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(54) Automotive vacuum vane pump

(57) The invention refers to an automotive vacuum vane pump (10), comprises a housing (40) with a radially moveable rotor vane (20), wherein the vane (20) consists of at least two components, i.e. a vane body (22) and one or two vane tips (24) at the end of the vane, The vane (20) abuts a pump chamber wall (44), separating the pump chamber (44) in an intake room (45) and a pressure room (46).

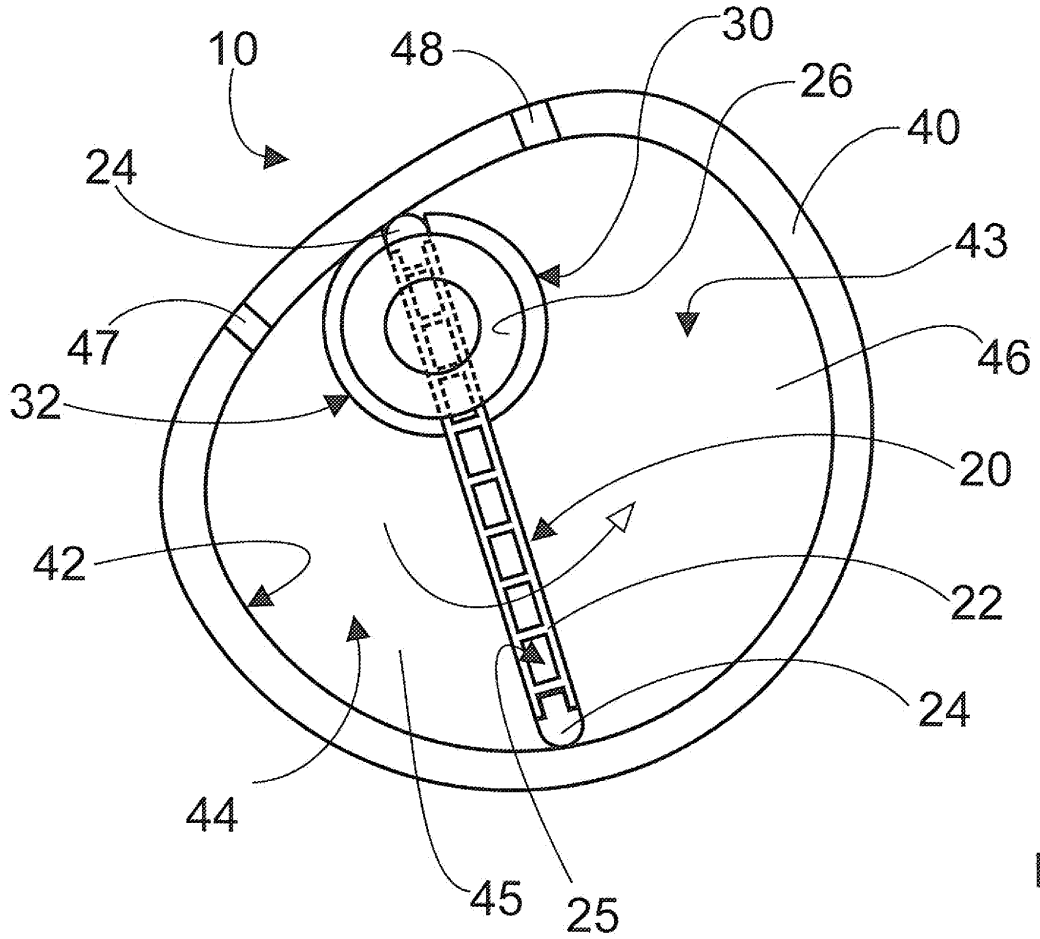

Fig. 1

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Description

[0001] The present invention refers to an automotive vacuum vane pump which comprises a housing with a radially moveable rotor vane.

[0002] Vacuum vane pumps of the state of the art comprise one or more vanes of a constant length, wherein the vane tips slide at a pump chamber wall. The vane separates the pump chamber in different rooms, for example in case of vacuum pump with a single vane assembly in an intake room and a pressure room. Vacuum vane pumps are used in automotive applications as a supply device for servo brake devices, valves etc.

[0003] The pump comprises a housing with a radially moveable rotor vane, wherein the one-pieced metal vane has a constant length and wherein the vane tips slide at a pump chamber wall. A vacuum vane pump with a relatively heavy metal vane tends to vibrations due to high centrifugal forces, and therefore the pump is subject to high energy consumptions and mechanical wear. Another relevant problem is the abrasion of the vane ends or tips and the pump chamber wall.

[0004] DE 10 2005 058 129 A1 discloses a vacuum vane pump construction with a single thermosetting plastic vane, wherein the complete vane is made of a fiber reinforced material. The manufacturing of these vanes is complex and cost-intensive, and the vane ends are subject to abrasion so that the vane length decreases during the lifetime of the pump.

[0005] It is an object of the present invention to provide a vane pump with improved long life properties.

[0006] This object is solved with an automotive vacuum vane pump with the features of claim 1.

[0007] The automotive vacuum vane pump according to claim 1 comprises a housing with a radially moveable rotor vane, wherein the vane consists of at least two components, i.e. a metal vane body and one or two separate plastic vane tips at one or both ends of the vane. Both, the metal vane body and the plastic vane tips can be optimized with respect to their special function. The metal vane body material, for example, can have a high stability. The plastic tips can have a hardness which is less than the pump chamber wall hardness. Therefore, the abrasion of the metal pump chamber wall can be reduced significantly.

[0008] Preferably, the vane body is made out of a light metal, preferably of an aluminum alloy which is produced via a continuous casting process. Aluminum alloy is a lightweight material and comprises the benefit of an enhanced stability whereby the weight remains unchanged in comparison with pure aluminum. The continuously cast material provides an inexpensive production due to the inherently lower cost of continuous, standardized production of the product.

[0009] According to a preferred embodiment of the invention, the metal vane body comprises axial recesses arranged in series in longitudinal direction of the vane, i.e. in radial direction of the rotor. This causes a weight reduction whereby the rigidity and the stability of the vane remains unchanged. Therefore, the automotive vacuum vane pump ensures long life properties and functionality, respectively.

[0010] Alternatively, the metal vane body comprises radial, i.e. longitudinal recesses arranged in series in axial direction of the vane. This causes a weight reduction whereby the rigidity and the stability of the vane remains unchanged. Moreover, the radial recesses which are arranged in axial direction cause a more stiff vane body in the direction of the main bending load.

[0011] The vane tips are preferably made out of a thermosetting plastic which is fiber reinforced. The vane tips are more elastic and stronger in comparison to pure thermosetting plastic.

[0012] According to a preferred embodiment of the invention, the vane tip is provided moveable in longitudinal direction at the vane body, i.e. moveable in radial direction of the rotor. The movability of the vane tip ensures air-tightness in case of abrasion.

[0013] According to a preferred embodiment of the invention, the combination of movable plastic tips and an aluminum alloy vane body leads to a lower impact of the centrifugal forces, which are primarily responsible for abrasion in view of maximum rotating speeds between 5000 and 10000 rpm. This assembly causes at one hand a reduced abrasion of said plastic vane tips and on the other hand ensures air-tightness.

[0014] Preferably, the vane tip is form-fitted hold at the vane body. The section of the vane tips has a mushroom form. The vane tips provide a semicircle head and a flat shaft. The flat shaft is arranged in a form-fitted recess of the vane body. This embodiment provides a torque-proof support of the vane tip at the vane body. The longitudinal movability of the tip provides an air-tight pump chamber separation during the life time of the pump.

[0015] The following is a detailed description of an embodiment of the invention with reference to the drawings, in which:

Figure 1 shows an automotive vacuum vane pump without a cover plate from the plan view,

Figure 2 shows a vane body with two moveable tips at the end of the vane, and

Figure 3 shows a vane body with radial recesses arranged in line in axial direction.

[0016] In figure 1, a vacuum vane pump 10 is shown in a plan view. The automotive vacuum vane pump 10 comprises a metal housing 40 with an inlet opening 47 and an outlet opening 48. The housing 40 surrounds the pump chamber 44. The pump chamber 44 is surrounded by a non-cylindrical pump chamber wall 42.

[0017] The pump chamber 44 comprises a circular pump rotor 30. The pump rotor 30 is with its circumferential rotor wall 32 arranged adjacent to the side wall 43

of the pump chamber 44, whereby a protrusion (not shown) of the pump rotor 30 protrudes axially to the outside of the side wall 43. The protrusion of the pump rotor 30 can be rotated by a pump motor (not shown).

[0018] The pump rotor 30 has a radial continuous vane guiding opening 26, wherein a radially moveable vane 20 is mounted. The vane 20 comprises a metal vane body 22 with two with respect to the rotor 30 radially moveable plastic vane tips 24 at the ends of the metal vane body 22, whereby the plastic vane tips 24 slide at the pump chamber wall 42. The vane tips 24 are arranged torque-proof with respect to the longitudinal axis of the vane 2°.

[0019] The vane 20 separates the pump chamber 44 into an intake room 45 and a pressure room 46, because the rotor wall 32 slides permanently at the pump chamber wall 42, and thereby separates the intake room 45 and the pressure room 46 air-tight.

[0020] As figure 2 shows, the vane 20 comprises a metal vane body 22 and two radially, i.e. in the longitudinal direction of the metal vane body 22, moveable plastic vane tips 24 at the end of the vane 20. The metal vane body 22 comprises rectangular and/or elongated axial recesses 25 arranged in series in radial direction of the vane 20 in order to reduce the weight of the vane 20.

[0021] Figure 3 shows the metal vane body 22. The metal vane body 22 comprises rectangular and/or elongated radial recesses 27 arranged in series in axial direction of the vane 20 in order to reduce the weight of the vane 20.

Claims

1. Automotive vacuum vane pump (10) with a radially moveable rotor vane (20), the vane (20) comprising:

   a metal vane body (22), and
   a separate vane tip (24) at one end of the vane (20), wherein
   the vane tip (24) is made out of plastic.

2. Automotive vacuum vane pump (10) of claim 1, wherein the metal vane body (22) is made out of a light metal, preferably of an aluminum alloy.

3. Automotive vacuum vane pump (10) of claim 1 or 2, wherein the vane body (22) comprises axial recesses (25) arranged in series in radial direction of the vane (20).

4. Automotive vacuum vane pump (10) of claim 1 or 2, wherein the vane body (22) comprises radial recesses (27) arranged in series in axial direction of the vane (20).

5. Automotive vacuum vane pump (10) of one of the preceding claims, wherein the vane tip (24) is made out of fiber reinforced polymer.

6. Automotive vacuum vane pump (10) of claim 5, wherein the fiber reinforced polymer is a thermosetting plastic reinforced with carbon fiber.

7. Automotive vacuum vane pump (10) of one of the preceding claims, wherein the vane tip (24) is provided radially moveable at the vane body (22).

8. Automotive vacuum vane pump (10) of one of the preceding claims; wherein the vane tip (24) is formfitted hold at the vane body (22).

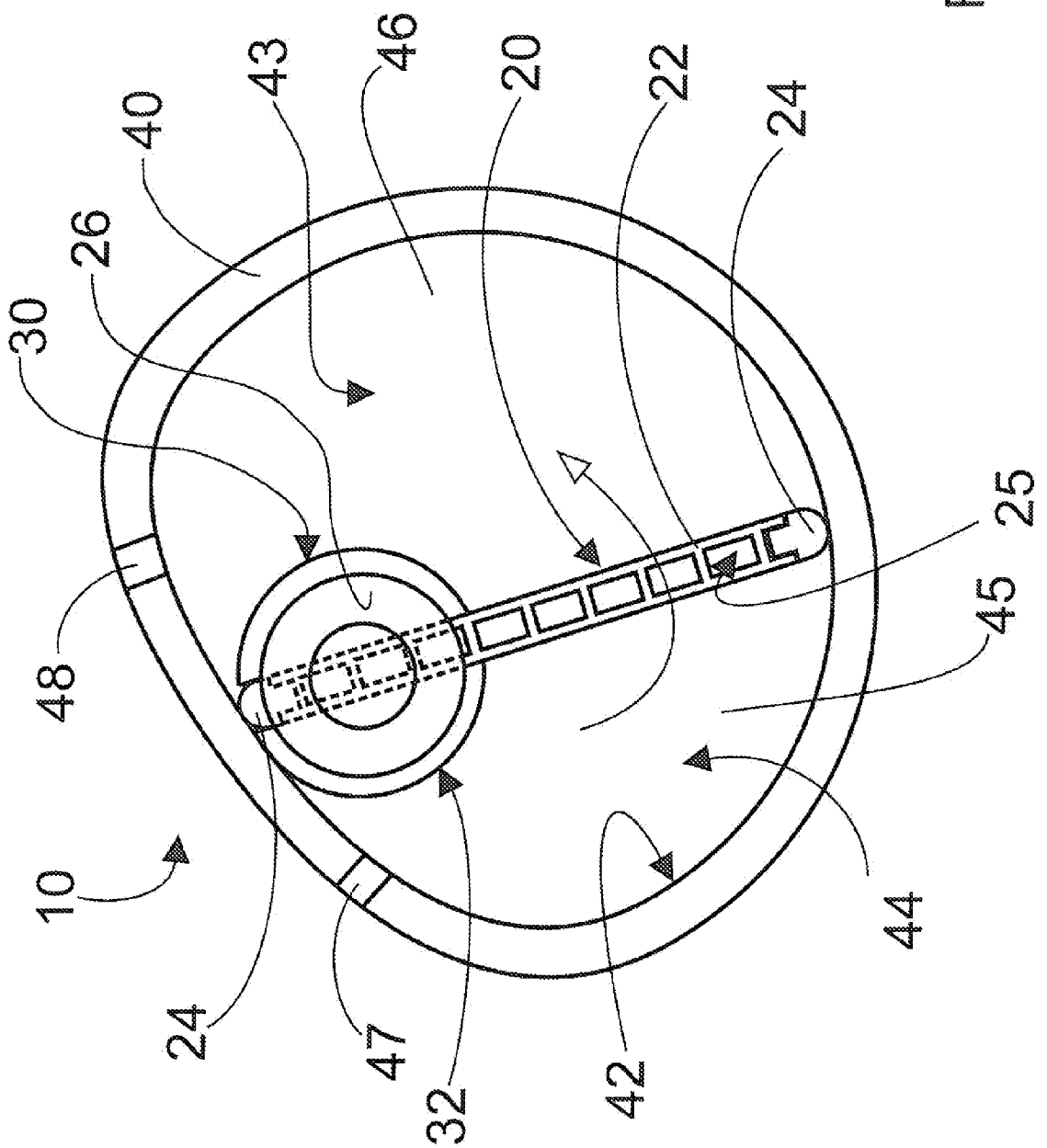


Fig. 1

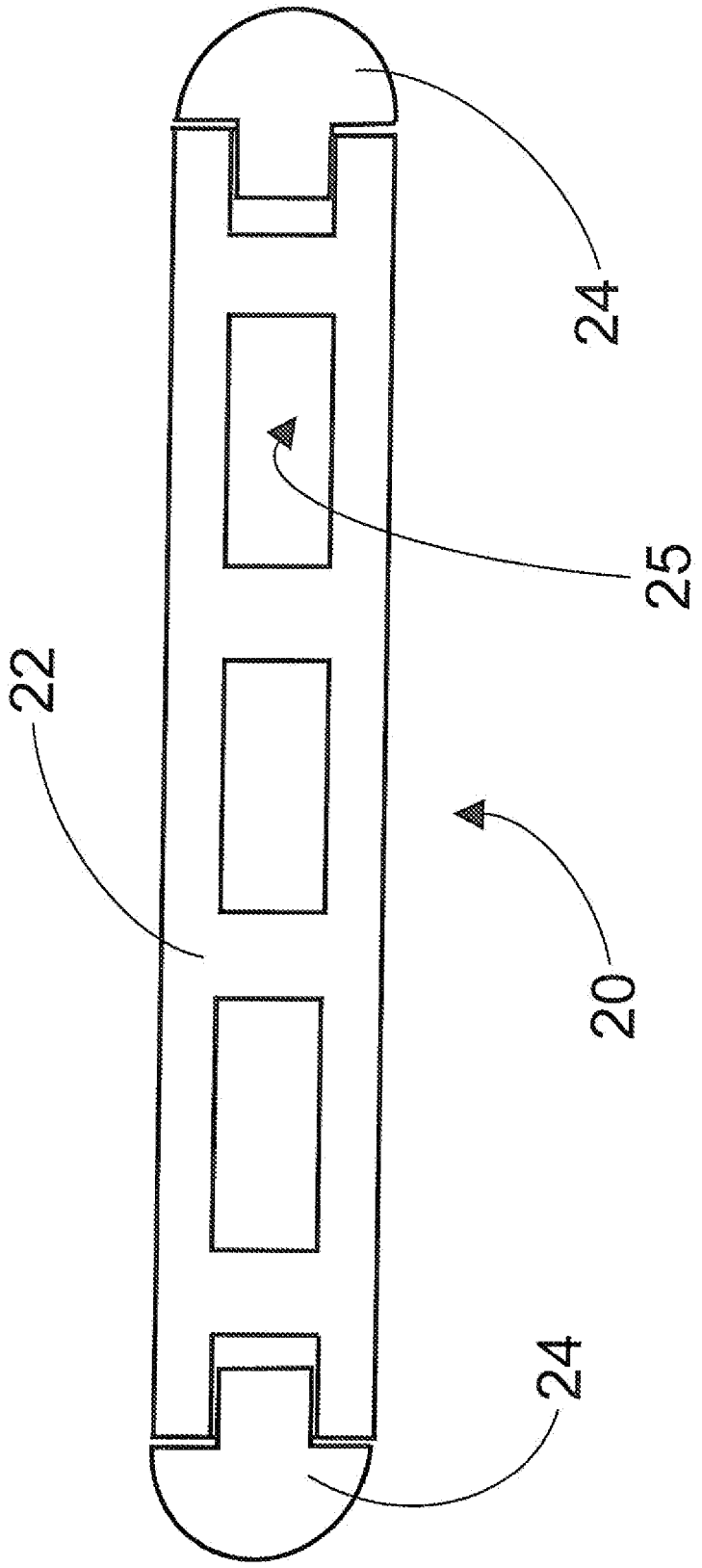
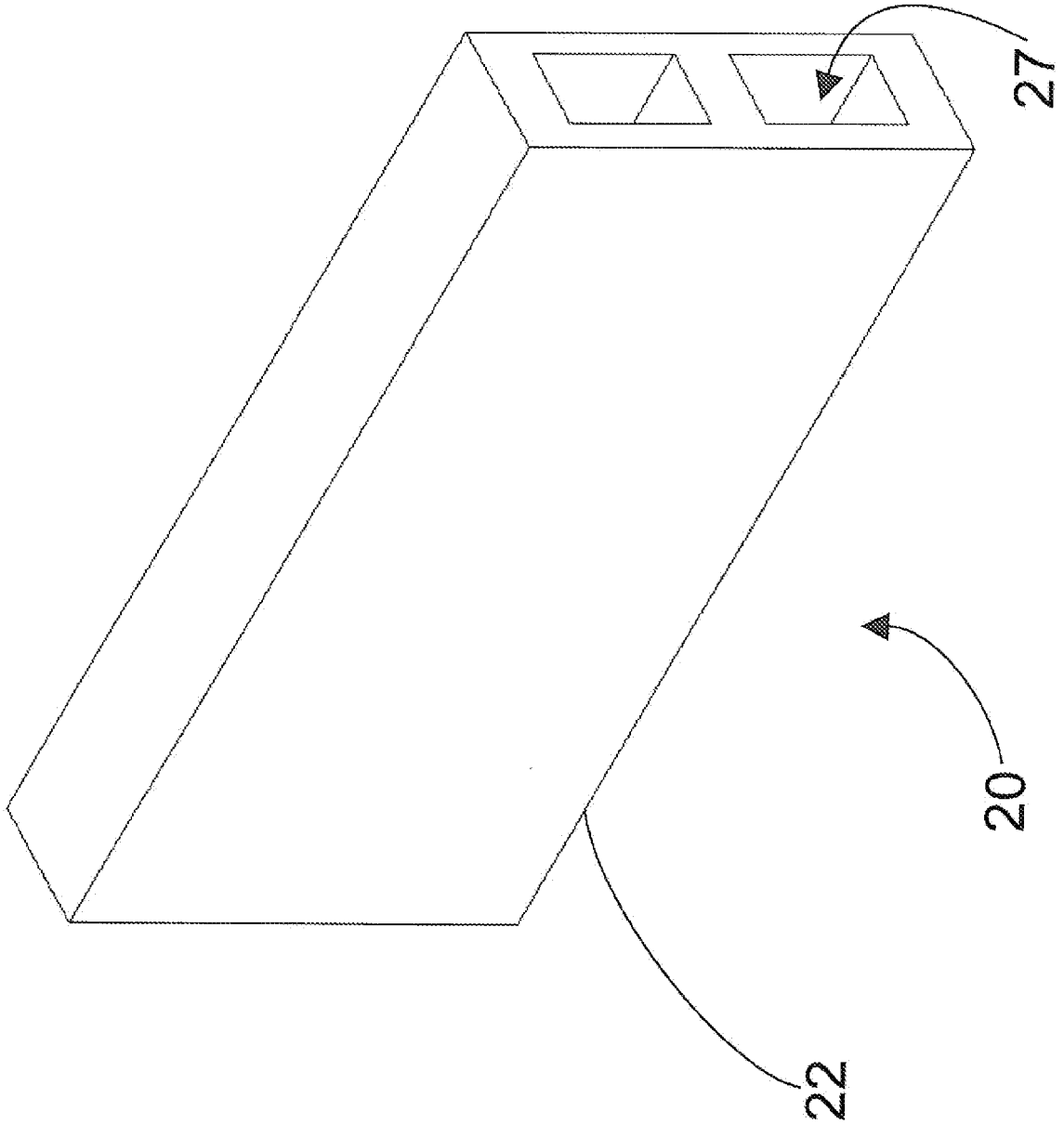


Fig. 2

Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 0219

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 February 2010	Descoubes, Pierre

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