a cooling system designed according to the climate of where the wind turbine is installed, i.e. to maximize power and efficiency of the electric machine according to the climate at the installation site.

Designing and building wind turbines according to the climate at the installation site, the scale economies made possible by mass production of the wind turbine component parts are greatly reduced.

In this respect, known cooling systems are not particularly versatile and perform poorly as regards cooling the electric generator.

To eliminate this drawback, the Applicant's Patent Application EP 2,354,542 proposes a rotor liquid cooling system with a tubular structure fitted with heat exchangers.

This system is highly effective and versatile, but the heat exchangers increase the weight of the rotor and are located on the opposite side to the active segments.

The active segments as disclosed in documents EP 2,378,631 and EP 2,109,208 normally comprise a laminated pack; and an active member normally defined by a coil or

a block of permanent magnets and housed inside a seat on the laminated pack.

One drawback observed by the Applicant is the failure of known cooling systems to maintain an even temperature along the active segment. In fact, the temperature varies widely between a maximum and minimum value.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide an active segment of a wind turbine rotary electric machine, designed to eliminate the drawbacks of the known art.

According to the present invention, there is provided an active segment of a wind turbine rotary electric machine, wherein the active segment is selectively and prismatically connectable to a tubular structure of a rotary electric machine, extends between two opposite ends to form, together with other active segments, an annular active part about an axis of rotation, and comprises a laminated pack; at least one active member, which extends axially, is fitted inside a

seat of the laminated pack, and comprises an electric coil having two U-shaped portions projecting from opposite sides of the laminated pack and defining two opposite ends of the active member; the active segment being characterized by comprising at least two heat pipes located at the opposite sides to cool the opposite ends of the active member partly inside the gaps formed by the U-shaped portions) and the laminated pack; wherein each heat pipe has one end located close to a cooling channel.

Tests by the Applicant show the temperature to be highest at the ends of the active member. So, providing a heat exchanger at one end of an active segment cools the hottest area of the active segment, provides for a more even temperature along the active segment, and improves performance of the rotary electric machine.

Each heat exchange member is preferably straight for easy handling and installation.

In a preferred embodiment of the present invention, the heat exchange member extends in a direction crosswise to the axial direction, preferably radially

with respect to the axis of rotation.

As a result, heat is removed crosswise to the axial direction along which the heat-generating active member extends.

In a preferred embodiment of the present invention, the heat exchange member is positioned contacting the active member. As a result, part of the heat is transmitted by direct conduction between the end of the active member and the heat exchange member.

To optimize its efficiency, cooling channels are formed in the rotary electric machine. Locating one end of the heat exchange member close to a cooling channel improves cooling of the active part. The cooling channel may be traversed by liquid or gas. If the cooling channel is traversed by a liquid, the heat exchange member is positioned contacting the heat exchanger. If the cooling channel is traversed by a gas, the heat exchange member may easily be exposed to the gas flow along the cooling channel. For example, the air gap of the rotary electric machine may define an annular cooling channel when traversed by gas, preferably air.

Moreover, the air gap is located close to the active member, so one end of the heat exchange member may easily be exposed to the gas flow.

Alternatively, the active segment comprises at least one cooling channel housed at least partly in the laminated pack. So, this cooling channel may also be used easily for the heat exchange member.

The active segment preferably comprises a pipe, which extends parallel to the active member, is housed in the laminated pack, and defines the cooling channel. As a result, the cooling channel is able to cool the whole of the active member, the laminated pack, and the ends of the active member. The pipe may be housed inside a groove on the laminated pack, or be fully enclosed in the laminated pack.

In a preferred embodiment of the present invention, the pipe has two opposite ends fitted with members for compressing the laminated pack.

CLAIMS

1) An active segment of a wind turbine rotary electric machine, wherein the active segment (24; 43) is selectively and prismatically connectable to a tubular structure (10) of a rotary electric machine (4), extends between two opposite ends to form, together with other active segments (24; 43), an annular active part (11) about an axis of rotation (A), and comprises a laminated pack (30; 44); at least one active member (31; 45), which extends axially, is fitted inside a seat of the laminated pack (30; 44), and comprises an electric coil having two U-shaped portions (33; 47) projecting from opposite sides of the laminated pack (30; 44) and defining two opposite ends of the active member (31; 45); and at least two heat pipes (40; 41; 42; 55) located at the opposite sides to cool the opposite ends of the active member (31; 45) partly inside the gaps (34; 48) formed by the U-shaped portions (33; 47) and the laminated pack (30; 44), wherein each heat pipe (40; 41; 42; 55) has one end located close to a cooling channel (29; T; 51).

2) An active segment as claimed in Claim 1, wherein each heat pipe (40; 41; 42; 55) is straight.

3) An active segment as claimed in any one of the foregoing Claims, wherein the heat pipe (40; 41; 42; 55) extends in a direction crosswise to the axial direction,

preferably radially with respect to the axis of rotation.

4) An active segment as claimed in any one of the foregoing Claims, wherein the heat pipe (40; 41; 42; 55) is positioned contacting the active member (31; 45).

5) An active segment as claimed in any one of the foregoing Claims, wherein the laminated pack (30; 44) is designed to support a plurality of active members (31; 45), each having two opposite ends projecting from opposite sides of the laminated pack (30; 44); the active segment (24; 43) comprising at least one heat pipe (40; 41; 42; 55) at each end of the active member (31; 45).

6) An active segment as claimed in any one of the foregoing Claims, and comprising at least one cooling channel (29; 51) housed at least partly in the laminated pack (30; 44).

7) An active segment as claimed in Claim 6, and comprising a pipe (36; 56), which extends parallel to the active member (31; 45), is housed in the laminated pack (30; 44), and defines the cooling channel (29; 51).

8) An active segment as claimed in Claim 7, wherein the pipe (56) is fully enclosed in the laminated pack (44).

9) An active segment as claimed in Claim 7 or 8, wherein the pipe (56) has two opposite ends (57) fitted

with members for compressing the laminated pack (44).

10) An active segment as claimed in any one of Claims 7 to 9, and comprising a plurality of parallel cooling channels (29; 51) housed in the laminated pack (30; 44).

11) An active segment as claimed in Claim 10, and comprising a plurality of pipes (36; 56) housed in the laminated pack (30; 44) and defining respective cooling channels (29; 51).

12) An active segment as claimed in Claim 10 or 11, and comprising a bend (37; 52) connecting the cooling channels (29; 51) and located outside the laminated pack (30; 44).

13) A segmented rotary electric machine for a wind turbine, comprising a rotor (9), and a stator (8) which comprises a tubular structure (10) extending about an axis of rotation (A), and a plurality of active segments (24; 43) selectively and prismatically connectable axially to the tubular structure (10) to form an annular active part (11); and wherein each active segment (24; 43) is as claimed in any one of the foregoing Claims.

14) A wind turbine for producing electric energy, and comprising a rotary electric machine (4) as claimed in Claim 13; and a liquid cooling system (6) comprising a stationary circuit (27) connected to each active segment (24; 43).

Dated this 18th day of February, 2015

S.K. PANGASA
OF K&S PARTNERS
AGENT FOR THE APPLICANT(S)

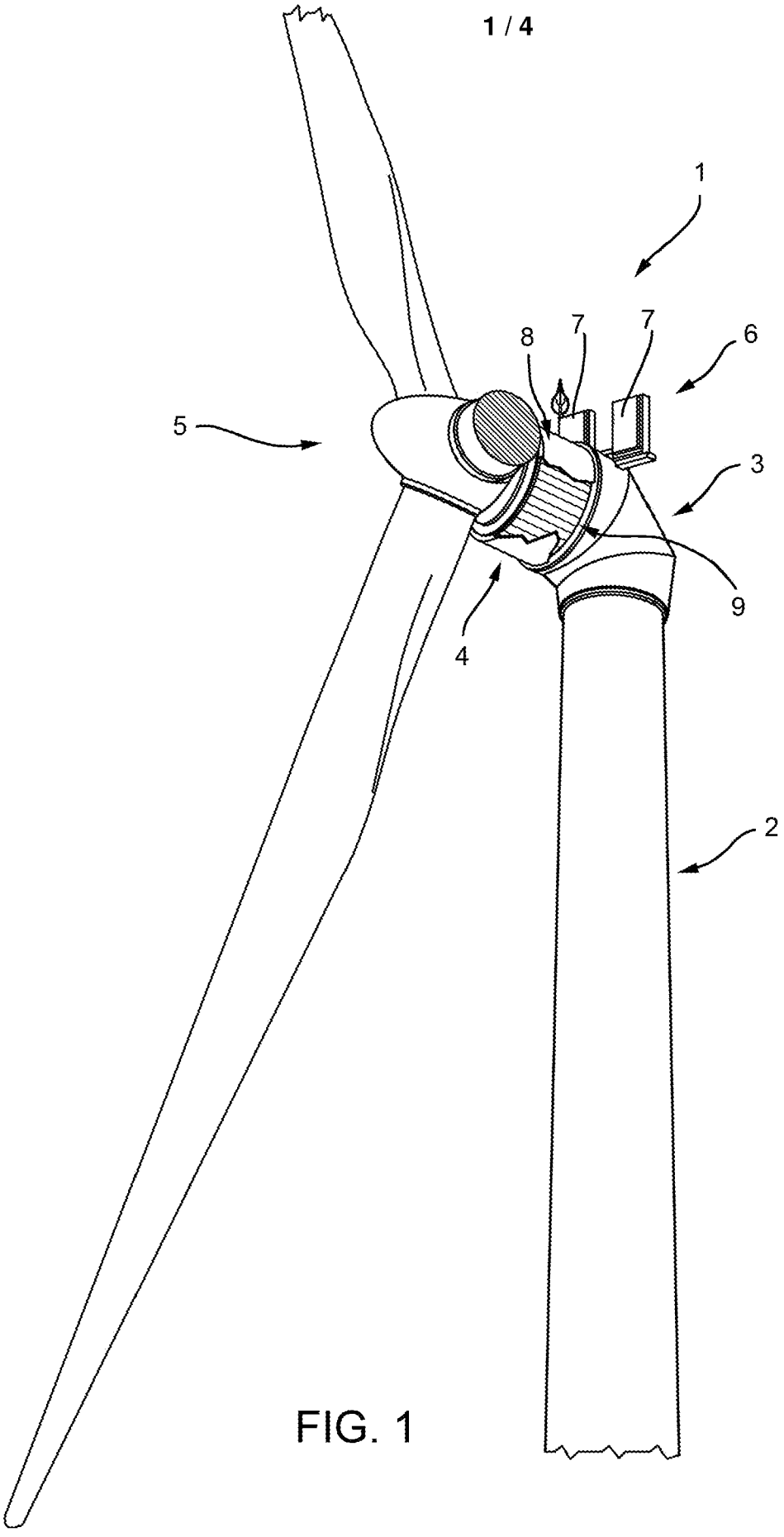
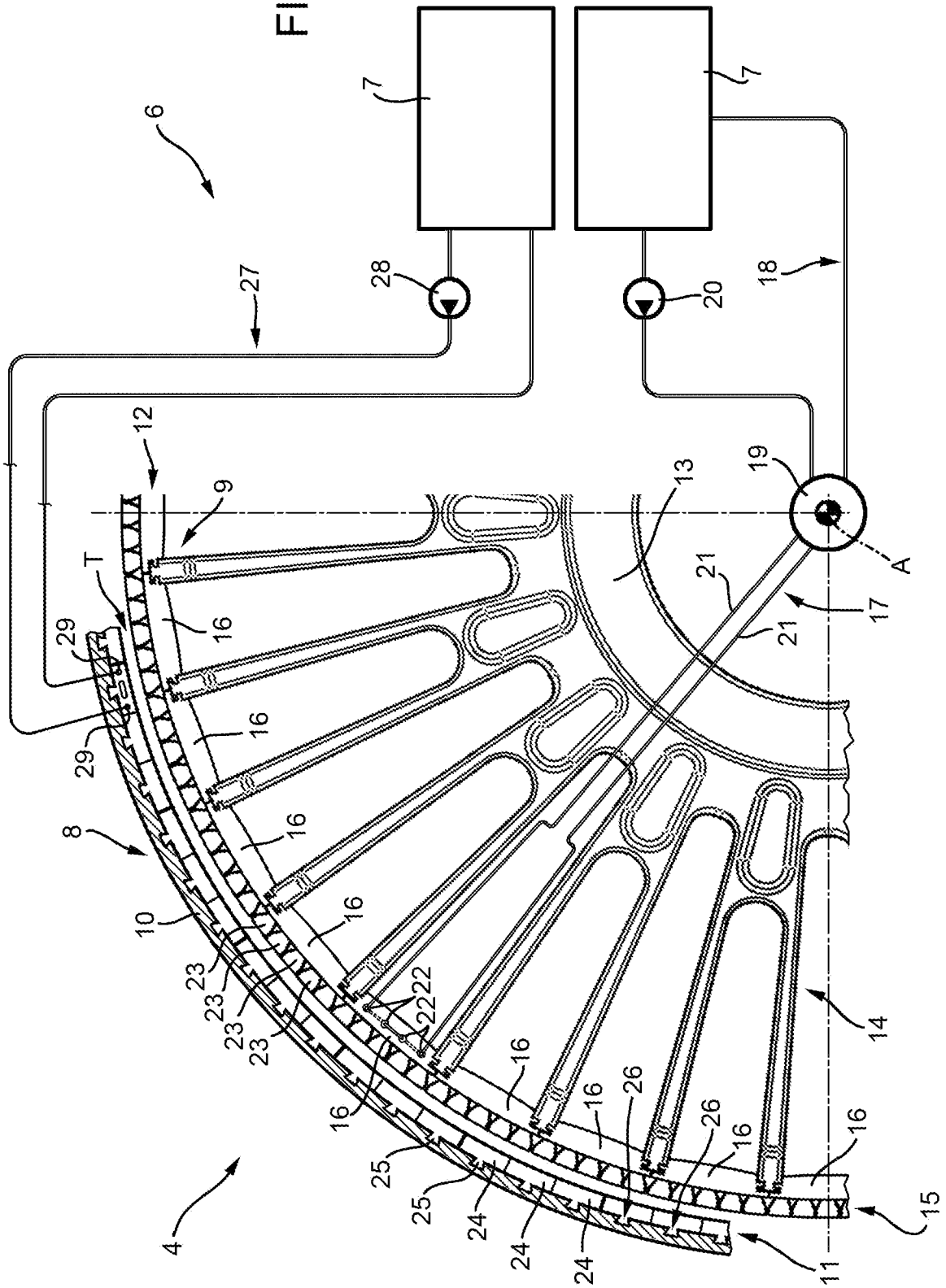


FIG. 1

FIG. 2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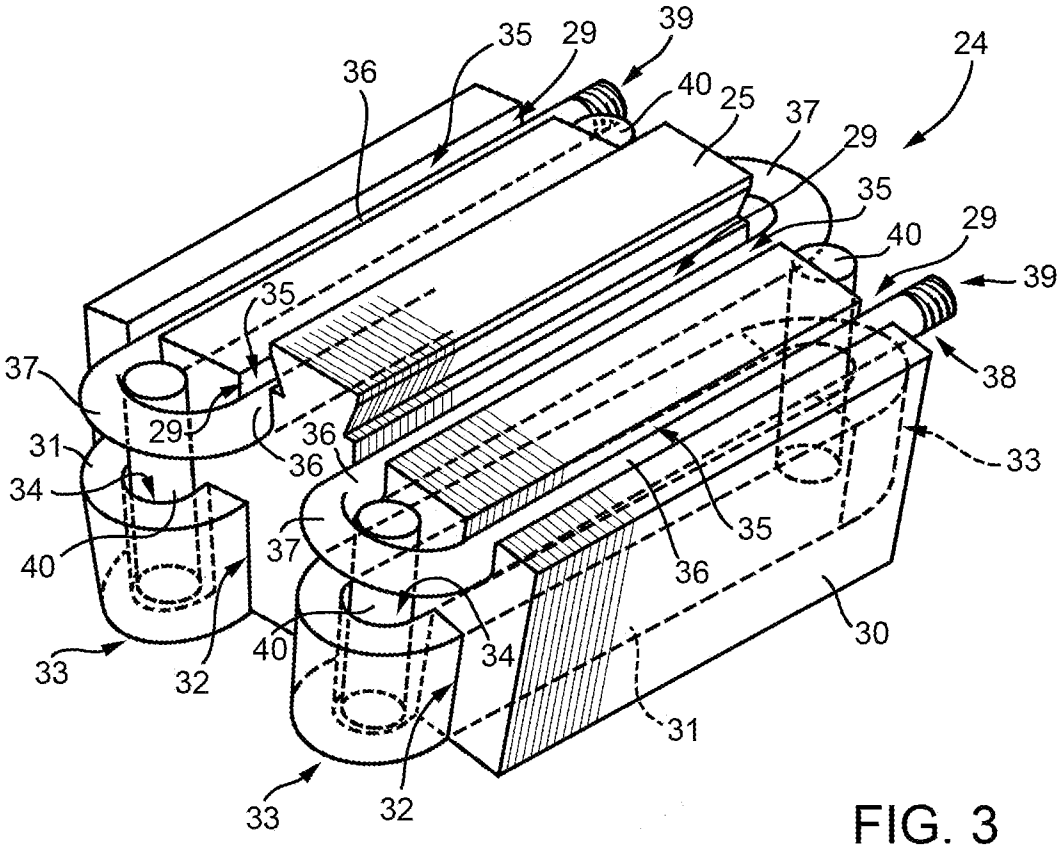

FIG. 3

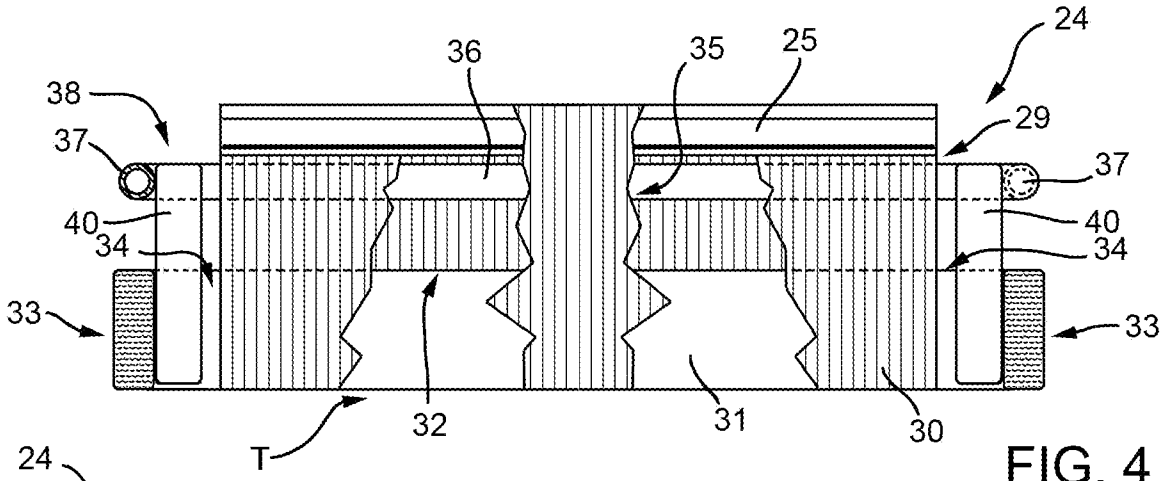

FIG. 4

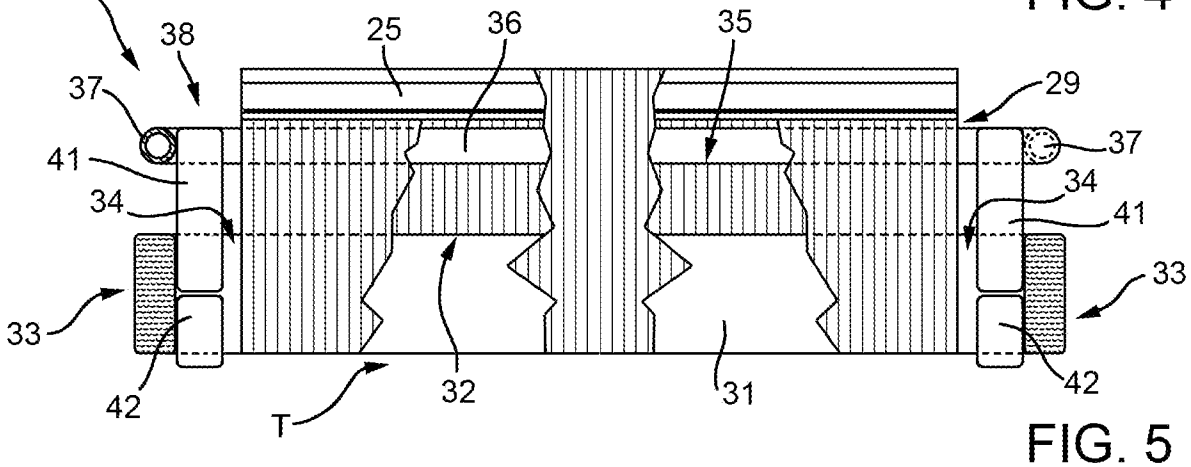

FIG. 5

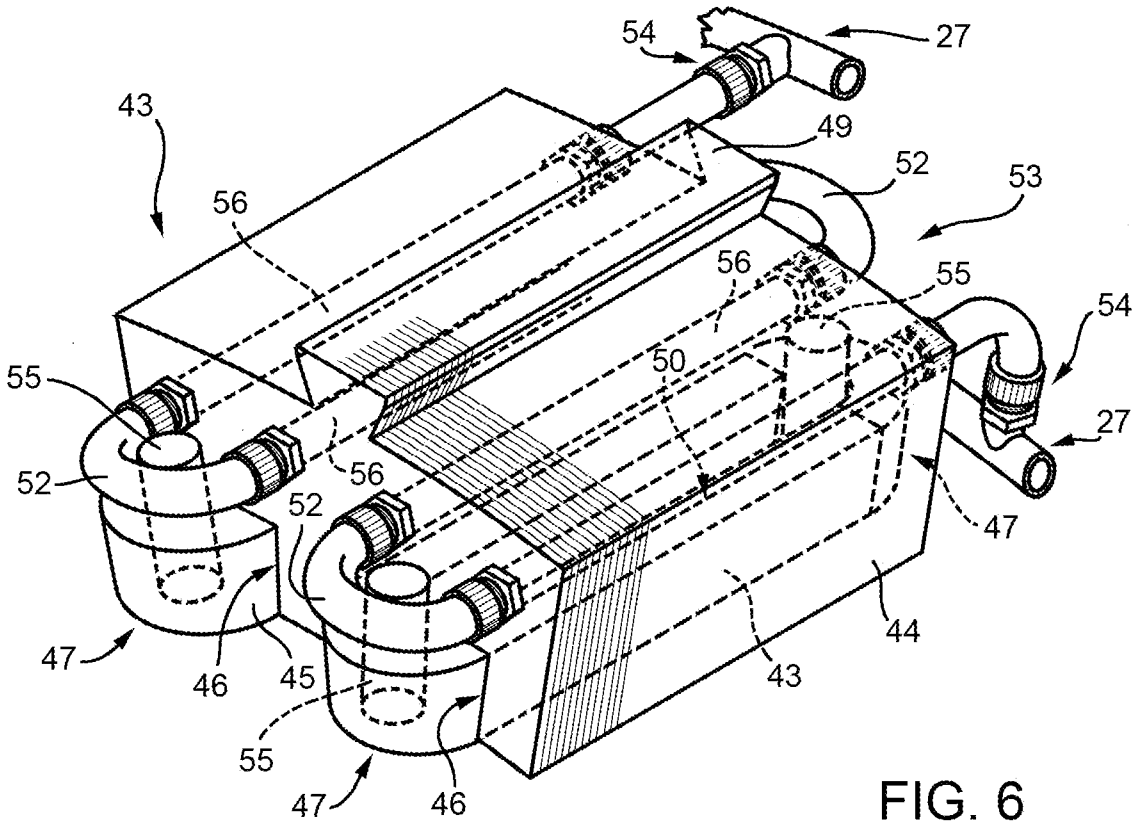
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FIG. 6

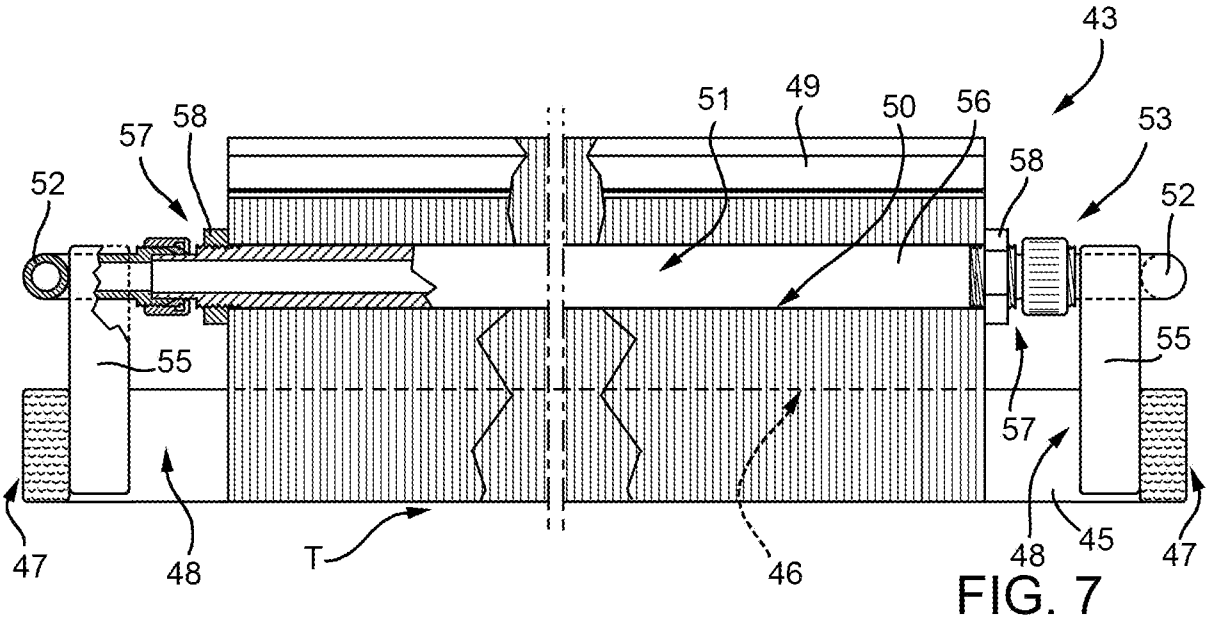
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FIG. 7