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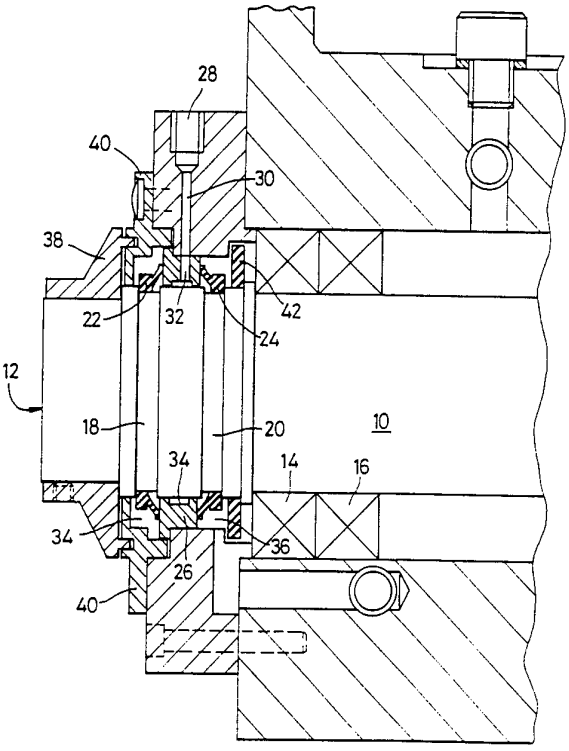
(54) Title: WIPING SEAL WITH MEANS FOR APPLYING FLUID PRESSURE TO SAID SEAL

(57) Abstract

The bearing of a machine tool spindle is sealed by a pair of wiping seals mounted on the shaft and resiliently urged into contact with opposite faces of a stationary ring through which the shaft extends. The very small clearance between the ring and the shaft is fed with gas for example air at low pressure. When there is no gas supply and for example when the shaft is stationary the seals contact the ring and the resilience ensures good contact and prevents seepage of for example lubricant along the shaft from one side of the seals to the other. When the shaft is to be driven, low pressure gas is supplied and this pressure deflects the seals to lift them from the face of the ring so that there is no frictional engagement and either power loss or heat generation, and any liquid which does go past the seals is thrown outwardly by centrifugal force and driven by the escaping gas.



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WIPING SEAL WITH MEANS FOR APPLYING FLUID PRESSURE TO SAID SEAL

This invention relates to machine tool spindles which support a cutting tool at one end and are journalled in bearings. It is usual to supply coolant/rinsing fluid such as suds to the tool, and it is important to prevent that fluid reaching the bearings. It is also usual to supply lubricant to the bearings and it is also desirable to prevent that lubricant leaking externally. So one or more seals are interposed between the bearings and cutting tool. This creates problems.

It is usual to employ wiping seals which maintain contact between rotating and non-rotating parts even when the rotation ceases. The wiping seal has to be resiliently held in place. It is known to use so-called V -rings which comprise a ring to fit tightly on the spindle and an integral radial flange, made from a slightly resilient material such as a suitable plastic or rubber. However, the wiping creates friction, which leads to temperature increase and this can lead to inaccuracy in the machining operation because the spindle centre portions will vary between cold and hot dimensions. Sometimes the shaft needs to be locally hardened or provided with for example ceramic surfaces as a seal component and to reduce wear and that also is expensive.

Labyrinth seals are often employed to avoid friction and its consequent heat and wear but multiple component labyrinths complicate the design, increase expense, and require addtional length which is a disadvantage in many designs.

Another well known seal system employs radially extending flanges freely located so that liquid - lubricant or coolant - creeping along the spindle will reach the flange and be thrown off by centrifugal force into an annular collector space. But these, like labyrinth seals are primarily and sometimes exclusively useful when the spindle is in use. When stopped for any

reason, undesired flow can occur from liquids already in place.

So the object of the invention is to provide an improved and simplified design.

According to the invention, a machine tool spindle comprises at least one wiping seal between the spindle and a fixed non-rotating part arranged to be displaced from contact with the said fixed part by an applied fluid pressure so as to avoid friction when so displaced.

The applied fluid pressure may be a purging gas. The effect of the purging gas may be not only to displace the parts to a non-contacting and hence non-friction position, but also to enable the flange to be used to throw off fluid by centrifugal force, and drain passages may be provided for such fluids.

Hence, when there is no purge gas the seal is a contact seal. When there is purge gas, the gas flow will prevent liquid flow in the counter-current direction through the seal, and when there is purge gas and spindle (including the seal) rotation, the seal can act to throw off liquid which reaches it.

Preferably a pair of such seals are arranged to contact opposite faces of a common fixed component through which the purge gas is fed and these may be oppositely inclined to form a V shape. The gas may be air.

One presently preferred embodiment of the invention is now more particularly described with reference to the accompanying drawing wherein the sole figure is a fragmentary sectional elevation of a single spindle. Those skilled in the machine tool art will recognise that multi-spindle assemblies are usual, and will realise that the invention may be employed on each and all of them.

In the drawing, the spindle is indicated by the

reference numeral 10 and end 12 is adapted in someway to carry the cutting tool (not shown). Bearings, diagrammatically indicated by the references 14,16, journal the spindle.

In this embodiment the spindle has a pair of shallow peripheral grooves 18,20. Each groove supports a V -ring 22,24 comprising a ring unitary with a radial flange which is inclined, i.e. the flange is a frusto-cone. The V -ring is made of a slightly resilient and slightly flexible synthetic resin as mentioned. The shape of the ring part cooperates with the corresponding groove to provide axial location. The resilience allows assembly by stretching (ring enlargement) to pass over the larger diameter portion of the spindle and then elastic recovery snaps the ring into the groove.

The spindle extends through a fixed stationary component 26 which has a small clearance between its bore and the spindle. The parallel faces of the fixed component form wiping surfaces which the two V -rings contact resiliently when stationary.

Air at a suitable pressure is supplied by a port 28 to flow through passages 30 32 and reach the rebate 34 in component 26 and then to flow axially in both directions through the small clearance and this deflects both flanges against their resilience so that they become slightly spaced from the component 26. This is done when the spindle is rotated. Consequently the lips of the seals make contact only when there is no air and when air is supplied and the spindle is rotated there is no friction.

The require air pressure depends upon the flinger characteristics, for example flexibility and resilience, but values as low as 0.042kg/sq.cm (0.6psi) have been found effective experimentally and a vlue of 0.14kg sq.cm (2psi) is typical.

When in operation it will be appreciated that the cutting fluid is flung and blown from the ring 22 and

lubricant from ring 24. In each case the effect is to throw the liquid to the outer and stationary wall of a collector chamber 34,36 for drainage through ports at the bottom of the chambers.

The drawing also shows a plate 40 and a further flinger disc 42 which protect the resilient material from direct impact by high velocity fluids.

A further front metallic flinger 38 with labyrinth seal to plate 40 is shown but at present is thought to be unnecessary to the fundamental operation of the invention.

CLAIMS

1. A machine tool spindle comprising at least one wiping seal extending between the spindle and a fixed non-rotating part, the seal being mounted on one of and making sealing contact with the other of the spindle and said part, and means for applying fluid pressure to said wiping seal so as to displace the same out of said contact.

2. A spindle as claimed in Claim 1 wherein means are provided for delivering a purging gas to effect said displacement.

3. A spindle as claimed in Claim 1 or Claim 2 wherein a pair of such seals are provided and mounted on said spindle, said pair of seals contacting opposite faces of a common fixed component.

4. A spindle as claimed in Claim 3 wherein said common component is provided with passages for feeding purge gas to displace both of said seals away from said component.

5. A spindle as claimed in Claim 2 wherein the purge gas is air.

6. A machine tool spindle substantially as described with reference to the accompanying drawing.

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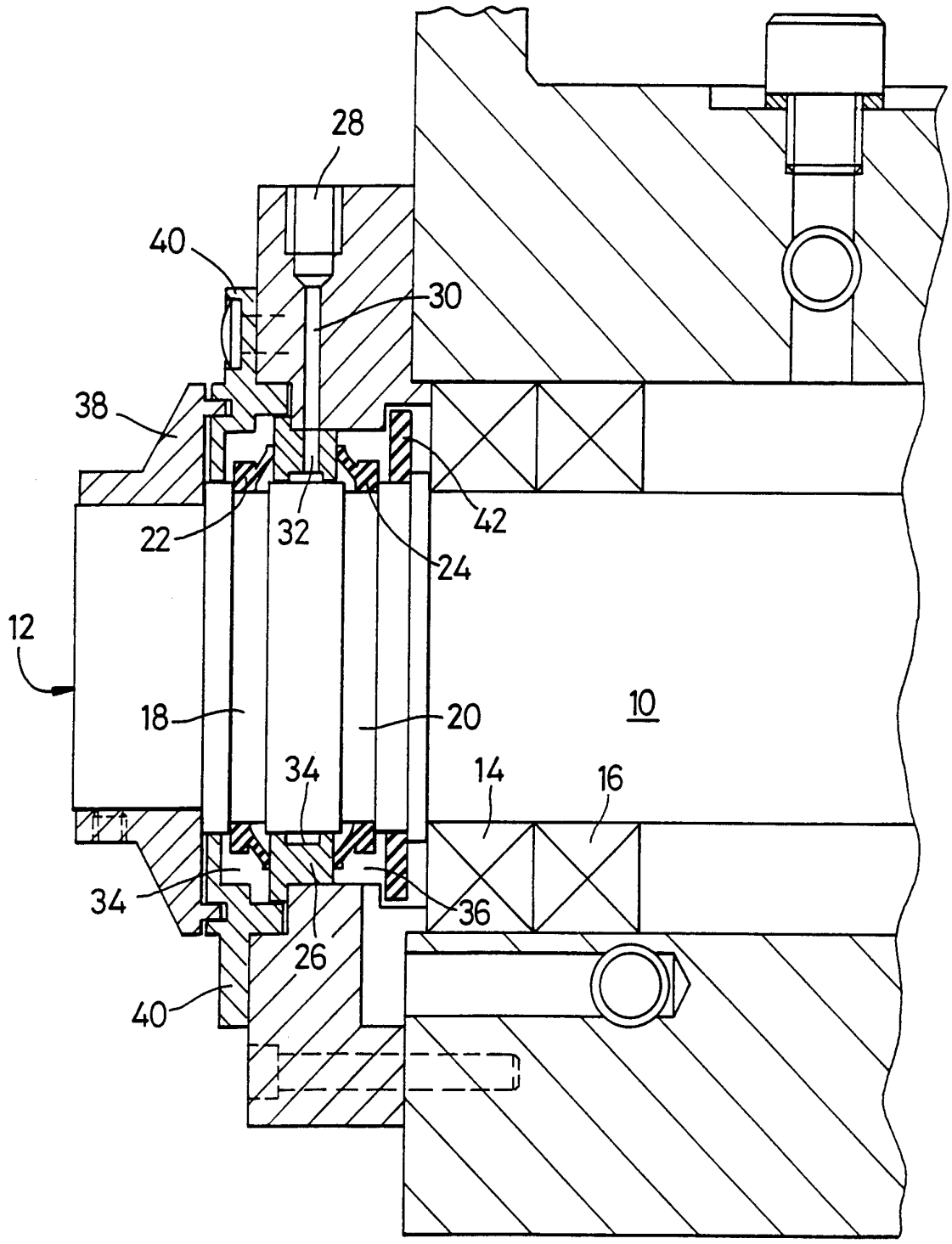

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 93/01791

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: F16J 15/40, B23Q 11/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: B23B, B23Q, F04D, F16C, F16J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y		3,4
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X	DE, C2, 2709243 (FORSHEDA GUMMIFABRIK AB), 21 April 1983 (21.04.83), column 3, line 19 - column 4, line 4, figure 1	1,2,5
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X	US, A, 4189157 (MAHAN ET EL), 19 February 1980 (19.02.80), column 4, line 30 - line 38; column 5, line 4 - line 29, figure 3	1,2,5
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE, A1, 2212165 (AEROQUIP (U.K.) LTD), 28 Sept 1972 (28.09.72), page 2, line 21 - page 4, line 2, figure 1 --	3,4
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/GB 93/01791

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DE-A1- 3438755	24/04/86	NONE	
DE-C2- 2709243	21/04/83	NONE	
US-A- 4189157	19/02/80	NONE	
DE-A1- 2212165	28/09/72	GB-A- 1389832	09/04/75
GB-B- 1147787	22/06/66	NONE	