curved stator vane.

9) The heat exchanger assembly of claim 2, wherein the dual flow impeller is located between in gate vanes and out gate vanes.

10) The heat exchanger assembly of any of claims 1 or 2, wherein the plurality of plenums are concentric to limit flow separations and to reduce the static pressure loss.

11) The heat exchanger assembly of claim 1, wherein counter flow heat exchanger is concentric for limiting heat lost and water dripping.

12) The heat exchanger assembly any of claims 1 or 2, wherein the vanes are airfoil shaped.

13) The heat exchanger assembly of claim 1, further comprising a dual impeller housing and being configured for the cold air flow to be isolated by the hot air flow.

14) The heat exchanger assembly of claim 5, the counter flow heat exchanger comprising a thermoformed exchanger core.

15) The heat exchanger assembly of claim 1, the heat exchanger assembly further comprising a supplementary splitter and a heating device operatively mounted to the supplementary splitter.

16) The heat exchanger assembly of claim 1, the heat exchanger assembly further comprising a shutter system operatively mounted to the axial fan unit.

17) The heat exchanger assembly of claim 1, the inner blade row and the outer blade row comprising angles of attack adapted to propel air in opposite directions.

18) The heat exchanger assembly of claim 1, further comprising a distribution baffle.

19) The heat exchanger assembly of claim 2, wherein both the inner blade row and outer blade row have in gate vanes and out gate vanes and wherein the in gate vane of the inner blade row and the out gate vane of the outer blade row form an outside stator.

20) The heat exchanger assembly of claim 19, wherein the outside stator comprises a fixation aperture adapted to mount the shutter system.

21) The heat exchanger assembly of claim 1, both the inner blade row and outer blade row comprising in gate vanes and out gate vanes , the in gate vane of the outer blade row and the out gate vane of the inner blade row forming an inside stator.

22) The heat exchanger assembly of claim 21, the inside stator comprising a rotation clip.

23) The heat exchanger assembly of claim 1, the heat exchanger unit comprising a core section and a shell section.

24) The heat exchanger assembly of claim 23, the core section being ice resistant, and being dimensioned to be larger than half an inch.

25) The heat exchanger assembly of claim 23, the core section having irregular winding patterns adapted to increase heat exchanges.

26) The heat exchanger assembly of claim 1, the plenum module comprising an inside plenum section, an outside plenum section, one or more support elements and a piping system.

27) The heat exchanger assembly of claim 26, the inside plenum section being adapted to limit cold airflow.

28) The heat exchanger assembly of claim 26, the outside plenum section being adapted to direct warm airflow from the heat exchanger unit to the fan assembly.

29) The heat exchanger assembly of claim 26, the inside plenum section being shaped to be inserted in the outside plenum.

30) The heat exchanger assembly of claim 26, the plenum module further comprising a water evaporation mean.

31) The heat exchanger assembly of claim 30, the outside plenum comprising a top side and the water elimination mean being on the top side of the outside plenum.

32) The heat exchanger assembly of claim 26, the water evaporation mean being an aperture.

* * *

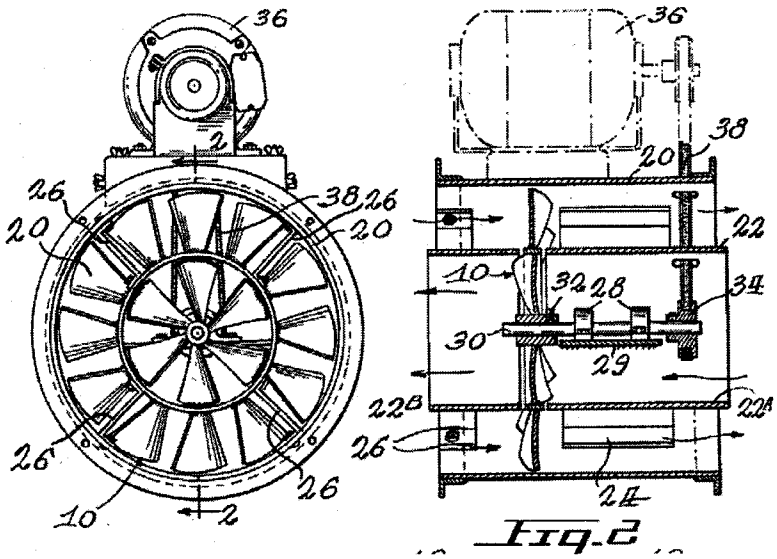


Figure 1

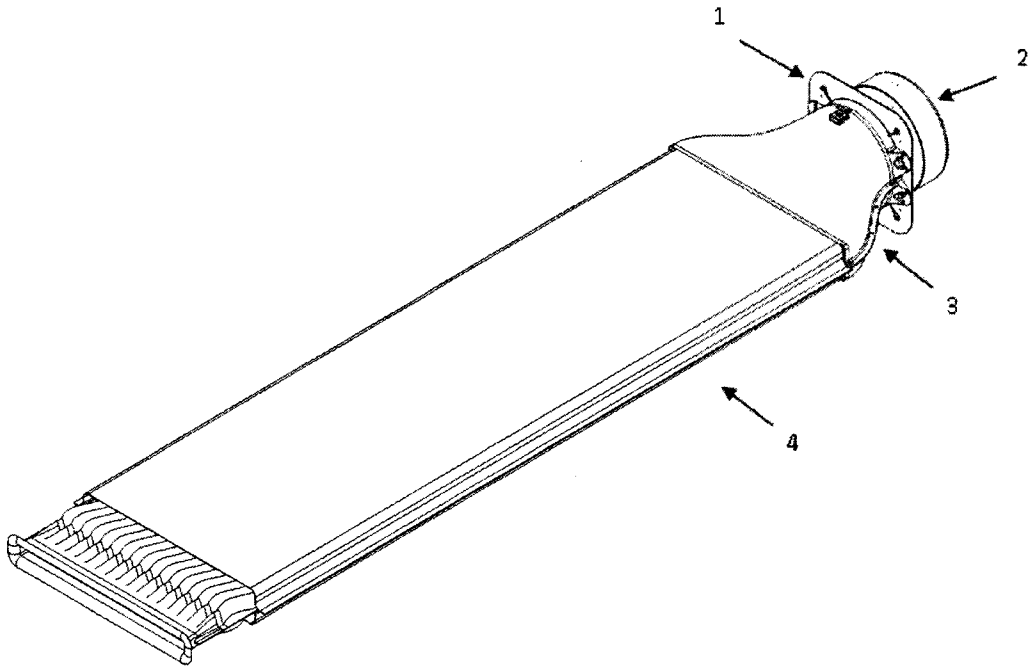


Figure 2

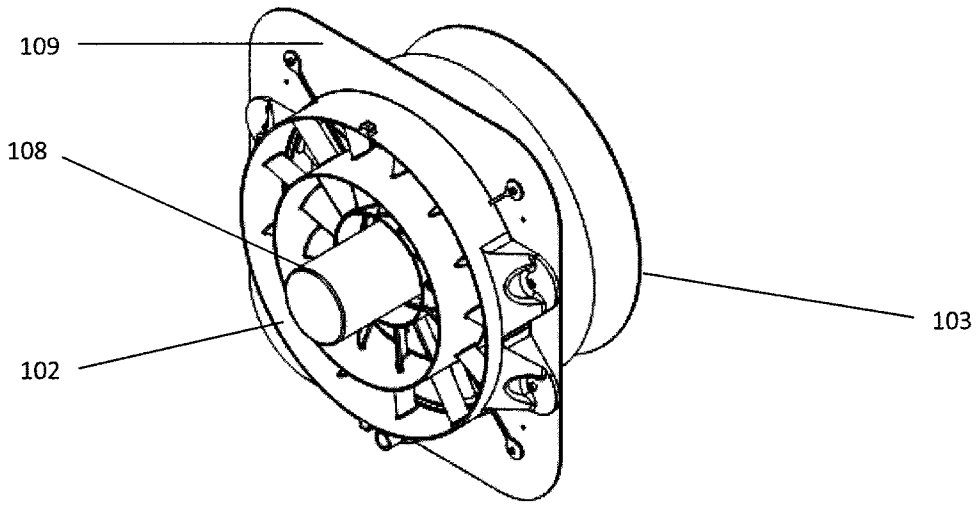


Figure 3

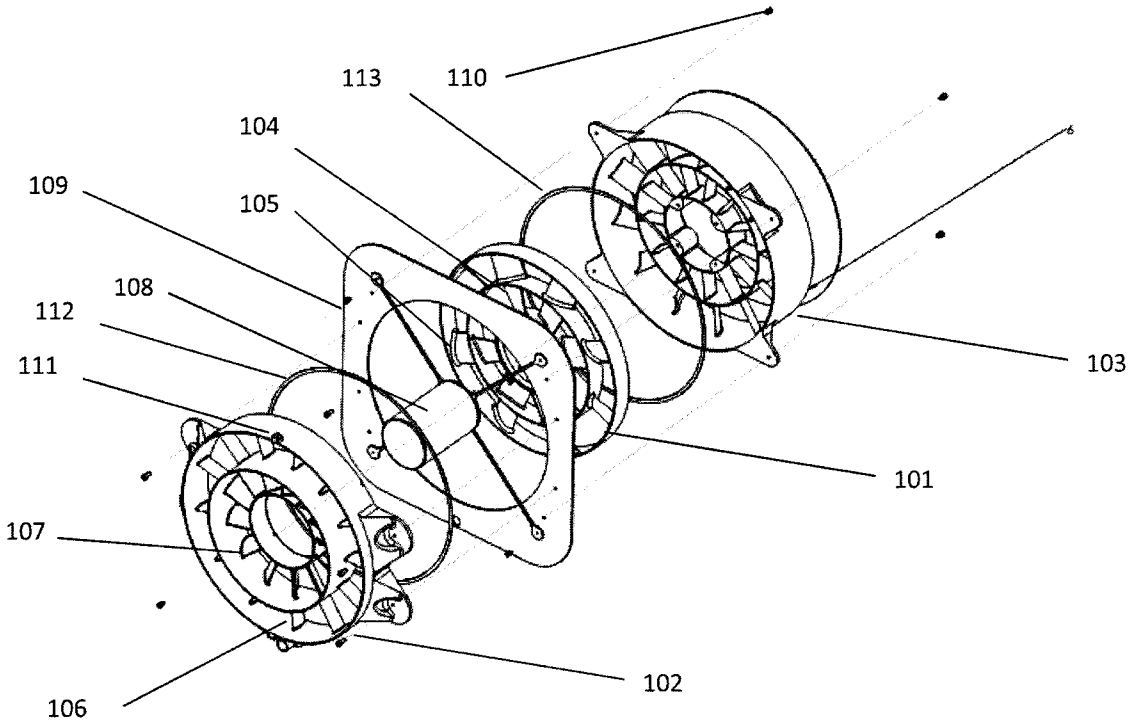


Figure 4

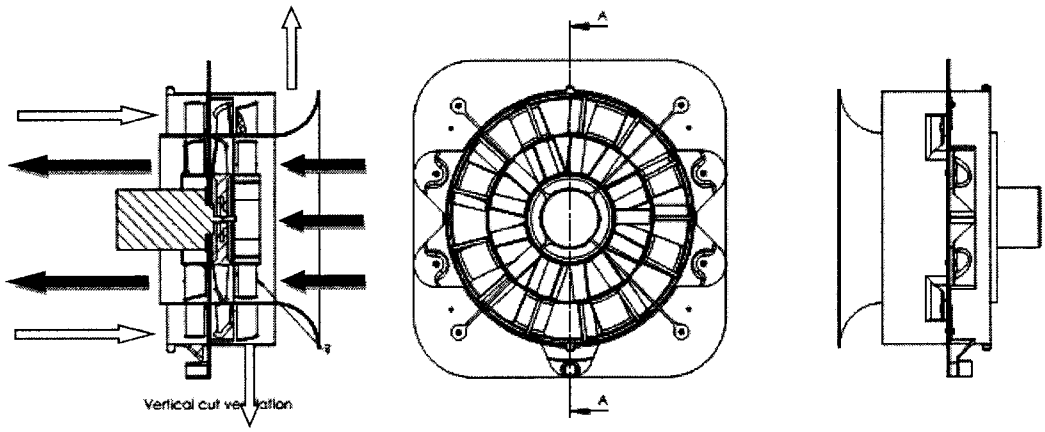


Figure 5

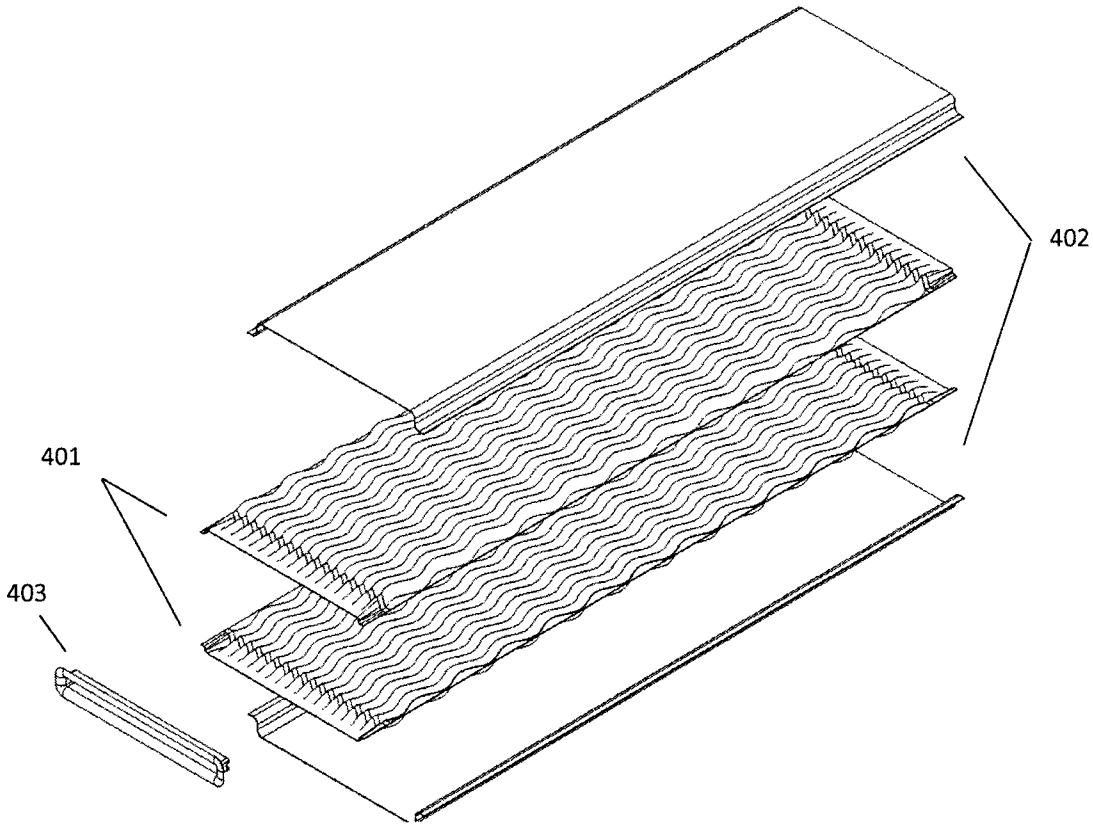


Figure 6

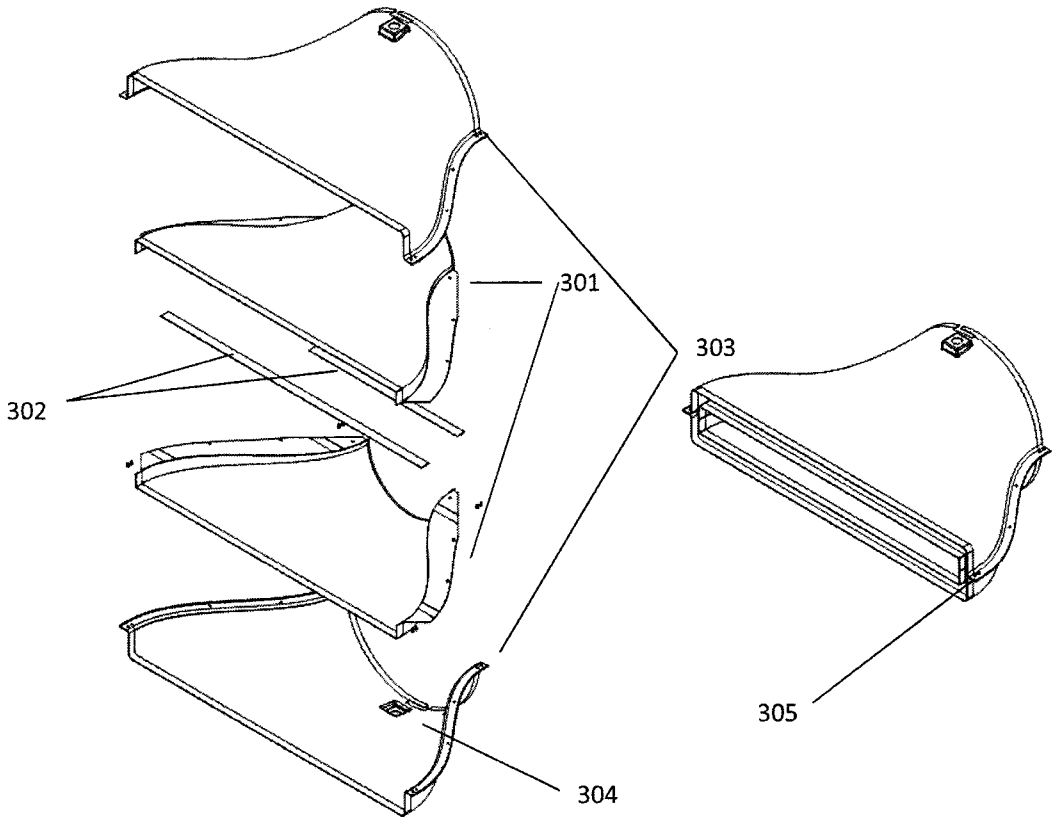
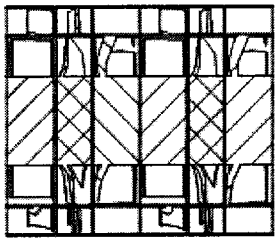
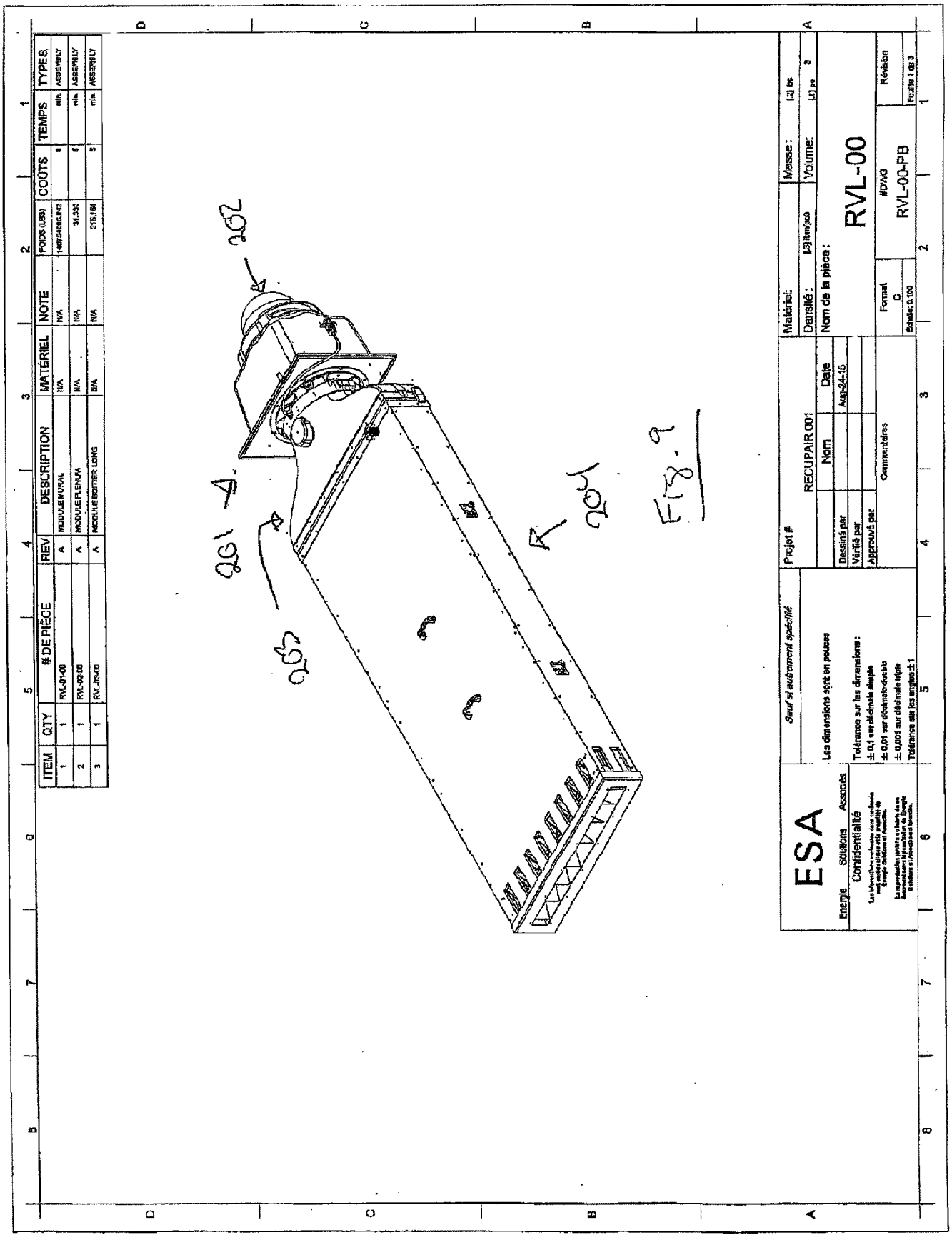


Figure 7



COUPE A-A

Figure 8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COÛTS
TEMPS
TYPES
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A
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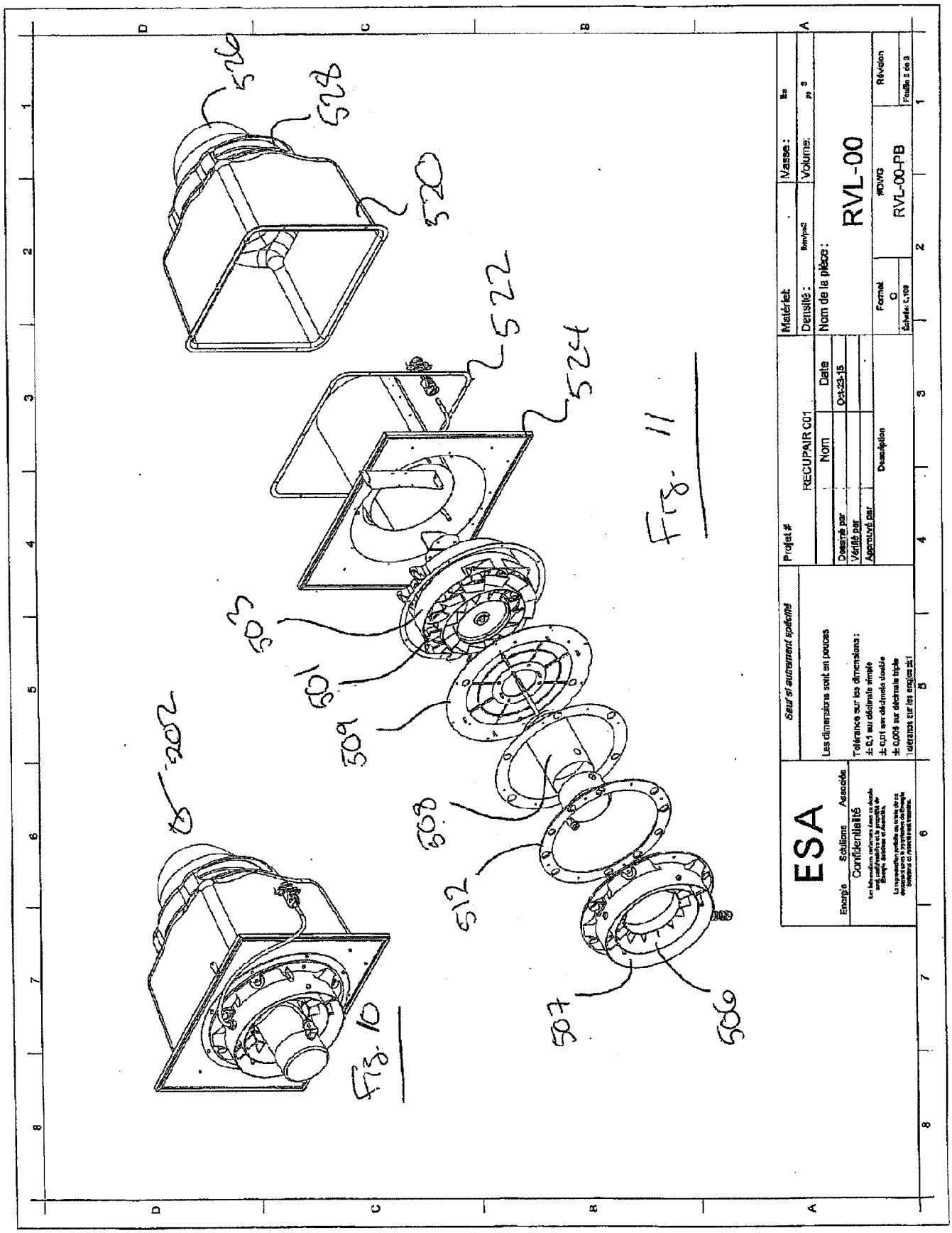
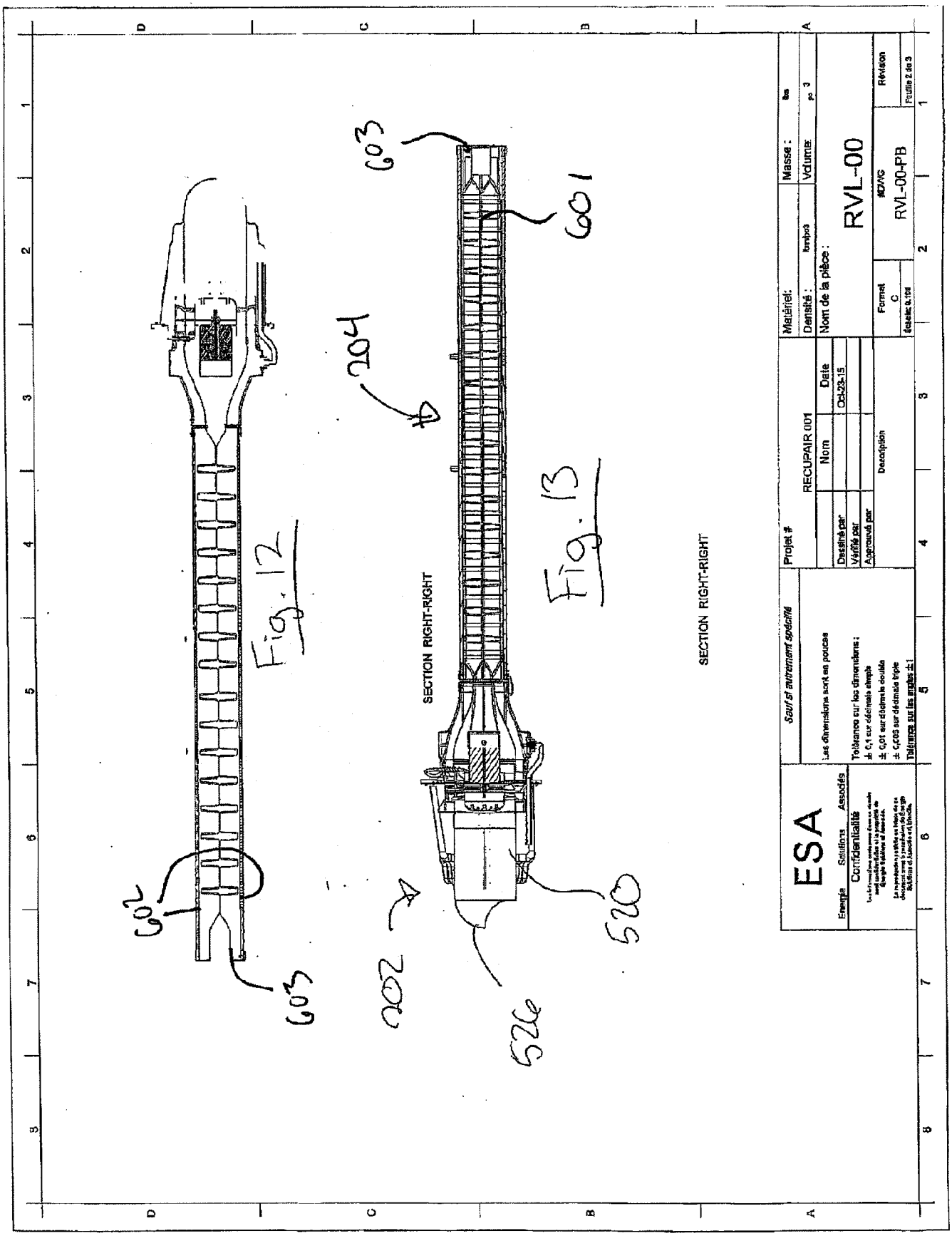
N/A
N/A
140758066.672
$
min.
ASSEMBLY
2
1
RVL-02-00
A
MODULE PLENUM
N/A
N/A
31.395
$
min.
ASSEMBLY
3
1
RVL-03-00
A
MODULE BOTTOM LONG
N/A
N/A
315.161
$
min.
ASSEMBLY
201
202
203
Fig. 9
ESA
Énergie Solutions Associés
Confidentialité
Seuil si autrement spécifié
Les dimensions sont en pouces
Projet #
RECUPAIR.001
Nom
Date
Dessiné par
Aug-24-16
Vérifié par
Approuvé par
Commentaires
Matériel:
Densité :
Nom de la pièce :
RVL-00
Masse :
Volume:
Format
C
Échelle: 0.100
#DWG
RVL-00-PB
Révision
Feuille 1 de 3


526
528
520
522
524
502
504
509
508
512
506
FIG. 10
FIG. 11
ESA
Énergie Solutions Associés
Confidentialité
Sauf si autrement spécifié
Les dimensions sont en pouces
Tolérance sur les dimensions :
Projet #
RECUPAIR C01
Dessiné par
Vérifié par
Approuvé par
Nom
Date
Oct-23-15
Description
Matériel:
Densité :
Masse :
Volume:
Nom de la pièce :
RVL-00
Format
C
Échelle: 1:10
#DWG
RVL-00-PB
Révision
Feuille 3 de 3


SECTION RIGHT-RIGHT
SECTION RIGHT-RIGHT
Fig. 12
Fig. 13
602
603
603
601
204
202
520
526
ESA
RECUPAIR 001
RVL-00
RVL-00-PB

ITEM	QTY	# DE PIÈCE	REV	DESCRIPTION	MATÉRIEL	NOTE	POIDS (lbs)	COÛTS	TEMPS	TYPES
1	1	BROSSE 02-PB								PART
2	1	BROSSE-02-PB-B								PART
3	1	BROSSE-03-PB								PART
4	1	BROSSE-04-PB								PART
5	1	RYL-K1-02-08-01								PART

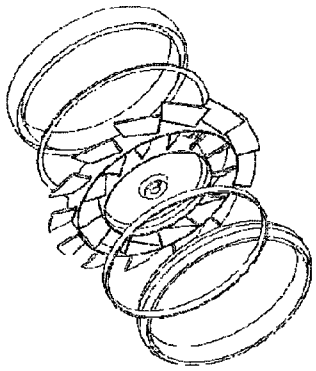


Fig. 15

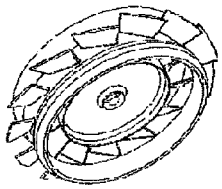


Fig. 14

Fig. 17

SECTION XSEC0001-XSEC0001

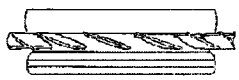


Fig. 16

ESA

Energie Solutions Associés

Confidentialité

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La reproduction partielle ou totale de ce dessin sans l'autorisation écrite de Énergie Solutions Associés est interdite.

Sauf si autrement spécifié

Les dimensions sont en pouces

Tolérance sur les dimensions :

± 0,1 sur décimale simple

± 0,01 sur décimale double

± 0,005 sur décimale triple

Tolérances sur les angles ±1

Projet #

RECUPAIR 001

	Nom	Date
Dessiné par		
Vérifié par		Aug-24-15
Approuvé par		

Commentaires

Matériel:

Densité : [3] lbm/po3

Nom de la pièce :

BROSSE-PB

Masse : [2] lbs

Volume: [0] po 3

Format C

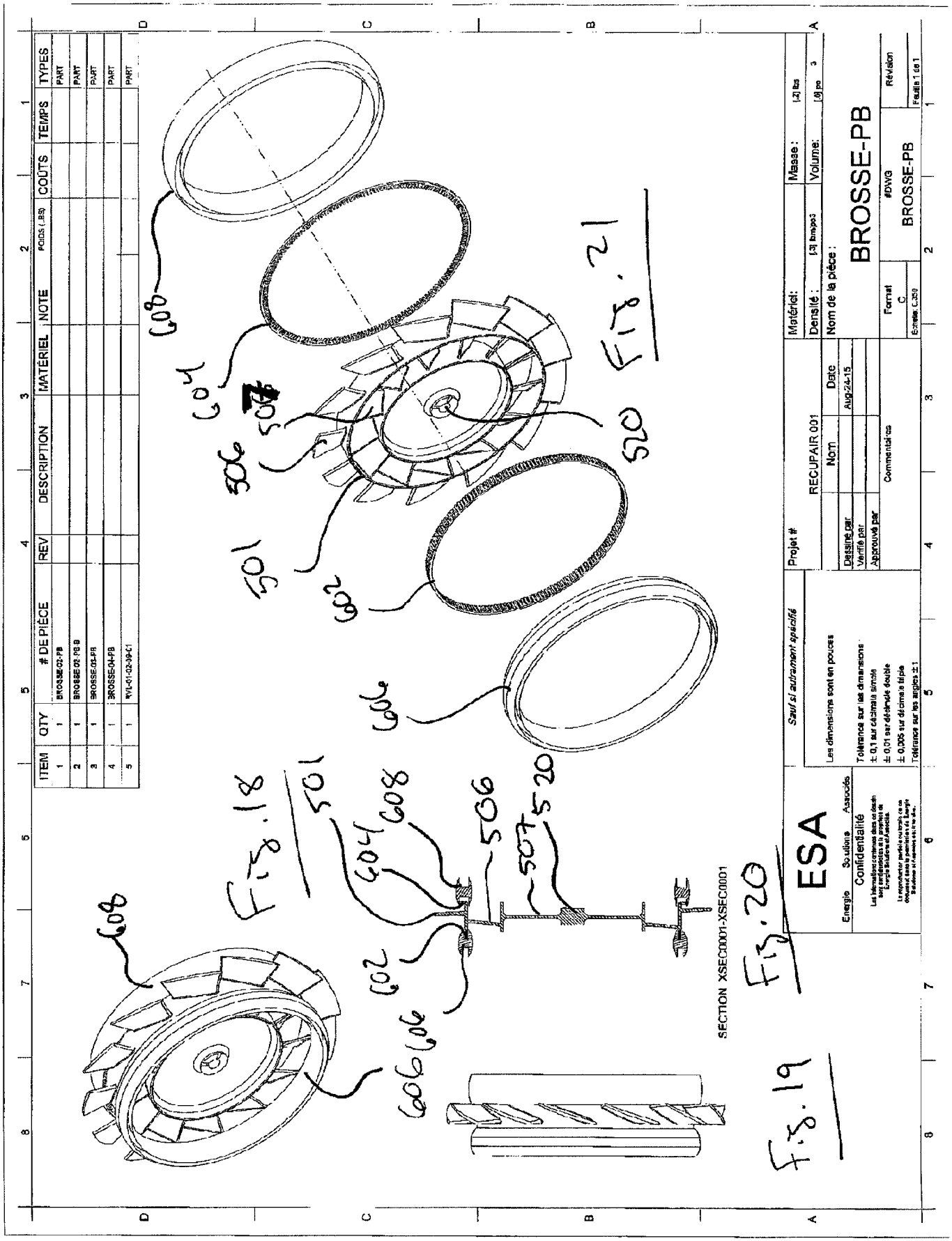
Échelle: 0.203

#DWG

BROSSE-PB

Révision

Feuille 1 de 1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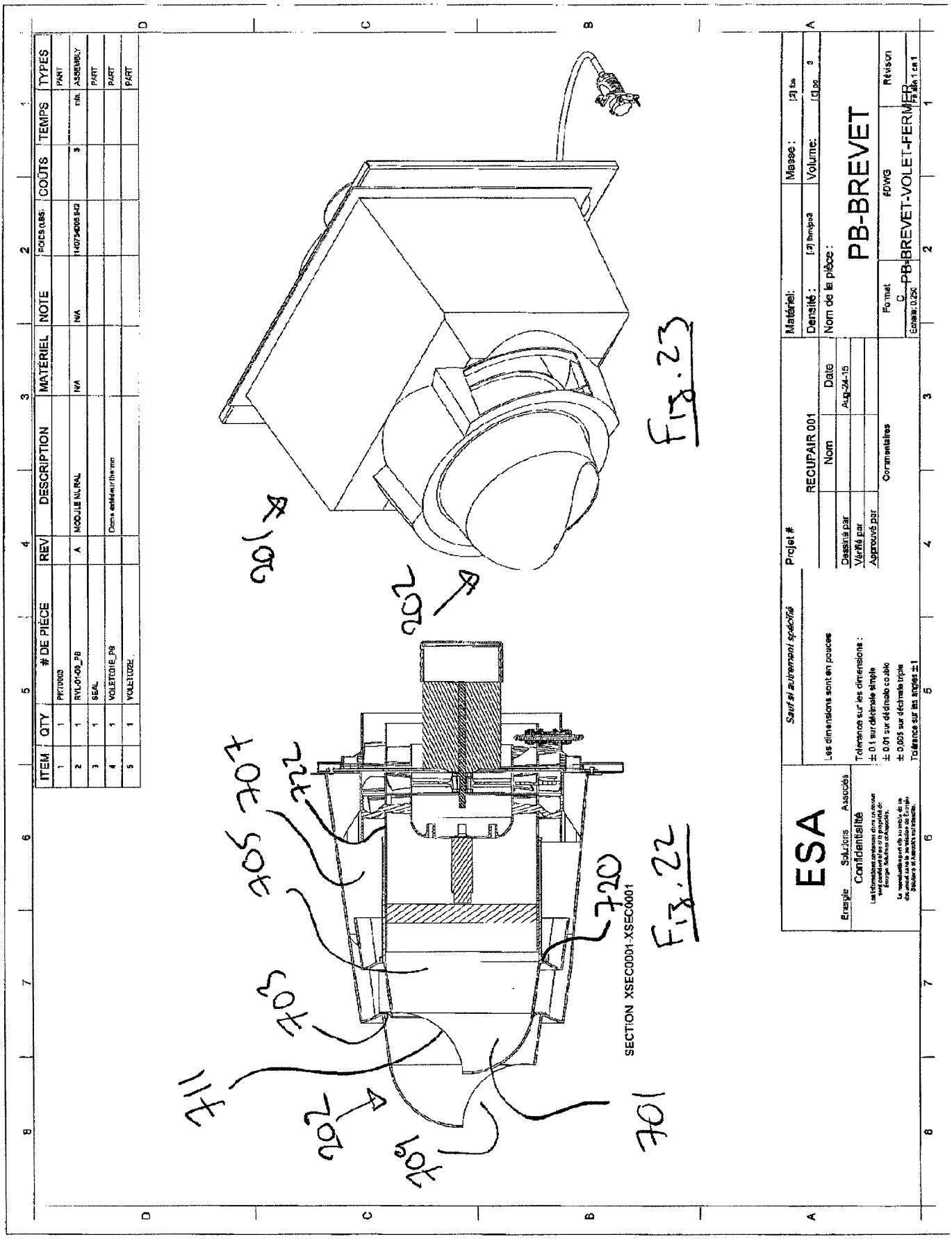
1 1 BROSSE-02-PB PART
2 1 BROSSE-03-PB PART
3 1 BROSSE-04-PB PART
4 1 BROSSE-04-PB PART
5 1 RVI-01-02-39-01 PART
Fig. 18
501
604
608
506
507
520
606
602
SECTION XSEC0001-XSEC0001
Fig. 20
Fig. 19
Fig. 21
ESA
Energie Soutions Associés
Confidentialité
Saut si autrement spécifié
Les dimensions sont en pouces
Tolérance sur les dimensions :
± 0,1 sur décimale simple
± 0,01 sur décimale double
± 0,005 sur décimale triple
Tolérance sur les angles ±1
Projet #
RECUPAIR 001
Nom Date
Dessiné par Aug-24-15
Vérifié par
Approuvé par
Commentaires
Matériel:
Densité : 13] lbm/po3
Masse : 12] lbs
Volume: [0] po 3
Nom de la pièce :
BROSSE-PB
Format C
Échelle: 0.250
#DWG
BROSSE-PB
Révision
Feuille 1 de 1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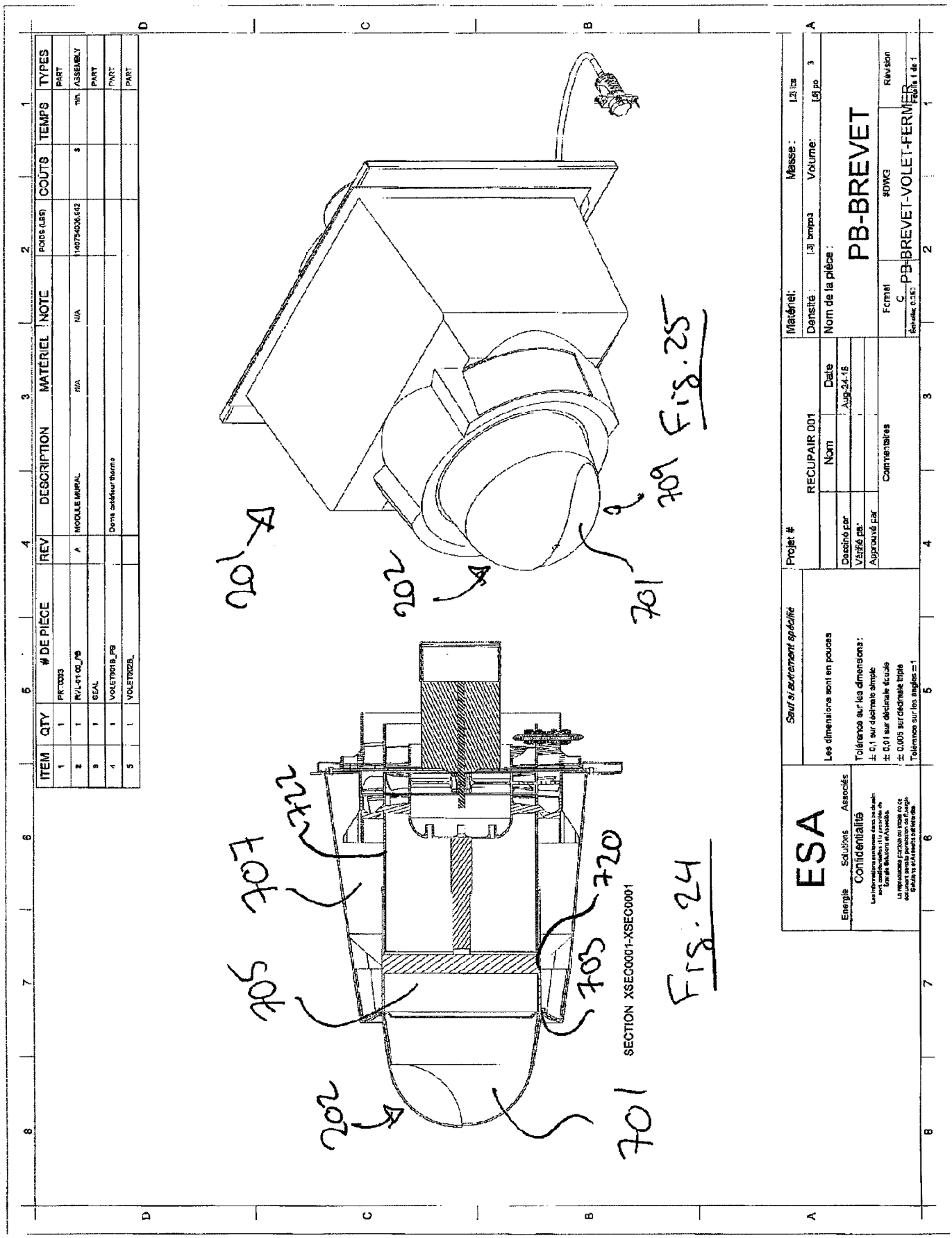
2 | 1 | RVL-01-09_PB | A | MODULE NU RAL | N/A | N/A | 1140734006.842 | $ | min. | ASSEMBLY
3 | 1 | SEAL | | | | | | | | PART
4 | 1 | VOLET01E_PB | | Dome extérieur rivé mm | | | | | | PART
5 | 1 | VOLET1002E | | | | | | | | PART
ESA
Energie Solutions Associés
Confidentialité
Les informations contenues dans ce dessin sont confidentielles et la propriété de Energie Solutions et Associés.
Sauf si autrement spécifié
Les dimensions sont en pouces
Tolérance sur les dimensions :
± 0.1 sur décimale simple
± 0.01 sur décimale double
± 0.005 sur décimale triple
Tolérance sur les angles ±1
Projet #
RECUPAIR 001
Nom
Date
Dessiné par
Aug-24-15
Vérifié par
Approuvé par
Commentaires
Matériel:
Densité :
Masse :
Volume:
Nom de la pièce :
PB-BREVET
Format
#DWG
Révision
C PB-BREVET-VOLET-FERMER
Échelle: 0.250
Feuille 1 de 1
SECTION XSEC0001-XSEC0001
Fig. 23
Fig. 22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1 | 1 | PRT0003 | | | | | | | | PART
2 | 1 | RVL-01-00_PB | A | MODULE MURAL | N/A | N/A | 1140754026.642 | $ | min | ASSEMBLY
3 | 1 | SEAL | | | | | | | | PART
4 | 1 | VOLET0018_PB | | Dans batteur therm | | | | | | PART
5 | 1 | VOLET0028_ | | | | | | | | PART
Seuf si autrement spécifié
Les dimensions sont en pouces
Tolérance sur les dimensions :
± 0,1 sur décimale simple
± 0,01 sur décimale double
± 0,005 sur décimale triple
Tolérances sur les angles ±1
Projet #
RECUPAIR 001
Nom
Date
Dessiné par
Aug-24-16
Vérifié par
Approuvé par
Commentaires
Matériel:
Masse:
Densité :
Volume:
Nom de la pièce :
PB-BREVET
Format
#DWG
Révision
C
PB-BREVET-VOLET-FERMER
Échelle: 0.357
Feuille 1 de 1
ESA
Energie Solutions Associés
Confidentialité
SECTION XSEC0001-XSEC0001
201
202
701
709
720
722
724
726
Fig. 24
Fig. 25

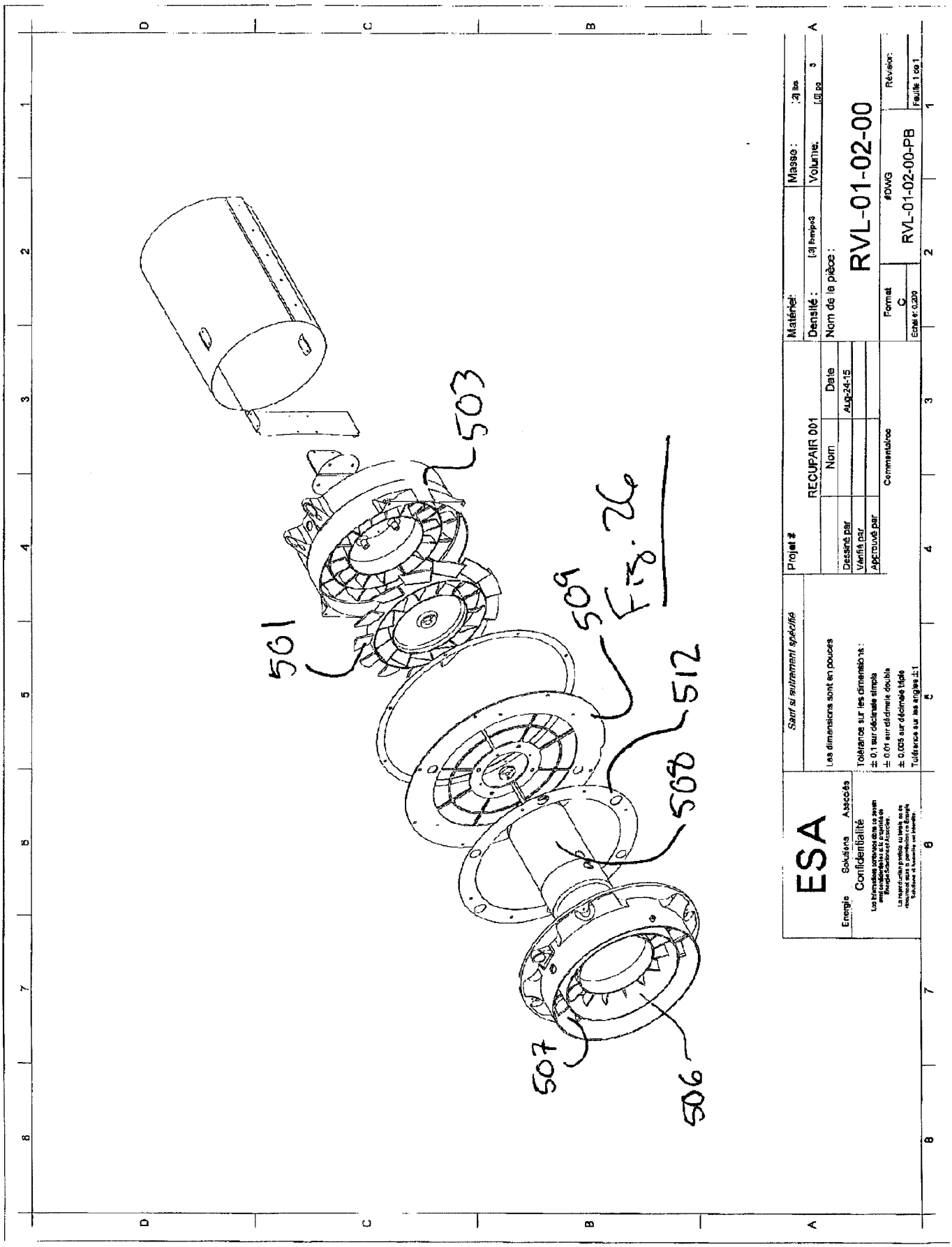
501
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Fig. 2c
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RVL-01-02-00
RECUPAIR 001
RVL-01-02-00-PB
ESA
Confidentialité

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2015/051098

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***F24F 12/00*** (2006.01), ***F04D 29/26*** (2006.01), ***F24F 13/30*** (2006.01), ***F24F 7/06*** (2006.01), ***F28D 7/00*** (2006.01)

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC : F24F 12/00 (2006.01), F04D 29/26 (2006.01), F24F 13/30 (2006.01), F24F 7/06 (2006.01), F28D 7/00 (2006.01)

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

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

DATABASES : Questel Orbit (FAMPAT), Canadian Patent Database (CPD)
KEYWORDS : concentri+ 8d (rotor+ or blade+ or flow or stream), heat 5d exchang+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 297 22 529 U1 (SCHMALHOFER) 22 April 1999 (22-04-1999) * see whole document	1-32
A	US 1,672,272 (MOORE) 5 June 1928 (05-06-1928) * see whole document	1-32
A	US 2,790,596 (STIRLING) 30 April 1957 (30-04-1957) * see whole document	1-32
A	CN 2270915 Y (PAN et al.) 17 December 1997 (17-12-1997) * see whole document	1-32
A	DE 29 39 827 A1 (NICHTNENNUNG) 23 April 1981 (23-04-1981) * see whole document	1-32

☐ Further documents are listed in the continuation of Box C.

☑ See patent family annex.

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search 12 January 2016 (12-01-2016)	Date of mailing of the international search report 25 January 2016 (25-01-2016)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Authorized officer Casey Thomas (819) 639-7907

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2015/051098

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
DE29722529U1	22 April 1999 (22-04-1999)	None	
US1672272A	05 June 1928 (05-06-1928)	None	
US2790596A	30 April 1957 (30-04-1957)	None	
CN2270915Y	17 December 1997 (17-12-1997)	None	
DE2939827A1	23 April 1981 (23-04-1981)	None	