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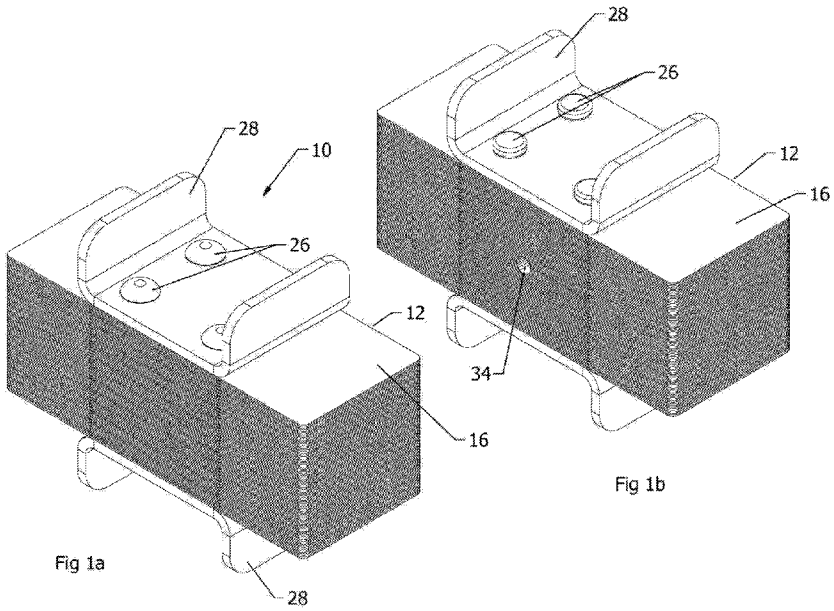

Fig 1a

Fig 1b

(57) Abstract: A heat sink (10) comprising a body (12) having a plurality of parallel fins (16) for dissipation of heat. A central chamber (30) is provided extending through the body (12) and a plurality of channels (36) are provided in the body portion (12). Each channel (36) extends from the central chamber (30) to a space between a pair of adjacent fins (16) such that compressed air delivered to the central chamber (30) flows outwardly through the channels (36) between adjacent fins (16) to draw heat away from the fins (16).

"HEAT SINK AND HEAT DISSIPATION SYSTEM FOR LIGHTING MODULE"

Field of the Invention

[001] The present invention relates to a heat sink and a system for dissipation of heat for a lighting module.

Background to the Invention

[002] Mobile lighting plants generally comprise a trailer mounted generator with a set of high powered lights mounted to a collapsible mast. In the past, the lights generally consisted of metal halide or high pressure sodium units. With advances in technology however, the use of LED lighting is increasingly being utilised for such applications.

[003] The use of LED lighting has a number of advantages over previous lighting units. LED lights have a longer lifetime and increased efficiency in relation to metal halide or high pressure sodium lights. The use of LED lights can therefore result in significant cost savings by reducing the fuel required by the mobile generator. Also, LED lighting can produce more uniform light coverage and does not create the environmental issues associated with disposal of the heavy metals used in metal halide or high pressure sodium lights. A further advantage is the possibility of driving the light units with lower voltage DC power, which can both increase efficiency and result in occupational health and safety benefits.

[004] Despite the numerous advantages of LED lights in mobile lighting applications, there is also a significant drawback in the heat output of such lights. A significant portion of the power consumed by LED lighting is converted to heat and this heat must be effectively dissipated. While the lighting units themselves may be produced in a relatively small size, dissipating the heat via a traditional aluminium fin heat sink can require a

relatively large heat sink arrangement. Some LED luminaires may in fact be significantly larger than the units they replace due to the size of the heat sink. This requires increased engineering requirements for the mast and the trailer to support the LED luminaires.

[005] In order to reduce these engineering requirements and allow the possibility of direct replacement of older luminaires with LED units, other heat dissipation technologies have been employed. Systems with heat pipes and fans for increased airflow over the heat sinks have been used to increase the efficiency of the heat sinks and therefore allow smaller units to be used. However, these fan units are likely to require maintenance due to wear, which can cancel out the advantages of the longer life of the LED lighting units.

[006] The present invention relates to a heat sink and heat dissipation system aimed at overcoming, at least in part, the abovementioned problems.

Summary of the Invention

[007] According to one aspect of the present invention there is provided a heat sink comprising:
a body including a plurality of parallel fins for dissipation of heat;
a central chamber extending through the body; and
a plurality of channels in the body portion, each channel extending from the central chamber to a space between a pair of adjacent fins such that compressed air delivered to the central chamber flows outwardly through the channels between adjacent fins to draw heat away from the fins.

[008] Preferably the body includes a plurality of parallel fins and the central chamber extends through the body transversely to the fins.

[009] In a preferred embodiment, the body comprises a plurality of planar fins and a plurality of planar plates, each plate being located between an adjacent pair of fins, and wherein each of the fins and plates includes an aperture such that the apertures align to form the central chamber.

[010] Preferably the fins extend beyond the extents of the plates such that spaces are defined between adjacent fins and the channels comprise grooves in a side surface of each of the plates extending from the aperture thereof to the space between the fins.

[011] In one embodiment, the fins and plates are rectangular such that each of the plates includes parallel sides aligned with adjacent sides of the fins and parallel ends offset inwardly from adjacent parallel ends of the fins.

[012] Preferably the channels extend outwardly from the apertures in the plates to each of the ends thereof.

[013] In a preferred embodiment, the apertures in the fins and the plates are located generally centrally between the sides and generally centrally between the ends.

[014] In a preferred embodiment, each of the grooves include a first portion which narrows from adjacent the aperture to a neck portion and a second portion which tapers outwardly from the neck portion to the end of the plate to spread the outwardly flowing air evenly across the surface of the adjacent pair of fins.

[015] Preferably an air inlet is provided via which compressed air may be delivered to the central chamber.

[016] Preferably the body acts as a heat sink for a component to be situated adjacent a first of the sides of the fins and plates and wherein the air inlet comprises a duct extending inwardly from a second of the sides of the fins and plates into the central chamber.

[017] In one embodiment, the duct is located generally midway between the endmost fins of the body adjacent a midpoint of the second of the sides and extends inwardly towards the central chamber perpendicular to the central chamber.

[018] In accordance with a second aspect of the present invention, there is provided a heat dissipation system for a lighting unit comprising a generator

and one or more light modules powered by the generator, the heat dissipation system comprising:

a power recovery unit in communication with an exhaust system of the generator;

a compressor in communication with the power recovery unit such that energy generated by the power recovery unit from the exhaust system drives the compressor to provide a source of compressed air; and

an air conduit provided from the compressor to each light module;

wherein the air conduit is arranged to deliver compressed air to a heat sink of each of the light modules such that the compressed air flows across the heat sink to aid in heat dissipation.

[019] Preferably each of the heat sinks includes a body having a plurality of parallel fins for dissipation of heat, a central chamber extending through the body and a plurality of channels extending from the central chamber to spaces between pairs of adjacent fins such that compressed air delivered to the central chamber flows outwardly through the channels between adjacent fins to draw heat away from the fins.

[020] Preferably the air conduit is distributed to each of the light modules via an accumulator.

[021] Preferably the exhaust line is fitted with a waste gate to allow exhaust gas to bleed off in the event that more energy is available from the engine than required.

[022] In accordance with a third aspect of the present invention, there is provided mobile lighting plant comprising:

a generator mounted on a trailer;

an extendible tower mounted to the trailer;

one or more light modules secured to the tower;

a power recovery unit in communication with an exhaust system of the generator;

a compressor in communication with the power recovery unit such that energy generated by the power recovery unit from the exhaust system drives the compressor to provide a source of compressed air; and

an air conduit provided from the compressor to each light module;

wherein the air conduit is arranged to deliver compressed air to a heat sink of each of the light modules such that the compressed air flows across the heat sink to aid in heat dissipation.

Brief Description of the Drawings

[023] The invention will now be described, by way of example, with reference to the following drawings, in which:

[024] Figure 1a is a front upper perspective view of a heat sink in accordance with the first aspect of the present invention;

[025] Figure 1b is a rear lower perspective view of the heat sink of Figure 1;

[026] Figure 2 is an exploded view of the heat sink of Figure 1;

[027] Figure 3a is a side view of the heat sink of Figure 1;

[028] Figure 3b is an end view of the heat sink of Figure 1;

[029] Figure 3c is a close up view of detail D of Figure 3b;

[030] Figure 4a is a side view of the heat sink of Figure 1;

[031] Figure 4b is a cross sectional view of the heat sink of Figure 4a though the line A-A;

[032] Figure 4c is a perspective cross sectional view of the heat sink of Figure 4a through the line A-A;

[033] Figure 5a is a close up view of Detail B of Figure 4c;

[034] Figure 5b is a top view of a plate of the heat sink of Figure 1;

[035] Figure 5c is a cross sectional view of the plate of Figure 5b through the line C-C;

[036] Figure 6 is an exploded view of a light module formed from the heat sink of Figure 1;

[037] Figure 7a is an upper front perspective view of the light module of Figure 6;

[038] Figure 7b is an upper rear perspective view of the light module of Figure 6; and

[039] Figure 8 is a system diagram of a heat dissipation system in accordance with the second aspect of the present invention

Detailed Description of Preferred Embodiments

[040] Referring to the Figures, there is shown a heat sink 10 comprising a body 12 to which may be attached a light unit 14 from which heat is to be dissipated. The body 12 includes a plurality of fins 16 which are arranged parallel to each other such that heat may be dissipated from the surfaces of the fins 16.

[041] The body 12 is formed by a plurality of fins 16 and a plurality of plates 18. Each of the fins 16 and each of the plates 18 comprises a planar member with a plate 18 being located between each adjacent pair of fins 16.

[042] In the embodiment shown, each of the fins 12 is rectangular in shape and therefore includes opposed parallel sides 20 and opposed parallel ends 21. Each of the plates 18 is also rectangular and therefore also includes opposed parallel sides 22 and opposed parallel ends 23. The sides 22 of the plates 18 are located adjacent and parallel to the sides 20 of the fins 16. The ends 23 of the plates 18 are located parallel to and offset inwardly from the ends 21 of the fins 16. When assembled, spaces are therefore defined between each adjacent pair of fins 16 between the ends 23 of the plates 18 and the ends 21 of the fins 16

[043] Each of the fins 16 and the plates 18 includes a plurality of holes 24 therein. The holes 24 of each of the fins 16 and plates 18 align when the heat sink 10 is assembled to receive fasteners 26. End plates 28 are provided adjacent the outermost fins 16. The end plates 28 also include holes 24 for receiving the fasteners 26. The heat sink 10 is assembled by compressing the fins 16 and plates 18 between the end plates 28 to fully engage the fins 16 and plates 18 and improve heat conduction between the fins 16. The fasteners 26, which may comprise clamping rivets, are then secured through

the holes 24 to lock the fins 16 and plates 18 together to form the body 12 of the heat sink 10.

[044] The body 12 is provided to act as a heat sink for a component to be situated adjacent a first of the sides 20 of the fins and plates 16 and 18. The component is to be secured generally adjacent a midpoint of the first of the sides 20 as can be seen, for example, in Figure 6.

[045] The body 12 of the heat sink 10 is provided with a central chamber 30. The central chamber 30 extends through the body 12 transversely to the fins 16 and the plates 18. The central chamber 30 is formed in the embodiment shown by an aperture 32 provided in each of the fins 16 and plates 18. The aperture 32 is located generally centrally on each fin 16 and plate 18 between the sides 20, 22 and generally centrally between the ends 21, 23. The apertures 32 of each of the fins 16 and plates 18 align to form the central chamber 30 when the fins 16 and plates 18 are secured together.

[046] An air inlet is provided via which compressed air may be delivered to the central chamber 30. In the embodiment shown, the air inlet comprises a duct 34 located generally midway between the endmost fins 16 of the body 12. The duct 34 extends generally perpendicular to the central chamber 30 and extends inwardly towards the central chamber 30 from adjacent a midpoint of a second of the sides 20 of the fins and the plates 16 and 18. In the embodiment shown, the duct 34 comprises a cylindrical bore.

[047] The body 12 is provided also with a plurality of channels 36, wherein each channel 36 is in communication with the central chamber 30 and one of the spaces defined between an adjacent pair of fins 16. In the embodiment shown, there is provided a plurality of channels 36 located between each adjacent pair of fins 16. The channels 36 are provided to allow compressed air delivered to the central chamber 30 to flow outwardly into the spaces between the adjacent pairs of fins 16.

[048] In the embodiment shown, the channels 36 are provided as grooves 37 in a side surface of each of the plates 18. The grooves 37 extend from the aperture 32 of the plate 18 outwardly to the ends 23 of the plates 18. As can

be seen in the Figures, there are provided a plurality of grooves 37 extending from the aperture 32 to a first of the ends 23 and a plurality of grooves 37 extending from the aperture 32 to a second of the ends 23.

[049] The grooves 37 are each shaped to provide efficient spread of the air flow exiting outwardly across the surfaces of the fins 16. The grooves 37 in the embodiment shown include a first portion 38 which narrows from adjacent the aperture 32 to a neck portion 39 and a second portion 40 which tapers outwardly from the neck portion 39 to the end 23 of the plate 18 (as best seen in Figure 5b). The outwardly tapered second portions 40 of the grooves 37 may be used to spread the outwardly flowing air evenly across the surface of the adjacent pair of fins 16 to maximise dissipation of heat from the fins 16.

[050] A light module 15 is formed by connection of a light unit 14 to the heat sink 10 of the present invention. The light unit 14 is secured to the heat sink 10 adjacent the sides 20 of the fins 16 and plates 18 as can be seen in Figure 6. The light unit comprises a first casing half 42 located adjacent the first of the sides 20 and a second casing half 43 located adjacent the second of the sides 20. The first and second casing halves 42 and 43 are secured together around the heat sink 10. An LED chip 44 is located between the first casing half 42 and the heat sink 10 adjacent the heat sink 10. The LED chip 44 forms the light source of the light module 15. Between the LED chip 44 and the first casing half 42 are provided a lens back plate 46, a lens adaptor 48 and a lens 50.

[051] Casing diffuser mesh 54 is provided adjacent the endmost fins 16 on either side of the end plates 28, as can be seen in Figure 6. The light module 15 is also mounted to a mounting bracket 58.

[052] An adaptor plate 52 is provided between the second of the sides 20 of the heat sink 10 and the second casing half 43. The adapter plate 52 includes an opening 53 in communication with the duct 34 such that compressed air may pass through the opening 53 into the duct 34. An inlet fitting 56 is provided for connection to the opening 53 to allow connection to a source of compressed air.

[053] The inlet fitting 56 also provides for electrical connection to power the light module 15. A single coaxial construction is used comprising an air conduit and conducting cables which are terminated by the inlet fitting 56. In this way, the number of cables required for connection to the lighting module 15 is reduced.

[054] Figure 8 shows a system 100 for dissipation of heat in accordance with the second aspect of the present invention, the system 100 incorporates light modules 15 having heat sinks 10 of the type described above. The system 100 of Figure 8 is provided to supply a source of compressed air to the central chambers 30 of each of the heat sinks 10.

[055] The system 100 is utilised with a generator 102 which is provided to supply electrical power to the light modules 15. The generator 102 comprises an engine 104 and a DC generator 105 which together supply electrical power to the light modules 15 via a driver box 106.

[056] The system 100 of the invention comprises a power recovery turbine 108, a compressor 110 and an air conduit 112. The power recovery turbine 108 is provided connected to the exhaust line 114 of the engine 104. The power recovery turbine 108 is arranged such that the exhaust gas stream from the engine 104 drives the power recovery turbine. The power recovery turbine 108 is then connected to the compressor 110 such that the compressor 110 is driven to create a supply of compressed air delivered to the air conduit 112. The air conduit 112 is distributed to each of the light modules 15 via an accumulator 116.

[057] The exhaust line 114 is fitted with a waste gate 118. The waste gate 118 is provided to allow exhaust gas to bleed off in the event that more energy is available from the engine than required, thereby relieving load on the engine 104. An over-run clutch 120 is also provided between the power recovery turbine 108 and the compressor 110.

[058] The system 100 of the second aspect of the present invention thereby allows provision of compressed air to be used for cooling of the light modules 15 by utilising only energy of the exhaust system of the engine 104. More

efficient cooling can therefore be achieved without increased power usage. The heat sinks 10 of the present invention also provide increased cooling efficiency by using this compressed air and generating an even flow of compressed air outwardly over the fins 16 from the centre of the body 12 of the heat sink 10. Such an arrangement allows a significant reduction in the size of the heat sinks 10 required. The heat sink 10 and system 100 therefore allow for more effective use of an LED based mobile lighting plant.

[059] It will be readily apparent to persons skilled in the relevant arts that various modifications and improvements may be made to the foregoing embodiments, in addition to those already described, without departing from the basic inventive concepts of the present invention.

Claims

1. A heat sink comprising:
a body including a plurality of parallel fins for dissipation of heat;
a central chamber extending through the body; and
a plurality of channels in the body portion, each channel extending from the central chamber to a space between a pair of adjacent fins such that compressed air delivered to the central chamber flows outwardly through the channels between adjacent fins to draw heat away from the fins.

2. A heat sink in accordance with claim 1, wherein the body includes a plurality of parallel fins and the central chamber extends through the body transversely to the fins.

3. A heat sink in accordance with claim 2, wherein the body comprises a plurality of planar fins and a plurality of planar plates, each plate being located between an adjacent pair of fins, and wherein each of the fins and plates includes an aperture such that the apertures align to form the central chamber.

4. A heat sink in accordance with claim 3, wherein the fins extend beyond the extents of the plates such that spaces are defined between adjacent fins and the channels comprise grooves in a side surface of each of the plates extending from the aperture thereof to the space between the fins.

5. A heat sink in accordance with claim 4, wherein the fins and plates are rectangular such that each of the plates includes parallel sides aligned with adjacent sides of the fins and parallel ends offset inwardly from adjacent parallel ends of the fins.

6. A heat sink in accordance with claim 5, wherein the channels extend outwardly from the apertures in the plates to each of the ends thereof.

6. A heat sink in accordance with claim 5 or 6, wherein the apertures in the fins and the plates are located generally centrally between the sides and generally centrally between the ends.

7. A heat sink in accordance with any one of claims 4 to 6, wherein each of the grooves include a first portion which narrows from adjacent the aperture to a neck portion and a second portion which tapers outwardly from the neck portion to the end of the plate to spread the outwardly flowing air evenly across the surface of the adjacent pair of fins.

8. A heat sink in accordance with any one of the preceding claims, wherein an air inlet is provided via which compressed air may be delivered to the central chamber.

9. A heat sink in accordance with claim 8, wherein the body acts as a heat sink for a component to be situated adjacent a first of the sides of the fins and plates and wherein the air inlet comprises a duct extending inwardly from a second of the sides of the fins and plates into the central chamber.

10. A heat sink in accordance with claim 9, wherein the duct is located generally midway between the endmost fins of the body adjacent a midpoint of the second of the sides and extends inwardly towards the central chamber perpendicular to the central chamber.

11. A heat dissipation system for a lighting unit comprising a generator and one or more light modules powered by the generator, the heat dissipation system comprising:

a power recovery unit in communication with an exhaust system of the generator;

a compressor in communication with the power recovery unit such that energy generated by the power recovery unit from the exhaust system drives the compressor to provide a source of compressed air; and

an air conduit provided from the compressor to each light module;

wherein the air conduit is arranged to deliver compressed air to a heat sink of each of the light modules such that the compressed air flows across the heat sink to aid in heat dissipation.

12. A heat dissipation system in accordance with claim 11, wherein each of the heat sinks includes a body having a plurality of parallel fins for dissipation of heat, a central chamber extending through the body and a plurality of channels extending from the central chamber to spaces between pairs of adjacent fins such that compressed air delivered to the central chamber flows outwardly through the channels between adjacent fins to draw heat away from the fins.

13. A heat dissipation system in accordance with claim 11 or 12, wherein the air conduit is distributed to each of the light modules via an accumulator.

14. A heat dissipation system in accordance with any one of claims 11 to 13, wherein the exhaust line is fitted with a waste gate to allow exhaust gas to bleed off in the event that more energy is available from the engine than required.

15. A mobile lighting plant comprising:
a generator mounted on a trailer;
an extendible tower mounted to the trailer;
one or more light modules secured to the tower;
a power recovery unit in communication with an exhaust system of the generator;
a compressor in communication with the power recovery unit such that energy generated by the power recovery unit from the exhaust system drives the compressor to provide a source of compressed air; and
an air conduit provided from the compressor to each light module;
wherein the air conduit is arranged to deliver compressed air to a heat sink of each of the light modules such that the compressed air flows across the heat sink to aid in heat dissipation.

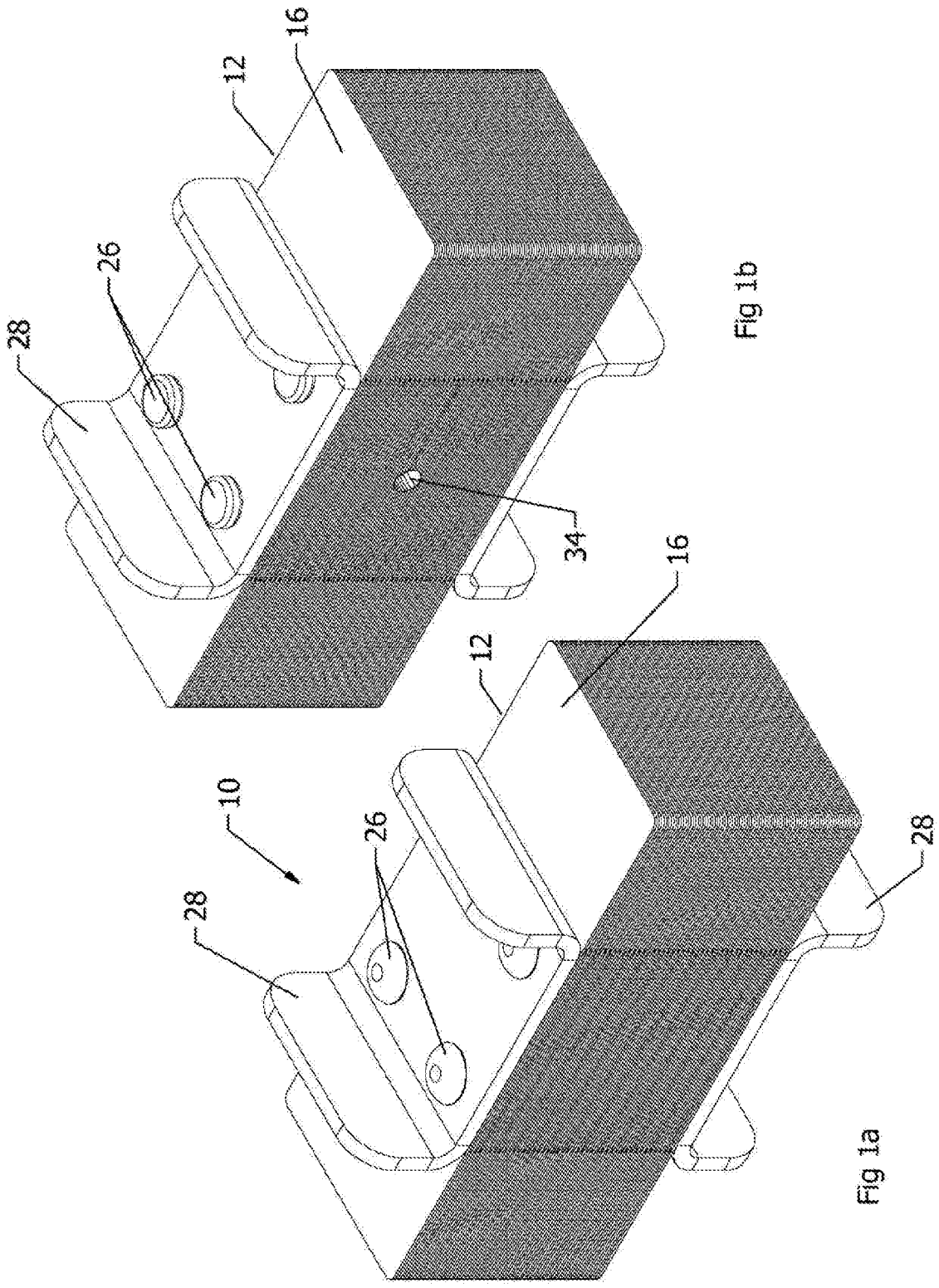

Fig 1b

Fig 1a

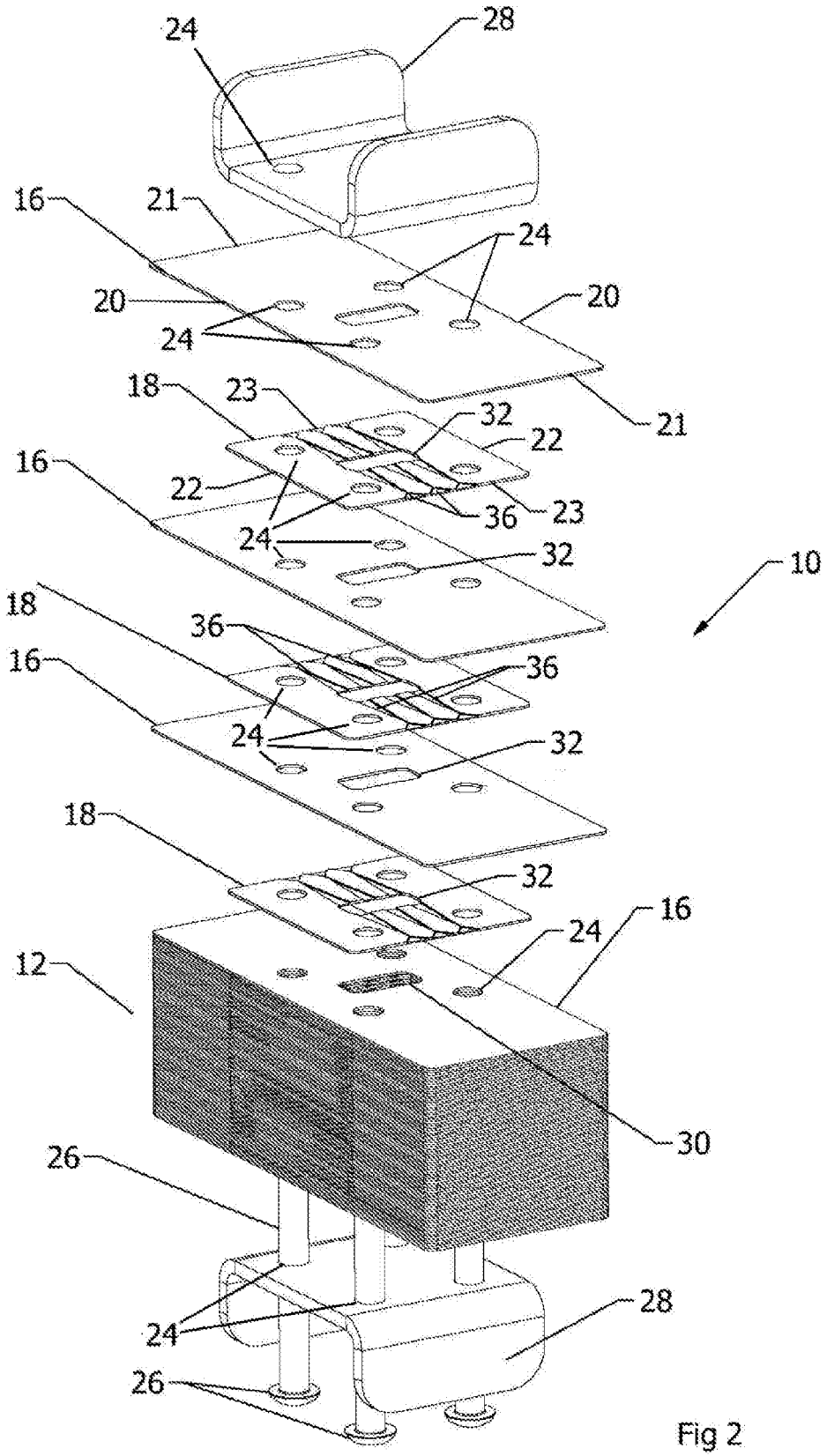
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Fig 2

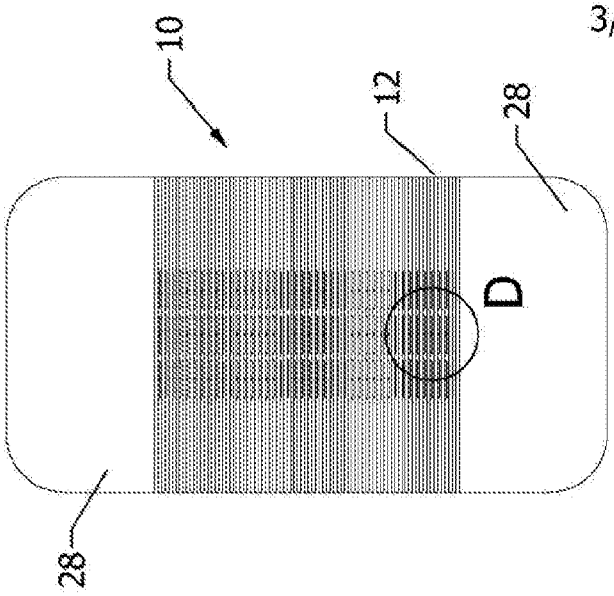


Fig 3b

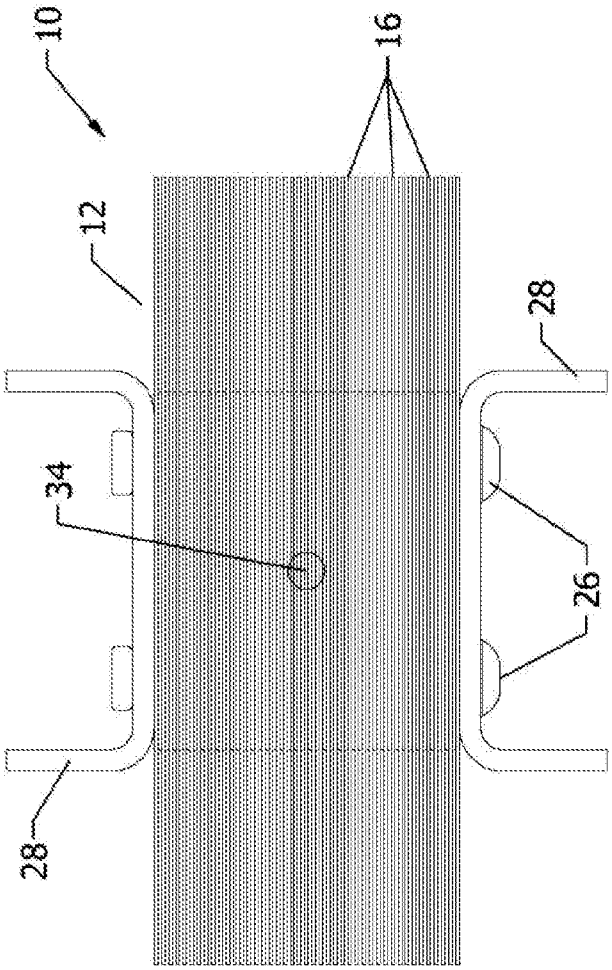


Fig 3a

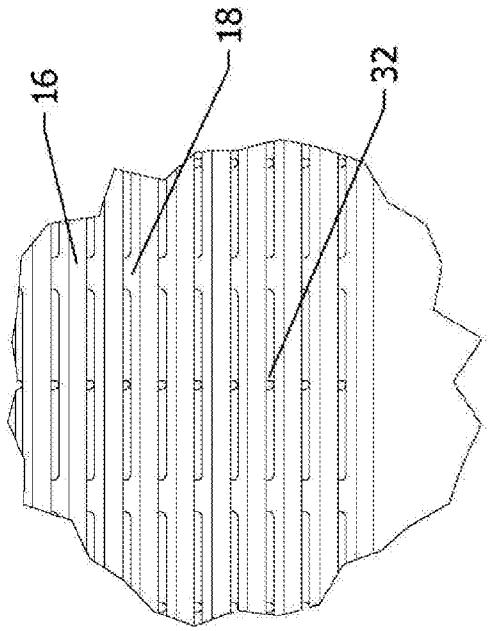


Fig 3c

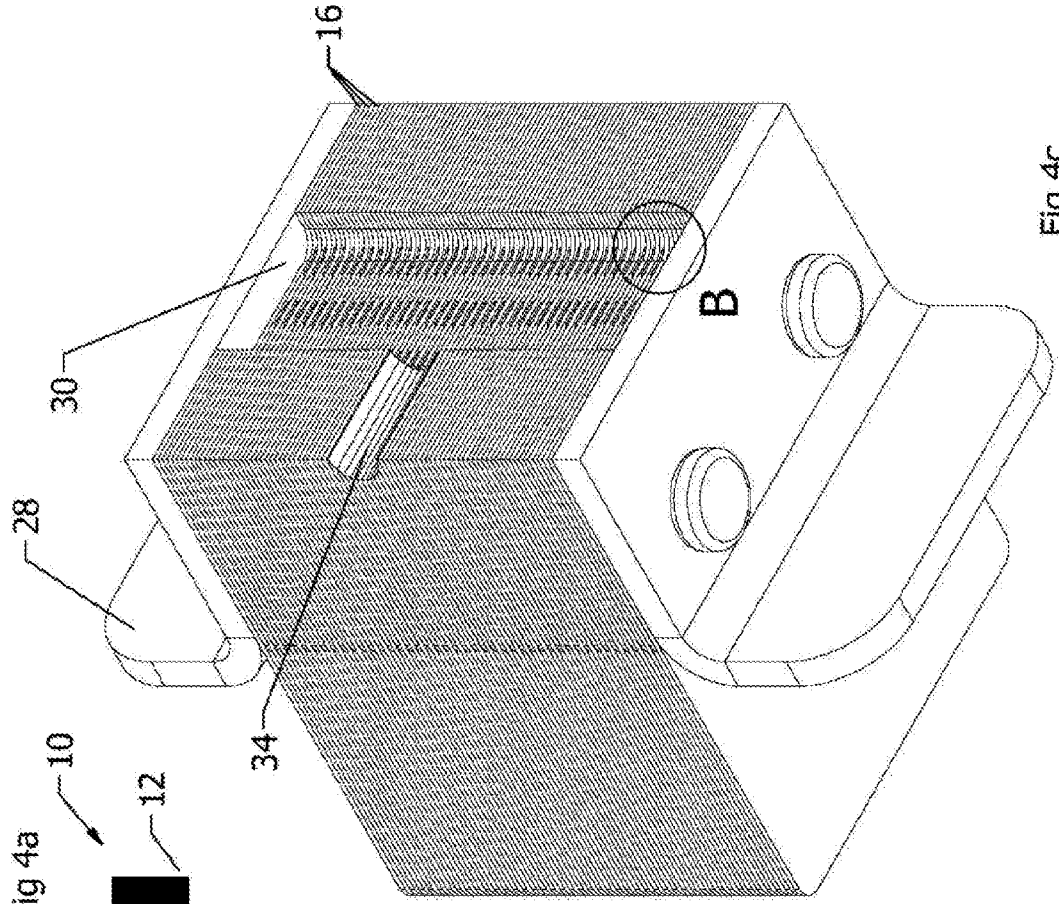


Fig 4c

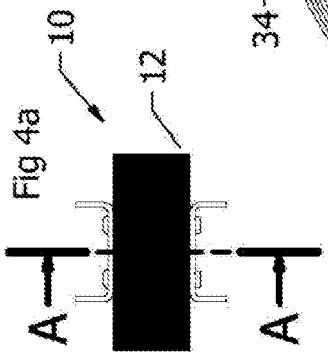


Fig 4a

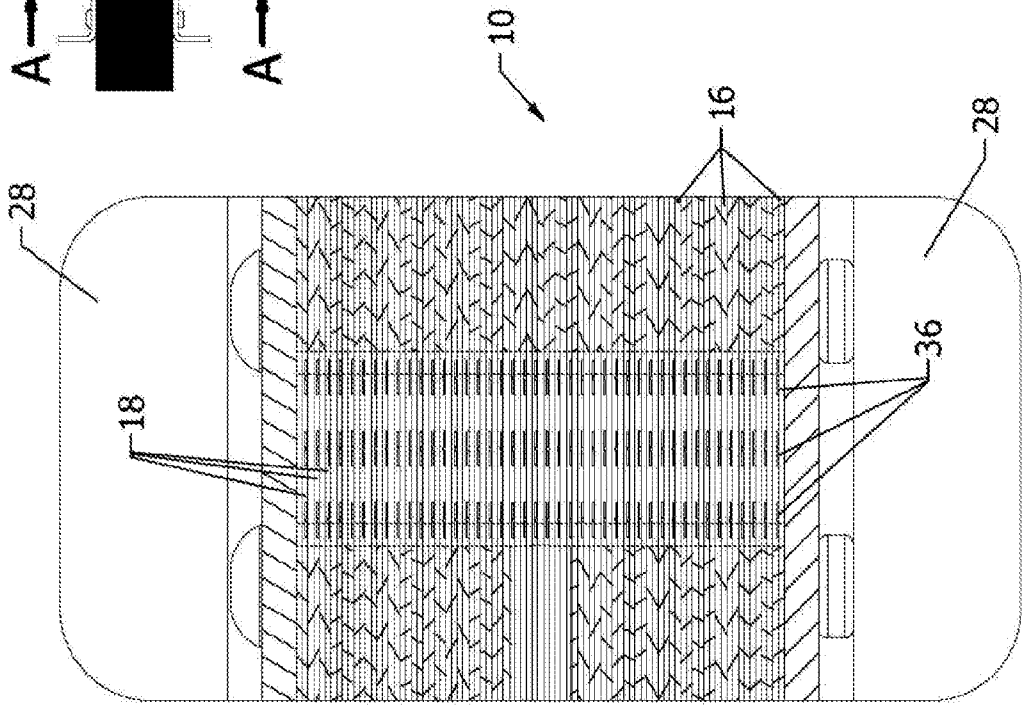


Fig 4b

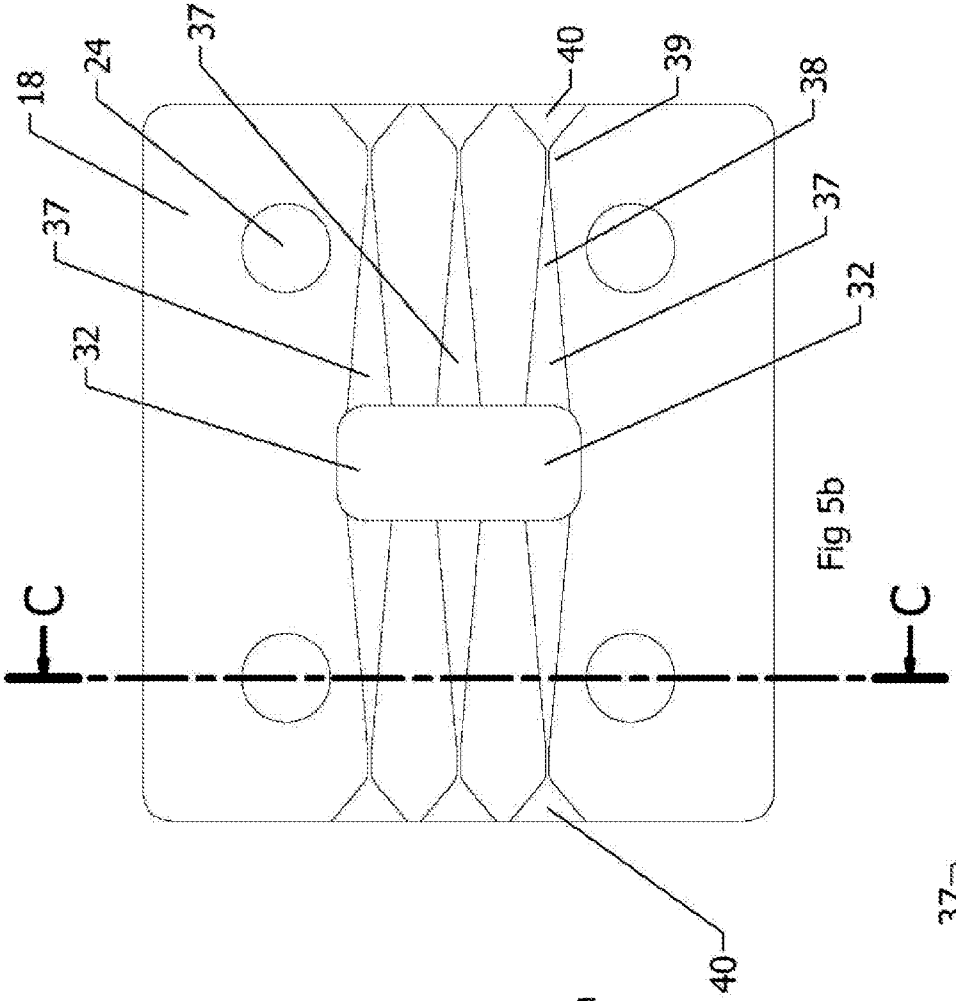


Fig 5a

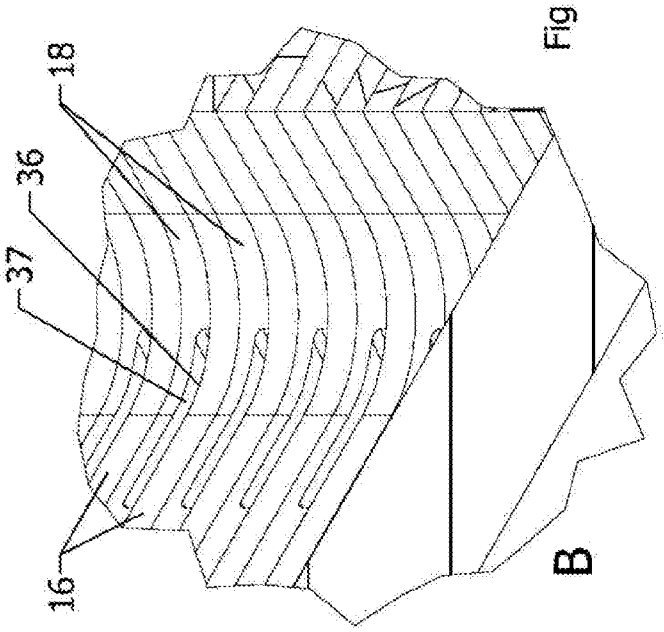
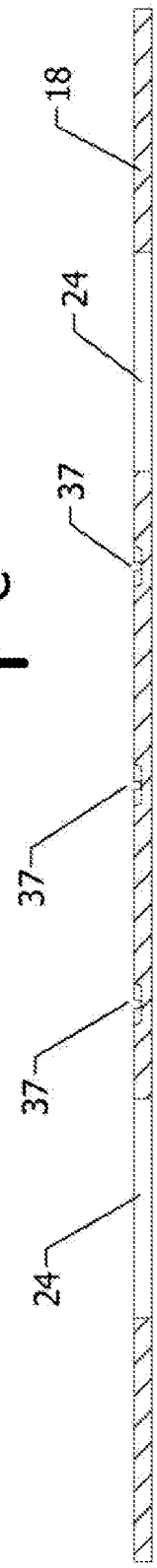


Fig 5b



C-C

Fig 5c

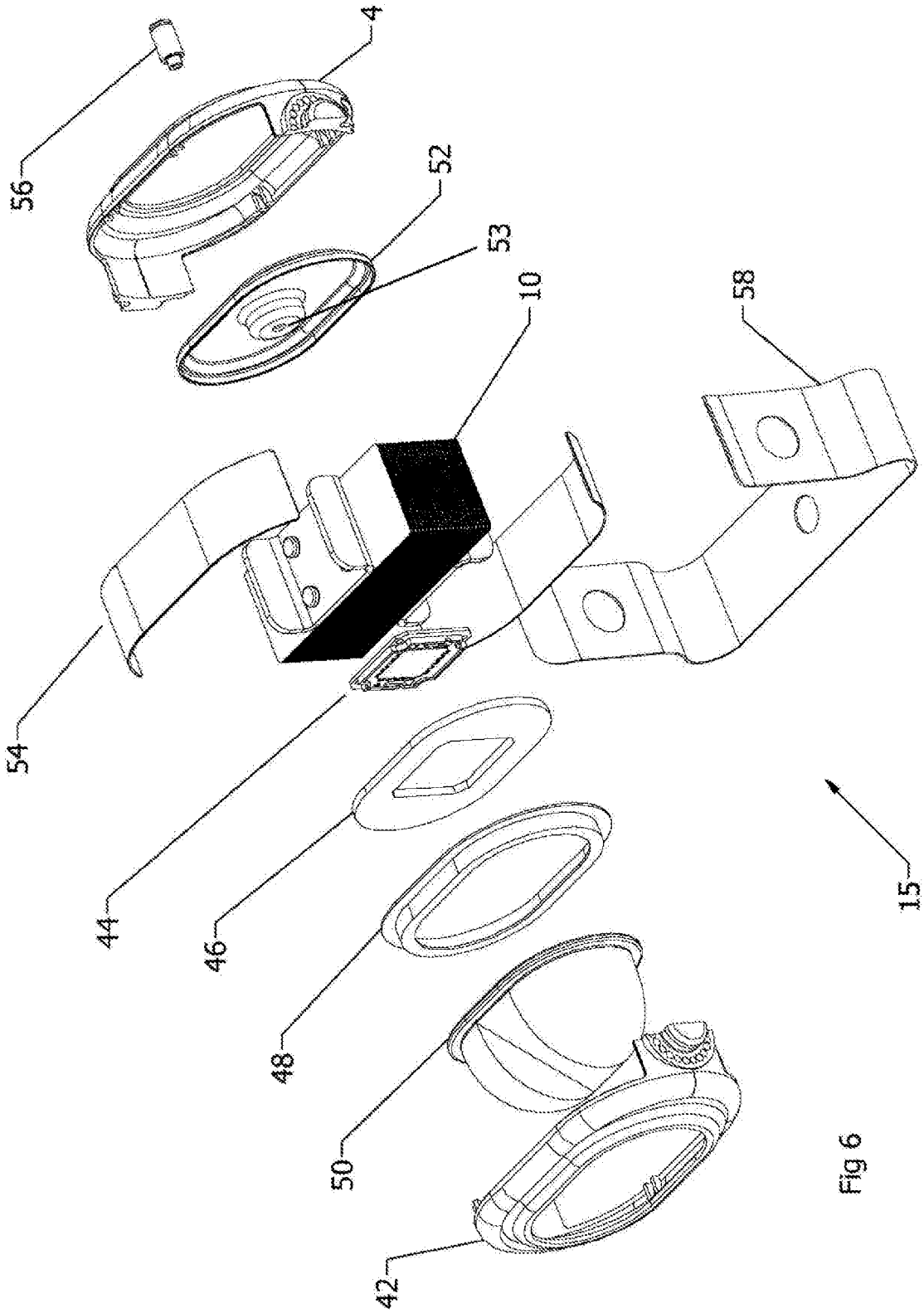


Fig 6

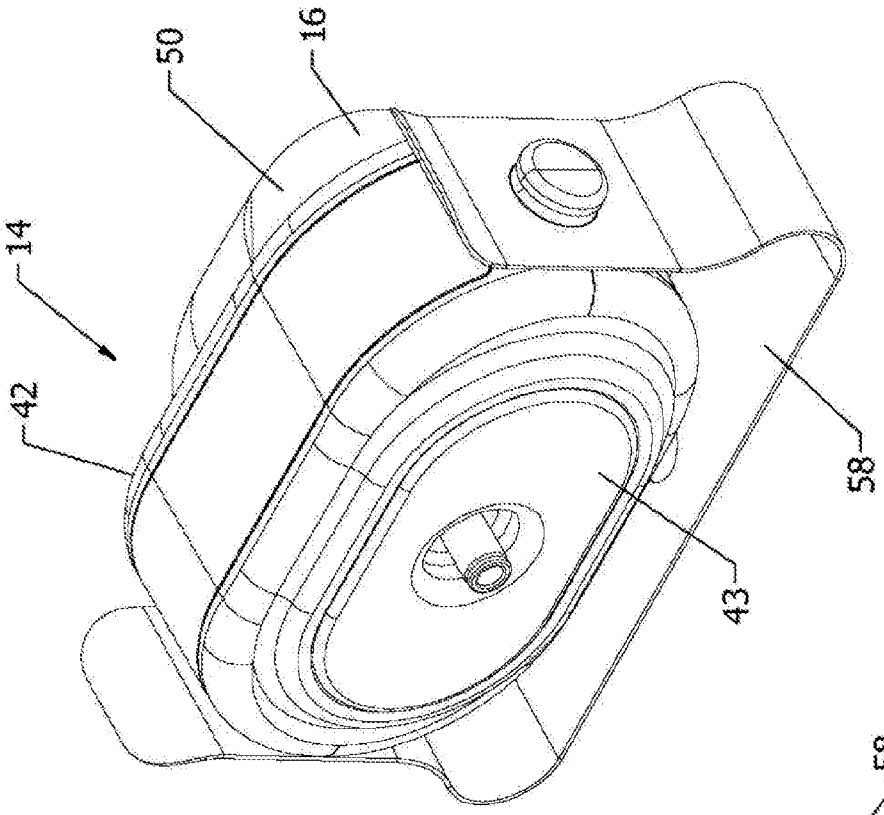


Fig 7b

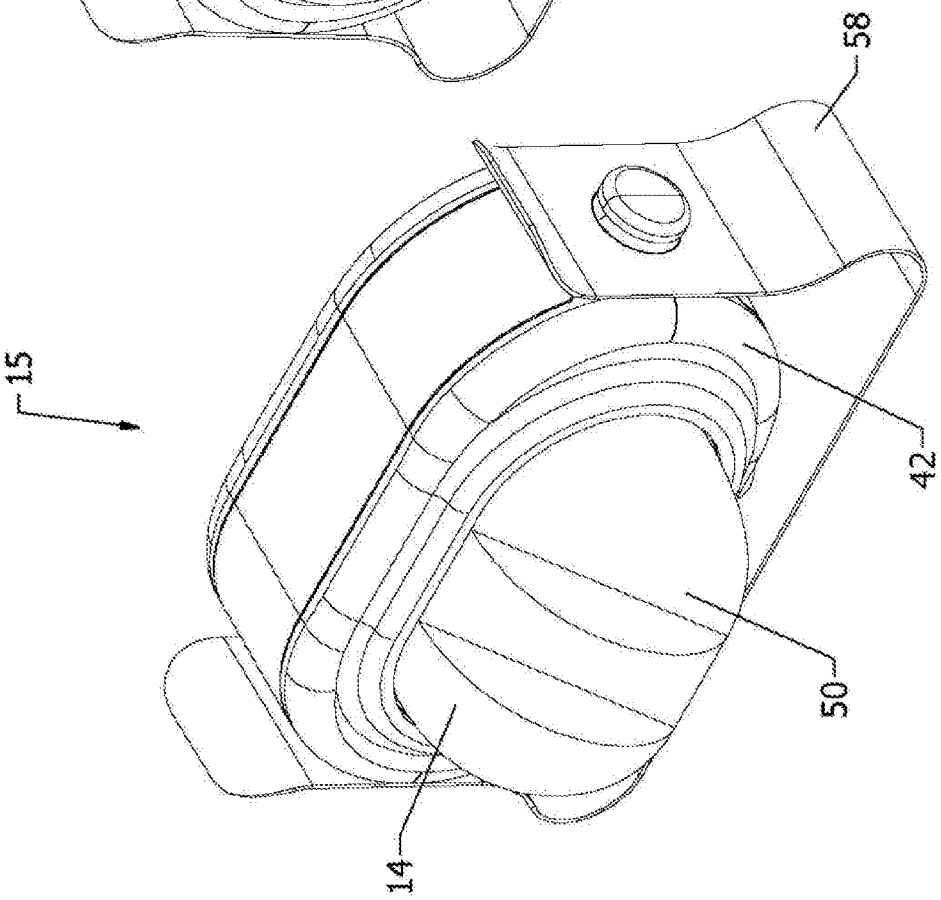
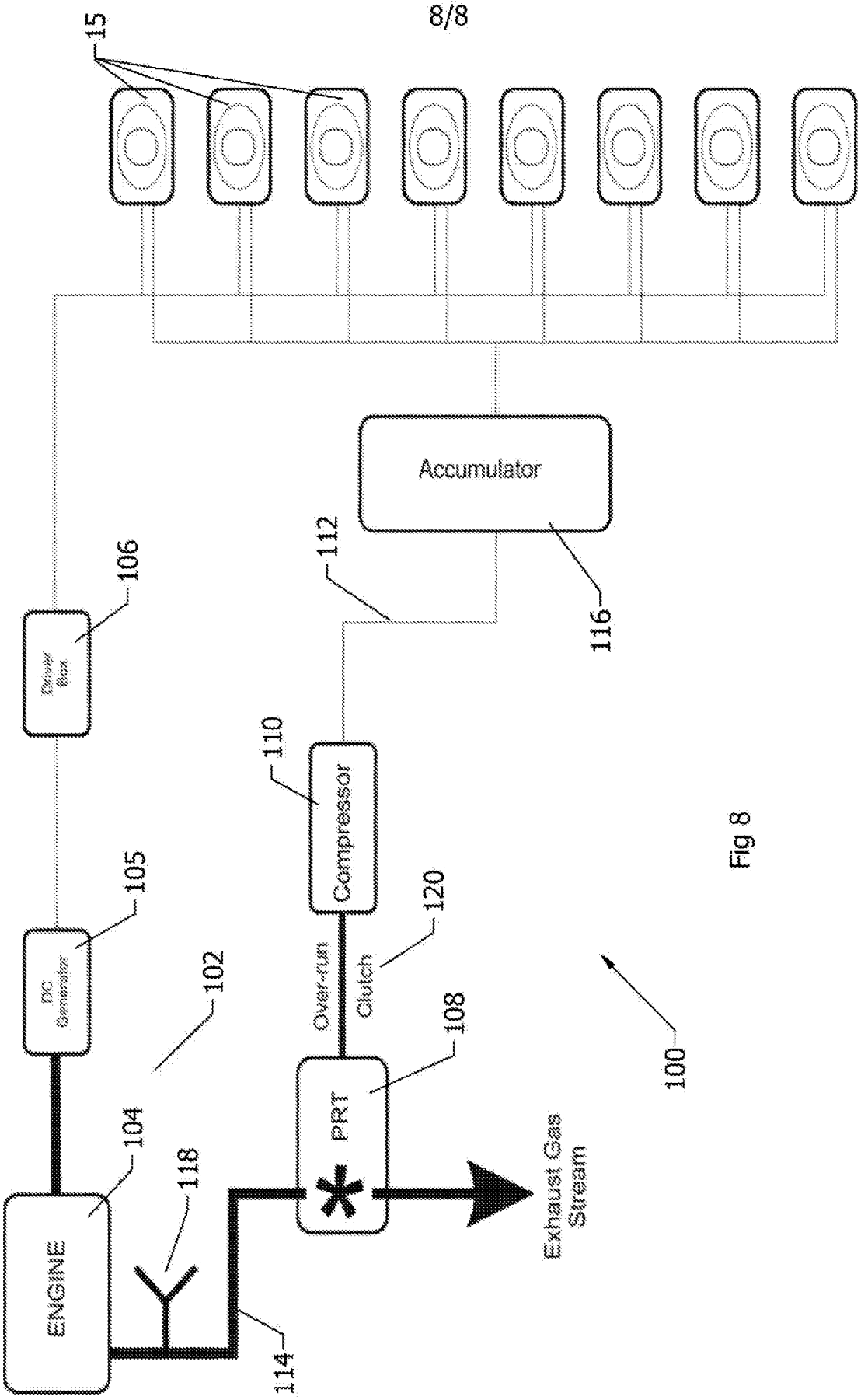


Fig 7a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Accumulator
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Driver Box
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Compressor
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DC Generator
120
Over-run Clutch
102
108
PRT
100
104
118
ENGINE
Exhaust Gas Stream
114

Fig 8