The invention relates to a helical screw compressor which comprises two rotors (7, 9) having ribs (7a, 9a) which extend a screw-like manner and grooves which engage with each other in a combing and sealing manner. The total number of ribs of both rotors is at least 14, and the height (H) of the grooves is no more than 0.15 times the external diameter (Da) of the rotor profile (7) and/or (9). The shaft journals of the rotors have a diameter which is not smaller than half of the external diameter (Da) of the rotor profile.
HELICAL SCREW COMPRESSOR

[0001] The invention pertains to a screw compressor with two screw rotors that are rotatably held in a rotor housing with parallel axes, each of which has a profile section with screw-shaped ribs and grooves. The ribs and grooves of the rotors mesh together, forming a seal, and the gas volumes contained between them and the rotor housing are conveyed and compressed when the rotors are operated.

[0002] In screw rotors of this type, the design of the profiles has until now focused on creating the largest possible volumes for the gas to be compressed, located between the rotors and the rotor housing, relative to a given outer rotor profile diameter. In other words, as high a rotor profile volumetric utilization as possible has been sought.

[0003] In contrast, the aim of the present invention is to provide a screw compressor that is suitable for the compression of gas at very high pressures, typically in the 30 to 50 bar range, and that can be operated primarily as the last stage of a multi-stage compressor system, in particular a three-stage compressor system. At such high pressures, the rotors are subjected to high lateral forces that act to bend the rotors away from each other due to the gas volume contained between them and the housing under high pressure. This can negatively affect the seal between the rotors, and thus to a loss of efficiency. Also, due to the separation of the rotors, the radial gap between the rotors and the rotor housing can not be as tightly tolerated as desirable to attain a good seal and a high efficiency.

[0004] Thus, the object of the invention is to provide a screw compressor that is suitable primarily for operation at high compressive pressures. The solution to this objective is indicated in claim 1. The dependent claims refer to further advantageous embodiments of the invention.

[0005] It was found that the design of the rotors indicated in the claims leads to an especially favorable relationship between the bending stiffness of the rotors on one hand and the volume of the contained compressed gas, which creates the bending forces, in the screw notches of the rotors on the other.

[0006] One embodiment of the invention is explained in more detail below with the help of the drawings. Shown are:

[0007] FIG. 1 a partial sectional view of a screw compressor according to the invention.

[0008] FIG. 2 a perspective representation of the rotors of the screw compressor of FIG. 1.

[0009] FIG. 3 The rotor profile of the two rotors in a cross section perpendicular to the axes.

[0010] The screw compressor shown as an exemplary embodiment in FIG. 1 has a rotor housing 1, shown in a sectional view, in which two rotors 3 and 5 are rotatably held with parallel axes. The rotating axes of the rotors 3, 5 lie in a common vertical plane that is also the sectional plane used to illustrate the rotor housing 1. Each rotor has a profile section 7, 9 with a profile exhibiting screw-shaped ribs and grooves, wherein the ribs and grooves of the two profile sections 7, 9 mesh with one another. On both sides of the profile sections 7, 9 are shaft pins 7a, 7b, 9a, 9b, the surfaces of which cooperate with seal rings 11 to seal the rotor in the rotor housing 1. The shaft pins 7a, 7b, 9a, 9b are also rotatably held in the rotor housing by bearings 13, 15.

[0011] The upper rotor 3 in FIG. 1 is the main rotor, at the left end of which in FIG. 1 is an extension 7c of its shaft pin provided to hold a drive gear (not shown) that meshes with a corresponding gear in a drive transmission (not shown) in order to turn the rotor 3. At the right end in FIG. 1, the two rotors 3, 5 have two gears 17, 19 that mesh with one another, thus forming a synchronizing transmission that conveys the rotation of the upper rotor 3 to the lower rotor 5, which is the secondary rotor, at the desired RPM ratio. This ensures that the profile sections 7, 9 of the rotors 3, 5 mesh with one another without touching.

[0012] The screw compressor described is preferred to be a “dry-running” compressor, i.e., in which no lubricating, cooling or sealing oil is fed to the compression chamber. Despite this fact, the rotor profiles mesh with one another without touching and form a seal nevertheless. This is an advantage for all applications in which the compressed gas must be completely free of oil. Oil is only fed external to the compression chamber, i.e., outside the zone sealed off by the seals 11. The oil is used to lubricate the drive gear (not shown), the bearings 13, 15 and the synchronizing transmission 17, 19.

[0013] In FIG. 2, the two rotors 3, 5 of the screw compressor of FIG. 1 are shown separately in a perspective view. It can be seen from FIG. 2 that rotor 3, which is the main rotor, has a profile section 7 whose profile is made up of six screw-shaped ribs 7. The lower rotor 5, which is the secondary rotor, has a profile section 9 with a profile that is made up of eight screw-shaped ribs 9. The total number of screw-shaped ribs 7, 9 of the two rotors, that is the total number of “teeth”, is thus 14.

[0014] Furthermore, FIG. 2 shows areas 7a, 7b, 9a, 9b of the shaft pins next to the profile sections 7 and 9 of each rotor 3, 5 on both sides, said areas having diameters (D, D’) that are more than half the outer diameter of their respective profile sections.

[0015] FIG. 3 shows the profile sections 7, 9 of the two rotors in a section perpendicular to the axes. Profile 7 of the main rotor has six screw-shaped ribs 7 that are separated from one another by grooves 7’. The tips of the ribs 7 define the outer circular envelope Ka of the profile with diameter Da. The bottom surfaces of the grooves 7’ define the inner circle Ki at diameter Di. The radial distance between circles Ka and Ki is called the rib height or the tooth height H.

[0016] This is not larger, and is preferably smaller than 0.15 times the diameter Da of the outer circle Ka. The same applies to the eight ribs 9’ and the grooves 9’ separating them for the lower rotor (secondary rotor) 9, i.e. the tooth height H is also not larger than 0.15 times the outer profile diameter Da in this case.

[0017] As the screw compressor shown in FIG. 1 is operated, the gas to be compressed (in particular air) is fed to its intake chamber 10, which is located adjacent to the left end of the profile sections 7, 9 in the rotor housing 1 in FIG. 1. This air is preferred to have been pre-compressed by one or more upstream compressor stages (not shown) to an intermediate pressure, for example a pressure in the range of 10 to 15 bar, preferably 12 bar. This pre-compressed gas is conveyed to the right to an outlet (not shown) in FIG. 1 by the profile sections 7, 9 of the two rotors 3, 5 and in the process compressed to a final pressure preferred to be in the range of 30 to 50 bar, in particular about 40 bar. The rotors of the screw compressor are designed such that they are insensitive to the lateral forces produced by the compressed gas at these high pressures.

1. A screw compressor with two rotatably held rotors (3, 5) that are rotated in opposite directions, said rotors having a profile (7, 9) along a section of their length that has screw-shaped ribs (7, 9') and grooves and meshing with one another via these ribs and grooves, forming a seal, characterized in that the total number of screw-shaped ribs (7, 9') of the two rotors is at least 14.
2. A screw compressor according to claim 1, wherein one rotor is the main rotor (3) and the other rotor is the secondary rotor (5), and wherein the profile (7) of the main rotor contains six ribs (7') and the profile (9) of the secondary rotor contains eight ribs (9').

3. A screw compressor according to claim 1, wherein the rib height of each rotor (3, 5) is not larger than 0.15 times the outer diameter of the profile (Da) of the rotor.

4. A screw compressor according to claim 1, wherein each rotor has shaft pins (7a, 7b, 9a, 9b) next to the profile section, characterized in that the diameter (D, D') of each shaft pin in the area adjacent to the profile section (7, 9) is not smaller than half the outer diameter of the profile (Da).

5. A screw compressor according to claim 2 wherein the rib height of each rotor (3, 5) is not larger than 0.15 times the outer diameter of the profile (Da) of the rotor.

6. A screw compressor according to claim 5, wherein each rotor has shaft pins (7a, 7b, 9a, 9b) next to the profile section, characterized in that the diameter (D, D') of each shaft pin in the area adjacent to the profile section (7, 9) is not smaller than half the outer diameter of the profile (Da).

7. A screw compressor according to claim 2, wherein each rotor has shaft pins (7a, 7b, 9a, 9b) next to the profile section, characterized in that the diameter (D, D') of each shaft pin in the area adjacent to the profile section (7, 9) is not smaller than half the outer diameter of the profile (Da).

8. A screw compressor according to claim 3, wherein each rotor has shaft pins (7a, 7b, 9a, 9b) next to the profile section, characterized in that the diameter (D, D') of each shaft pin in the area adjacent to the profile section (7, 9) is not smaller than half the outer diameter of the profile (Da).