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(54) **Lubricating system for regenerative vacuum pumps**

(57) In a vacuum pump of the regenerative type or including a regenerative section in which a rotatable substantially vertical shaft is supported by upper and lower bearings, a lubricating system for lubricating the bearings comprising an axial bore extending along the shaft and in communication with radial holes aligned respectively with the lower bearing and the upper bearing, the lower open end of the axial bore extending in to a shaft reservoir containing lubricating fluid, and in which the radial holes in alignment with the lower bearing are formed in a tapered surface of the axial bore

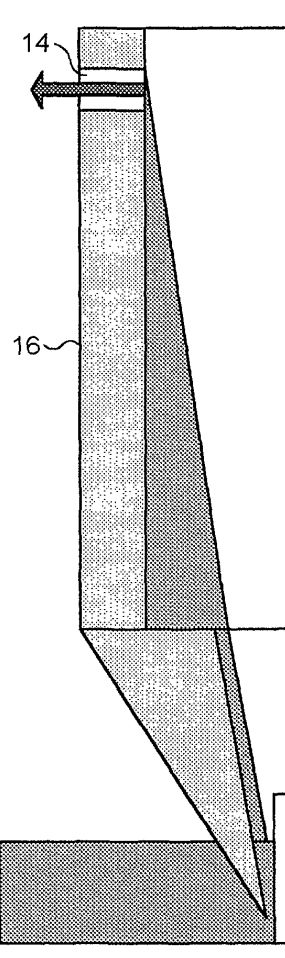


FIG. 2

EP 1 267 082 A2

Description

[0001] This invention relates to vacuum pumps of the regenerative type or which incorporate a regenerative section and which incorporate a high speed rotatable vertical shaft supported by bearings at each end of the shaft, and in particular to lubricating systems for such bearings.

[0002] In vacuum pumps of the regenerative type, a rotor is mounted on a vertical shaft for rotation within a surrounding stator. The shaft is supported by upper and lower bearings which require lubrication. To facilitate lubrication of the bearings the shaft is provided with a central axial bore which communicates with radial holes in alignment with the upper and lower bearings for delivering a lubricating fluid to the bearings.

[0003] It is known to utilise centrifugal force generated by the rotating shaft to draw the lubricating fluid from a reservoir up the axial bore in the form of a thin film to reach the radial holes in alignment with initially the lower bearing and finally the upper bearing. The lubricating fluid establishes its own taper in a straight axial bore provided that a small ledge is available at the lower end of the axial bore. In known lubricating systems the radial holes in alignment with the lower bearing terminate the taper and thus prevent further flow up the axial bore thereby starving the upper bearing of lubrication.

[0004] It is an aim of this invention to obviate this disadvantage.

[0005] According to the present invention, in a vacuum pump of the regenerative type or including a regenerative section in which a rotatable vertical shaft is supported by upper and lower bearings, a lubricating system for lubricating the bearings comprises an axial bore extending along the shaft and in communication with radial holes aligned respectively with the lower bearing and the upper bearing, the lower open end of the axial bore extending in to a shaft reservoir containing lubricating fluid, and in which the radial holes in alignment with the lower bearing are formed in a tapered surface of the axial bore.

[0006] An embodiment of the invention will now be described, by way of example, reference being made to the Figures of the accompanying diagrammatic drawings in which:

Figure 1 is a cross section through a known compound vacuum pump including a regenerative section;

Figure 2 is a detail of a known lubricating system illustrating how lubricating fluid establishes its own taper in a straight axial bore;

Figure 3 is a detail similar to Figure 2 but illustrating how in the known art excessive lubricating fluid can be delivered to the lower bearing whilst insufficient lubricating fluid is delivered to the upper bearing;

and

Figure 4 is a detail similar to Figures 2 and 3 but illustrating the lubricating system according to the present invention.

[0007] Referring first to Figure 1, which illustrates a known compound vacuum pump comprising a regenerative section 1 and a molecular drag (Holweck) section 2. The pump includes a casing 3 made from a number of different body parts bolted or otherwise fixed together and provided with relevant seals therebetween.

[0008] Mounted within the casing 3 is a vertical shaft 6 supported by an upper bearing 4 and a lower bearing 5. The shaft 6 is rotatable about its longitudinal axis and is driven by an electric motor 7 surrounding the shaft 6. Securely attached to the shaft for rotation therewith is a rotor 9. An axial bore 8 extends along a substantial length of the shaft and communicates with radial oil holes 8' delivering lubricating fluid to the upper and lower bearings.

[0009] Referring now to Figure 2, it is known that a lubricating fluid such as oil establishes its own taper in a straight axial bore providing a small ledge is available at the bottom (as shown) end of the axial bore.

[0010] Referring now to Figure 3, it is known to provide two sets of radial holes 14, 12 which communicate at one end with the axial bore 18 of a rotatable shaft 16 and respective upper and lower bearings (not shown). When the shaft 16 rotates, centrifugal force will force lubricating fluid from a reservoir through an open lower end of the shaft 16 and along the inside surface of the axial bore in the form of a thin film. However, the lower radial holes 12 effectively finalise the taper of the lubricating fluid film and prevent further flow of the film up the axial bore thereby starving the upper bearing of lubrication.

[0011] According to the present invention and with reference to Figure 4 the lower radial holes 12 in alignment with the lower bearing are formed in a tapered surface of the axial bore. This mechanical taper means that the lubricating fluid will continue to flow both out from the lower radial holes 12 and also past the holes 12 to the upper radial holes 14 to the upper bearings.

[0012] The ratio of lubricating fluid leaving the respective holes 12, 14 is dependent upon oil jet hole diameter, taper angle, hole height within the taper and taper diameter.

Claims

1. In a vacuum pump of the regenerative type or including a regenerative section in which a rotatable substantially vertical shaft is supported by upper and lower bearings, a lubricating system for lubricating the bearings comprising an axial bore extending along the shaft and in communication with

radial holes aligned respectively with the lower bearing and the upper bearing, the lower open end of the axial bore extending in to a shaft reservoir containing lubricating fluid, and in which the radial holes in alignment with the lower bearing are formed in a tapered surface of the axial bore. 5

2. In a vacuum pump of the regenerative type or including a regenerative section in which a rotatable substantially vertical shaft is supported by upper and lower bearings, a lubricating system for lubricating the bearings comprising an axial bore extending along the shaft and in communication with radial holes aligned respectively with the lower bearing and the upper bearing, the lower open end of the axial bore extending in to a shaft reservoir containing lubricating fluid, and in which the radial holes in alignment with the lower bearing are formed in a tapered surface of the axial bore and lower bearings, a lubricating system constructed and arranged substantially as hereinbefore described with reference to Figure 4 of the accompanying drawings. 10 15 20

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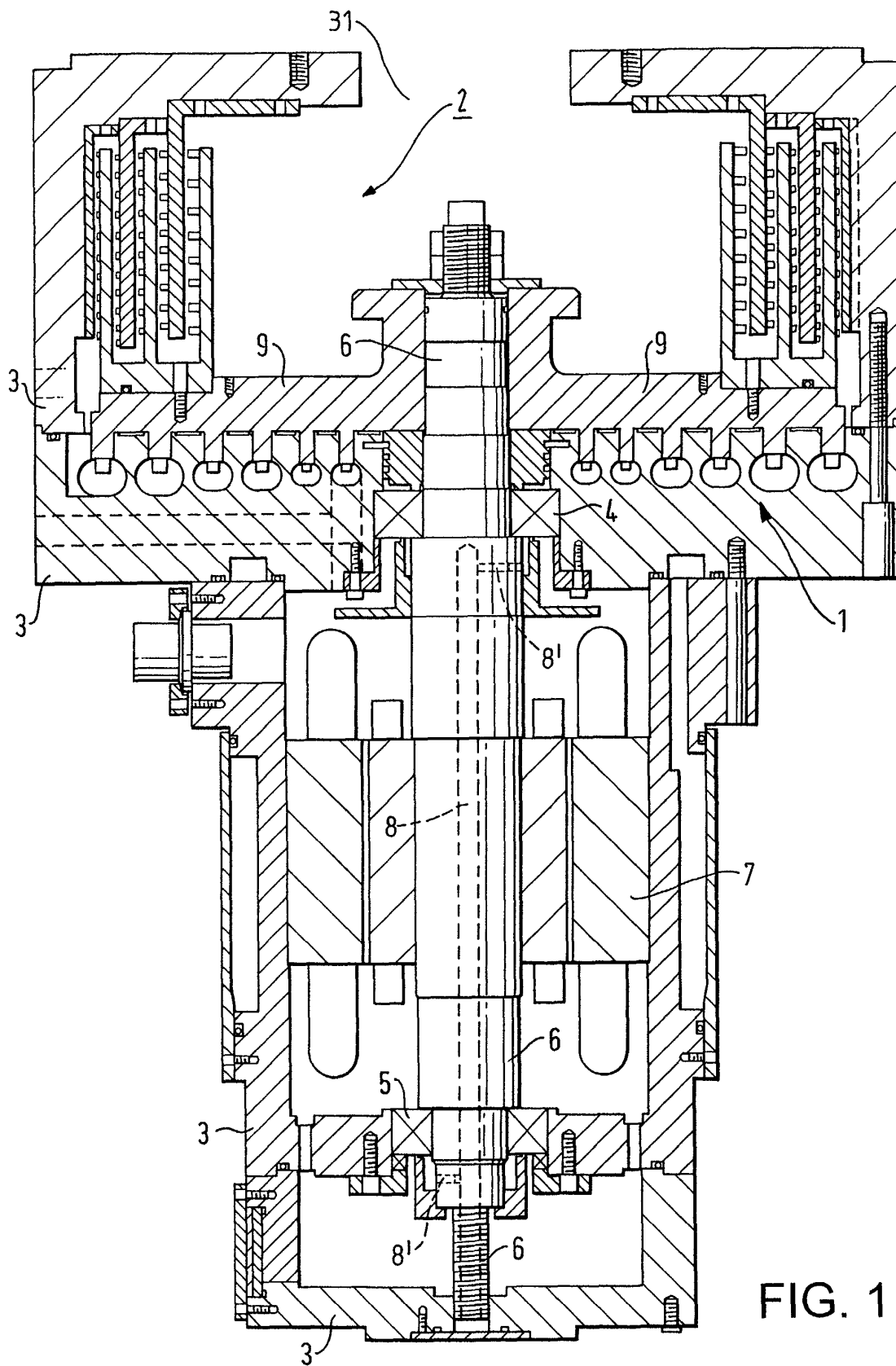


FIG. 1

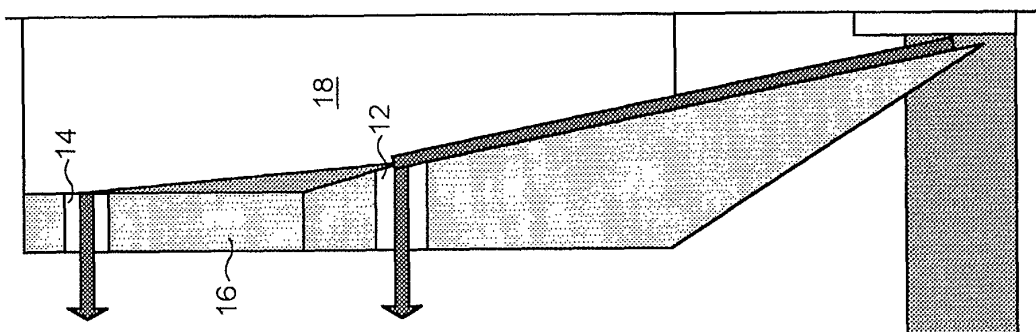


FIG. 4

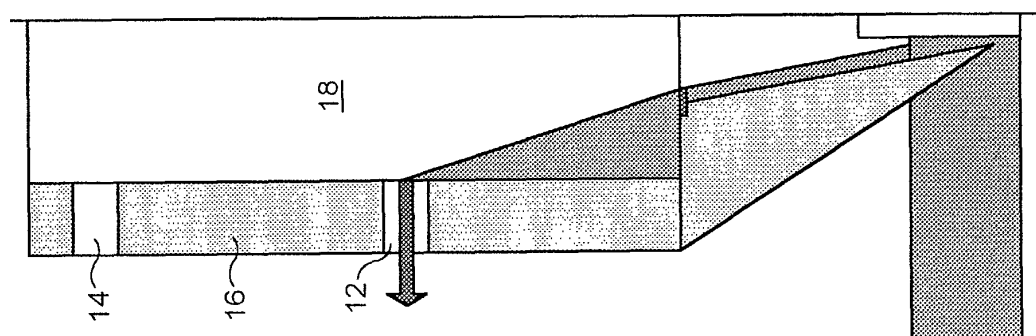


FIG. 3

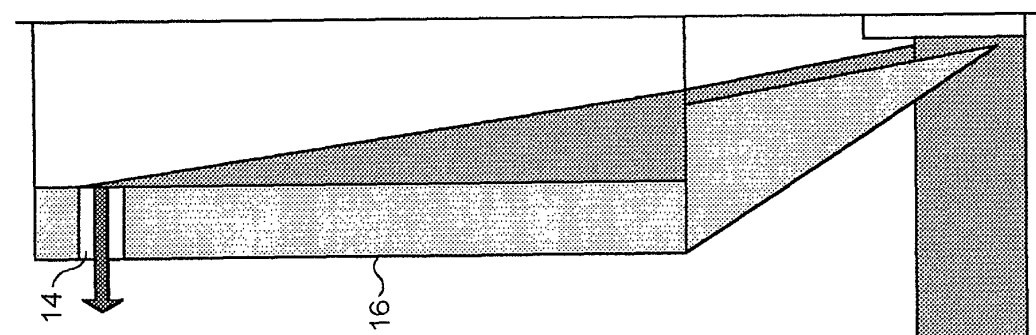


FIG. 2