A friction vacuum pump (10) comprises a housing (12) defining a vaneless pump stator (30), a rotor drive and a rotor support which rotatably supports a pump rotor (16) provided with a vane (18). The housing (12) surrounds the overall axial length of the pump rotor (16), the rotor drive and the rotor support. Prior art housings are of multipart configuration and thus comprise seals between the housing portions. The seals are difficult to coat and may be or become locations where leaks occur. In contrast, the housing (12) is of one-piece configuration such that, in any case, the region of the housing (12) which is in contact with the vacuum gas is free of seals.
DRAG VACUUM PUMP

BACKGROUND

[0001] The invention relates to a friction vacuum pump comprising a housing having a vaneless pump stator, a rotor drive and a rotor support.

[0002] The housing of such friction vacuum pumps, for example turbomolecular pumps or Holweck pumps, surrounds the overall axial length of the pump rotor, the rotor drive and the rotor support. From US 2005/220607 a screw pump is known whose housing essentially comprises three axially adjacent portions which are joined together, for example screwed together, to form a housing. The three housing portions are a stator housing portion, an outlet housing portion which supports a cartridge comprising the motor and/or the support, and a bearing housing portion. Between two adjacent housing portions respective seals are arranged for ensuring the required tightness, which seals may be difficult to coat or impossible to coat at all with a corrosion-inhibiting coating material, for example. Even the greatest care taken during the assembly work cannot completely prevent leaks from occurring in the sealing region. Further, the temperature behavior of the overall housing is inhomogeneous due to the multipart configuration of the housing.

[0003] From U.S. Pat. No. 6,514,035 a screw pump is known whose housing is composed of two portions, wherein the discharge-side housing portion is integrally formed with a bearing and motor housing. The two-part configuration of the housing leads to the aforementioned drawbacks.

[0004] It is an object of the invention to improve the physical properties of a friction vacuum pump.

SUMMARY

[0005] In the friction vacuum pump according to the invention, the housing is configured in one piece over its overall axial length such that the one-piece housing surrounds the overall axial length of the pump rotor, the rotor drive and the rotor support. The one-piece configuration of the housing ensures a homogeneous temperature behavior of the housing. Since no seals are provided, tightness of the housing can be ensured even over a long term. It is not necessary that the housing itself is composed of a plurality of parts, such that no assembly work and resultant sources of defects occur. Since no seals are provided in the housing region, the housing inside can be easily and continuously coated. The friction vacuum pump housing comprises only an end-side cover, for example, which has no load-bearing function and does thus not require any particular precision during assembly work.

[0006] The one-piece configuration of the housing improves numerous physical properties of the friction vacuum pump, in particular the temperature behavior, the tightness and the quality of coating of the housing inside.

[0007] According to a preferred aspect, the rotor support and the rotor drive are arranged in a cartridge supported by the housing and surrounded over its overall axial length by the housing. As used herein, the term cartridge refers to a device designed as a cartridge housing which is of pot-shaped or completely closed configuration and in which a shaft of the rotor support is rotatably supported, said shaft being adapted to be driven by a rotor drive disposed in the cartridge. The support and the drive are arranged in a completely preassembled condition in the closed or nearly closed cartridge. When assembling the friction vacuum pump, first the shaft extending from the cartridge can be connected with the pump rotor, and this structure can then be inserted into the housing, wherein the cartridge is mounted in the housing interior. In this manner, the friction vacuum pump can be easily and reliably assembled. The one-piece configuration of the friction vacuum pump housing and the provision of a single drive and support cartridge result in a modular design of the friction vacuum pump. Both features together facilitate the assembly and disassembly work, which, in turn, improves the assembly accuracy, reduces the assembly expenditure, and facilitates and accelerates the maintenance and repair work.

[0008] Preferably, the cartridge comprises a pot-shaped housing which is integrally formed with the friction vacuum pump. When the rotor support and the rotor drive are inserted in the pot-shaped housing, the pot opening is closed by a cartridge cover. The one-piece configuration of friction vacuum pump housing and pot-shaped cartridge housing facilitates the assembly work, reduces leaks, and in particular ensures a more precise positioning of the cartridge and/or the rotor drive and the rotor support.

[0009] According to a preferred aspect, at least 50% of the axial length of the cartridge is surrounded by the pump rotor, i.e. at least half the axial length of the cartridge axially extends into the pot-shaped pump rotor. In this manner, a friction vacuum pump configuration which is compact with regard to the overall axial length is realized.

[0010] According to a preferred aspect, a portion of the cartridge housing is defined by the friction vacuum pump housing. The cartridge housing comprises two sections, i.e. one arranged on the rotor side as seen from the mounting location of the cartridge at the housing, and one arranged remote from the rotor. The cartridge section arranged remote from the rotor may be defined by the friction vacuum pump housing, i.e. the pot-shaped cartridge housing does not comprise a cartridge cover but is terminated by the friction vacuum pump housing. Thus, the total number of components is reduced.

[0011] According to a preferred aspect, the housing comprises a circular shoulder at its inside, against which the cartridge preferably bears on the suction side and to which the cartridge is fastened. The cartridge, together with the rotor, is inserted into the housing preferably from the suction side. The cartridge is placed upon the circular shoulder and fastened by suitable fastening means, for example threaded screws, preferably from the discharge side of the shoulder. The circular shoulder is easy to produce and allows the cartridge to be fastened in a gas-tight manner to the housing.

[0012] Preferably, the pump rotor is a Holweck pump rotor. The surface in the radial plane between a housing-side stator wall and a rotor-side hub may decrease towards the discharge side.

[0013] Thus the inlet cross-section of the friction vacuum pump is relatively large, which results in a relatively large gas throughput.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] An embodiment of the invention will now be described in greater detail with reference to the drawing.
1. A friction vacuum pump comprising:
a housing forming a vaneless pump stator, and
a rotor drive and a rotor support which supports a pump
rotor comprising a vane,
wherein said housing surrounds the overall axial length of
the pump rotor, the rotor drive and the rotor support, and
the housing is of one-piece configuration.
2. The friction vacuum pump according to claim 1, char-
acterized in that wherein the rotor support and the rotor drive
are arranged in a cartridge which is supported by the housing
and surrounded over its overall axial length by said housing.
3. The friction vacuum pump according to claim 2, wherein
the cartridge comprises a pot-shaped housing which is inte-
grally formed with the friction vacuum pump housing.
4. The friction vacuum pump according to claim 2, wherein
at least 50% of the axial length of the cartridge is surrounded
by the pump rotor.
5. The friction vacuum pump according to claim 2, wherein
a portion of the cartridge housing is defined by the friction
vacuum pump housing.
6. The friction vacuum pump according to claim 2, wherein
the housing comprises a circular shoulder to which the car-
tridge is fastened.
7. The friction vacuum pump according to claim 1, wherein
the pump rotor is a screw pump rotor.
8. The friction vacuum pump according to claim 1, the
wherein a surface in a radial plane between a pump stator and
a hub of the pump rotor decreases towards a discharge side.
9. A friction vacuum pump comprising:
a funnel-shaped housing which tapers from an inlet end
towards a discharge end, the housing being an integral
one-piece construction;
the one-piece housing including an integrally formed
shoulder adjacent the discharge end, the shoulder being
in a plane transverse to a central axis of the one-piece
housing;
a cartridge which houses a rotor drive and a rotor support,
the cartridge being supported on the integral shoulder
and extending along the central axis of the one-piece
housing;
a rotor having at least one vane, the rotor being supported
on the rotor support and received within the housing.
10. A method of assembling the friction vacuum pump of
claim 9 comprising:
inserting the cartridge into the integral, one-piece housing
from the inlet end;
attaching the cartridge to the flange;
attaching the rotor to the rotor support.

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