

Description

[0001] The present invention relates to vacuum pumps of the screw type and, more particularly, to such pumps with an improved screw thread design.

[0002] Vacuum pumps having a screw mechanism and comprising two externally threaded rotors mounted in the pumping chamber of a pump body (stator) and adapted for counter-rotation in the chamber with intermeshing of the rotor threads are known. Close tolerances between the rotor threads at the points of intermeshing and with the pumping chamber surfaces causes volumes of gas being pumped between an inlet and an outlet to be trapped between the threads of the rotors and said surfaces and thereby urged through the pump as the rotors are rotating.

[0003] Such pumps are potentially attractive because they can be manufactured with few working components and have the ability to pump from a high vacuum environment at the inlet down to atmospheric pressure at the outlet.

[0004] However certain disadvantages are evident from existing designs of screw vacuum pump, in particular that they generally require a high power consumption in view of the fact, for example, that the action of the intermeshing rotors does not provide for compression of the gas as it passes through the pump.

[0005] A further disadvantage is that the thread profiles of each rotor must be machined and fitted to close tolerances to allow the threads of the rotors to intermesh correctly with close tolerance but without contact between the respective threads.

[0006] It is an aim of the present invention to provide a vacuum pump incorporating a screw mechanism the threads of which are profiled to facilitate the machining and fitting of the rotors whilst ensuring that no direct contact between the rotors and between each rotor and the pump body (stator) takes place.

[0007] According to the present invention there is provided a vacuum pump incorporating a screw mechanism and comprising two externally threaded rotors mounted in a pump body and adapted for counter-rotation in the body with intermeshing of the rotor threads and with close tolerances between the threads and internal pump body surfaces in order to pump gas from a pump inlet to a pump outlet by action of the rotors and wherein the thread profile of each rotor is tapered in a substantially radial direction.

[0008] Advantageously, the tapering is effected from close to the pitch circle diameter of each rotor. The tapering angle in general may usefully be of the order of 1° to 6° on each side of the thread, preferably 2° to 3° , for example 2.5° .

[0009] The inlet to the pump may be substantially at the centre of the pump so that gas being pumped is directed directly in to the gap formed between the top of the rotors and to stator body.

[0010] An embodiment of the invention will now be de-

scribed by way of example, reference being made to the Figures of the accompanying diagrammatic drawings in which:

Figure 1 is a view of the pumping chamber of a vacuum pump according to the present invention;

Figure 2 is an enlarged view showing the profiles of two intermeshing threads at the centreline of the pumping chamber; and

Figure 3 is a sectional profile view (not to scale) of the pumping chamber of the vacuum pump of Figure 1.

[0011] As shown, a vacuum pump comprises a pump body 1 which together with a top plate 2 and a bottom plate 4 defines a pumping chamber 20. The top plate 2 has formed therein an inlet 3 to the pumping chamber 20 and the bottom plate 4 has formed therein an outlet 5 from the pumping chamber to atmosphere.

[0012] As illustrated most clearly in Figure 3, the pumping chamber 20 is in the form of a 'figure of eight', the substantially circular cross-sectional portions of which taper gradually in the direction from the inlet 3 towards the outlet 4.

[0013] Received in the circular cross-sectional portions of the pumping chamber 20 are two rotors 7, 8 of cylindrical type shape overall but each comprising a root portion 9, 10 respectively, the (root) diameter D_1 of which increases gradually in a direction from the pump inlet 3 to the pump outlet 5, on which is present a continuous helical thread, the (thread) diameter D_2 of which decreases gradually in a direction from the pump inlet 3 to the pump outlet 5.

[0014] The rotors 7, 8 are attached to respective shafts 11, 12 which are adapted for rotation in opposite directions (counter-rotation) within bearings 13, 14 respectively at the top of the shafts 11, 12 and bearings 15, 16 respectively at the bottom of the shafts 11, 12.

[0015] In use, counter-rotation of the shafts is effected by a motor positioned about the shaft 11 with a connection with the shaft 12 by means of interconnecting gears attached to the respective shafts such that, in use, both shafts rotate at the same speed but in opposite directions.

[0016] The overall shape of the pumping chamber 20 and the rotors, 7, 8 and in particular the external thread diameter of the rotors 7, 8 are all carefully calculated to ensure close tolerances between the outer thread surfaces and the pumping chamber 20 and to ensure close tolerances also in the vicinity of the centreline of the pump where the threads of the rotors 7, 8 intermesh. All tolerances must ensure no direct contact between the rotors and between each rotor and the pump body (stator) but effecting as small a leakage path between the parts as possible.

[0017] According to the present invention, this is ef-

fectured as shown most clearly in Figure 2 by having thread profile of each rotor taper in a radial direction from close to the pitch circle diameter D_3 by an angle A as shown in Figure 2 on each side of the helical thread. A preferred angle A of 2.5° is shown in Figure 2 but an angle of taper between 1° and 6° on each side of the thread is effective.

[0018] In a preferred embodiment the taper is started from just inside the pitch circle.

[0019] Such tapering allows in general for a ready accommodation of the tapered rotors in pumps of the invention with the required close tolerances.

Claims

1. A vacuum pump incorporating a screw mechanism and comprising two externally threaded rotors mounted in a pump body and adapted for counter-rotation in the body with intermeshing of the rotor threads and with close tolerances between the threads and internal pump body surfaces in order to pump gas from a pump inlet to a pump outlet by action of the rotors and wherein the thread profile of each rotor is tapered in a substantially radial direction.
2. A vacuum pump as claimed in Claim 1, in which the tapering is effected from close to the pitch circle diameter of each rotor.
3. A vacuum pump as claimed in Claim 1 or Claim 2, in which the angle of taper is between 1° and 6° on each side of the thread.
4. A vacuum pump as claimed in Claim 3, in which the angle of taper is 2.5° .
5. A vacuum pump constructed, arranged and adapted to operate substantially as hereinbefore described with reference to and as illustrated in the Figures of the accompanying drawings.

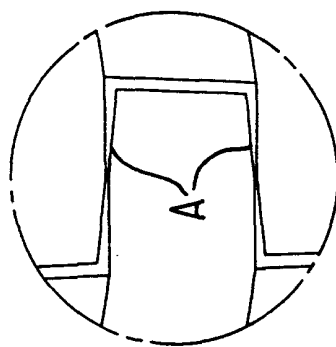
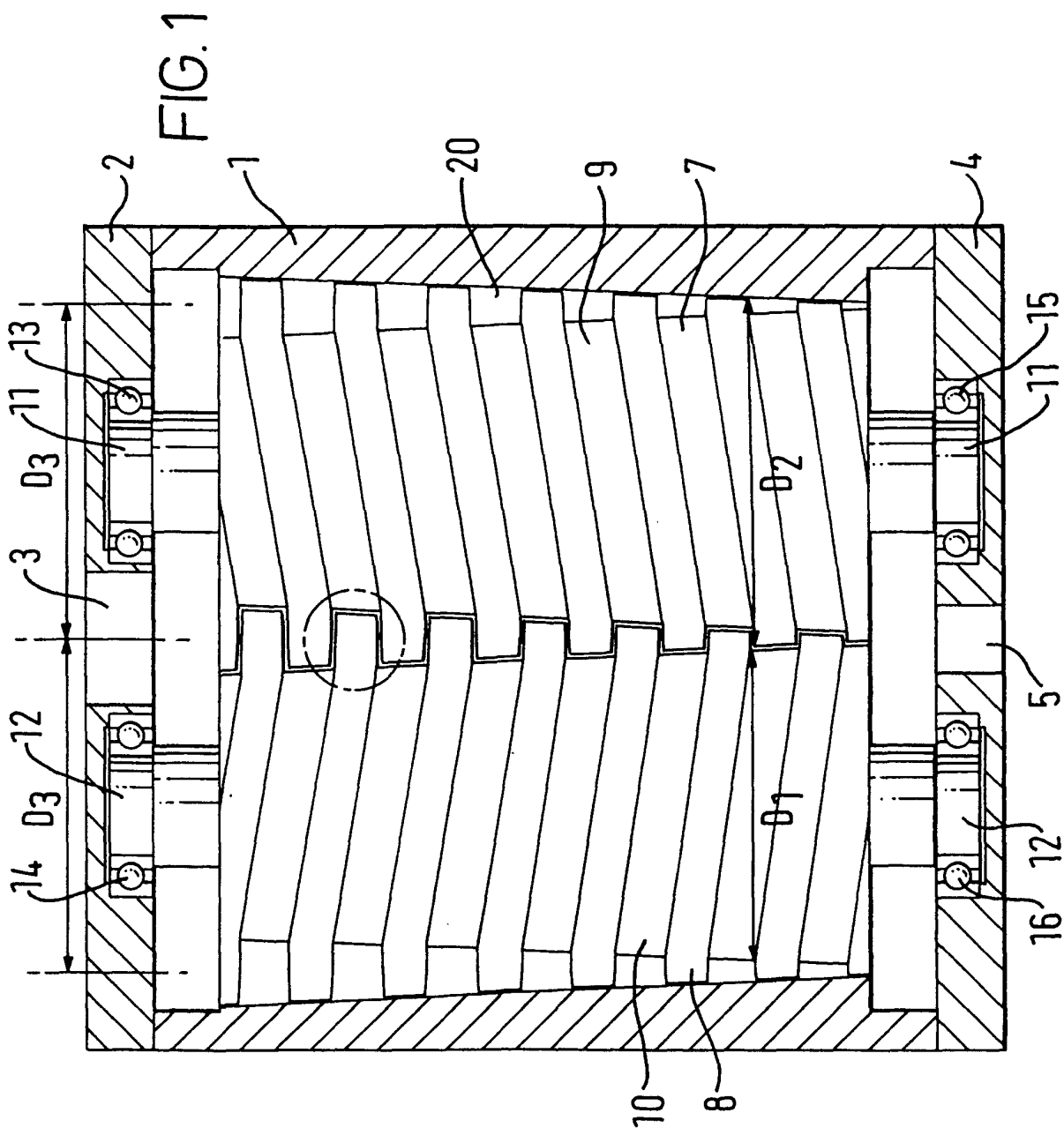


FIG. 2

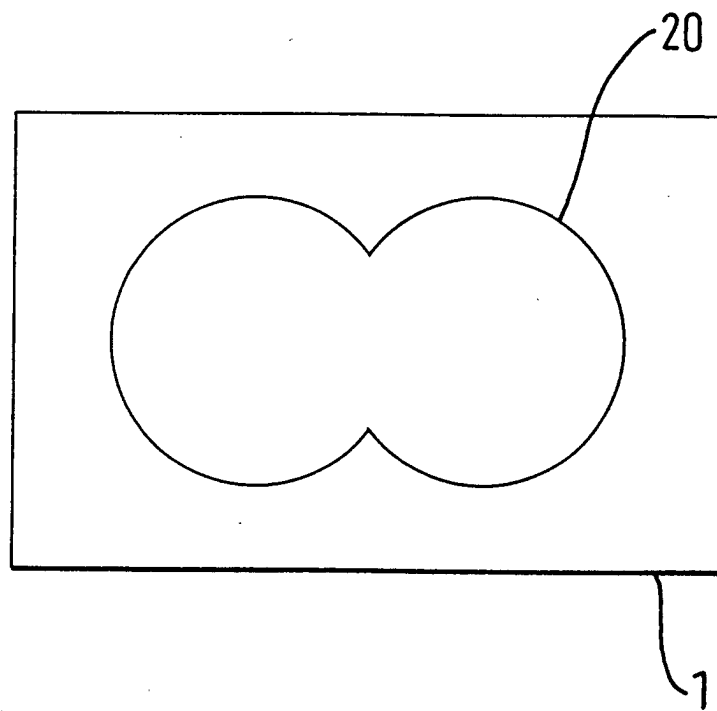


FIG. 3