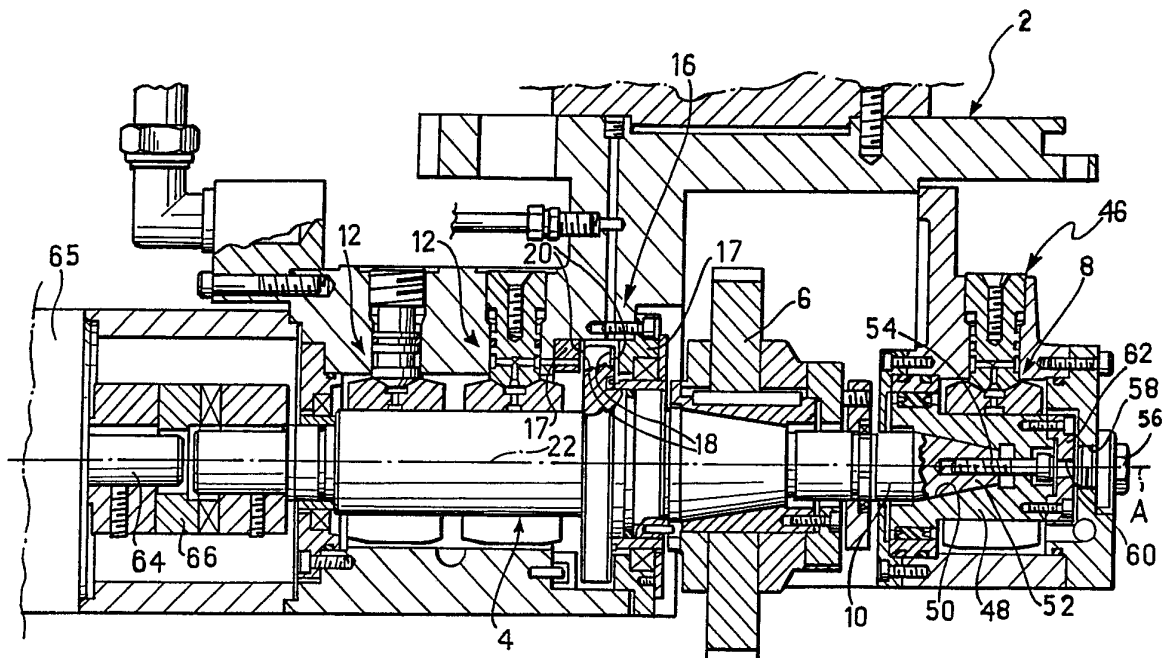




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification 5 : B23F 19/06, 23/12, B23Q 1/08 B23Q 1/26, F16C 32/06</p>	A2	<p>(11) International Publication Number: WO 91/04120 (43) International Publication Date: 4 April 1991 (04.04.91)</p>
<p>(21) International Application Number: PCT/EP90/01566 (22) International Filing Date: 14 September 1990 (14.09.90) (30) Priority data: 53350 B/89 19 September 1989 (19.09.89) IT (71) Applicant (for all designated States except US): BOCCA & MALANDRONE DI MALANDRONE & C. S.A.S. [IT/IT]; Via XXV Aprile, 166, I-10042 Nichelino (IT). (72) Inventor; and (75) Inventor/Applicant (for US only): MALANDRONE, Attilio [IT/IT]; Via XXV Aprile, 166, I-10042 Nichelino (IT). (74) Agents: SACONNEY, Piero et al.; Jacobacci-Casetta & Perani S.p.A., Via Alfieri, 17, I-10121 Torino (IT).</p>		<p>(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent)*, DK (European patent), ES (European patent), FR (European patent), GB (European patent), HU, IT (European patent), JP, LU (European patent), NL (European patent), RO, SE (European patent), SU, US.</p> <p>Published Without international search report and to be republished upon receipt of that report.</p>

(54) Title: A GEAR-SHAVING MACHINE



(57) Abstract

The machine includes a fixed support structure (2) with a hydrostatic unit for supporting a spindle (4) carrying a shaving blade (6). The hydrostatic support unit includes a first radial hydrostatic bearing (8) arranged at one end (10) of the spindle (4), a pair of radial hydrostatic bearings (12) arranged on a part of the spindle (4) which is on the opposite side of the shaving blade (6) from the end (10) carrying the first bearing (8), an axial hydrostatic bearing (16), and an oleodynamic unit for supplying pressurised lubricating fluid to the bearings. The first radial bearing (8) is carried by a door (46) which is articulated to the fixed support structure (2) about an axis (B) perpendicular to the longitudinal axis (A) of the spindle (4) but not incident thereon.

DESIGNATIONS OF "DE"

Until further notice, any designation of "DE" in any international application whose international filing date is prior to October 3, 1990, shall have effect in the territory of the Federal Republic of Germany with the exception of the territory of the former German Democratic Republic.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MC	Monaco
AU	Australia	FI	Finland	MG	Madagascar
BB	Barbados	FR	France	ML	Mali
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Fasso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GR	Greece	NL	Netherlands
BJ	Benin	HU	Hungary	NO	Norway
BR	Brazil	IT	Italy	PL	Poland
CA	Canada	JP	Japan	RO	Romania
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	LI	Liechtenstein	SN	Senegal
CM	Cameroon	LK	Sri Lanka	SU	Soviet Union
DE	Germany	LU	Luxembourg	TD	Chad
DK	Denmark			TG	Togo
				US	United States of America

A gear-shaving machine

The present invention relates to a gear-shaving machine.

Shaving is a finishing operation which consists of the elimination of deformities and roughness resulting from the gear-cutting operation.

In known shaving machines, the shaving blade is carried by a spindle mounted rotatably on the structure of the machine by means of rolling bearings, typically oblique ball bearings. The ball bearings tend to wear quite quickly and the resulting play of the spindle affects the working accuracy of the shaving blade, causing anomalous working of the gear and bad finishing of the involutes. In prior-art shaving machines, in order to avoid these problems, mechanical corrections were performed on the shaving blade to compensate for the errors and the play of the spindle. These corrections, which were achieved through several repeated attempts, involved losses of time and productivity as a result of the lengthy periods necessary for setting up the blades, with consequent stoppages of the machine, and also involved the costs of sharpening the shaving blades.

The object of the present invention is to provide a gear-shaving machine which overcomes the aforesaid problems and also enables the shaving blade to be replaced without the need for lengthy and complex operations.

According to the present invention, this object is achieved by a gear-shaving machine characterised in

that it comprises a support structure with a hydrostatic unit for supporting a spindle carrying a shaving blade, the hydrostatic support unit including:

- a first radial hydrostatic bearing arranged at one end of the spindle,
- a pair of radial hydrostatic bearings arranged on a part of the spindle which is on the opposite side of the shaving blade from the end carrying the first bearing,
- an axial hydrostatic bearing, and
- an oleodynamic unit for supplying pressurised lubricating fluid to the bearings,

the said radial bearing being carried by a door which is articulated to the fixed support structure about an axis which is perpendicular to the longitudinal axis of the spindle but not incident thereon.

In order to prevent working errors caused by the kinematic chain which transmits the drive from the electric motor to the spindle, in the shaving machine of the present invention, the spindle is, to advantage, rotated by an electric motor whose shaft is coaxial with the spindle and is connected directly thereto.

Further characteristics and advantages of the present invention will become clear in the course of the detailed description which follows with reference to the appended drawings, provided purely by way of non-limiting example, in which:

Figure 1 is a perspective view of a shaving machine according to the present invention,

Figure 2 is an axial section of the machine of Figure 1, and

Figure 3 is a section taken on the line III-III of Figure 1.

With reference to the drawings, a gear-shaving machine, indicated 1, includes a fixed support structure 2 carrying a spindle 4 which is rotatable about its own longitudinal axis A and carries a shaving blade 6.

As can be seen in Figure 2, the spindle 4 is mounted on the support structure 2 by means of a hydrostatic support unit comprising a first radial hydrostatic bearing 8 arranged at one end 10 of the spindle 4 and a pair of radial hydrostatic bearings 12 arranged on a part of the spindle 4 which is on the opposite side of the shaving blade 6 from the end 10. The hydrostatic support unit also includes an axial bearing 16 constituted by a pair of rings 17 which are fixed to the support structure 2 and whose end surfaces 18 face the opposite end faces 20 of a flange 22 formed on the spindle 4.

As can be seen in Figure 3, each radial bearing 8, 12 is constituted by three sectors 24, each of which has a cylindrical surface 26 facing the surface of the spindle 4. Each sector 24 has a spherical seat 28 in the surface of the sector 24 opposite the cylindrical surface 26. The spherical seat 28 in each sector 24 is engaged by a spherical head 30 of a bearing member 32 arranged in a respective hole 34 in the support

structure 2. Each bearing member 32 has a radial hole 36 which communicates with a respective pressurised-oil supply duct 38. The hole 36 communicates with a groove 40 formed in the cylindrical surface 26 of the corresponding sector 24 through two radial holes 42, 44 formed in the spherical head 30 and in the sector 24 respectively. The ducts 38 are connected to a hydraulic unit (not shown) which sends oil to the bearings 8, 12, and 16 at a pressure of approximately 3.5 bars. The oil is kept circulating in the hydraulic unit and its circulation stabilises the temperature of the unit supporting the spindle 4. The sectors 24 of the radial bearings 8, 12 and the rings 17 of the axial bearing 16 are kept spaced from the corresponding surfaces of the spindle 4 by oil films approximately 10 microns thick, preventing wear of the parts and the creation of both radial and axial play.

The radial bearing 8 at the end 10 of the spindle 4 is carried by a door 46 articulated to the support structure 2 about an axis B which is perpendicular to the longitudinal axis A of the spindle 4 but is not incident on the axis A (Figure 1). As can be seen in Figure 2, the radial bearing 8 rotatably supports for rotation a sleeve 48 fixed to the end 10 of the spindle 4. A conical cavity 50 is formed in the sleeve 48 and mates with a conical end shank 52 of the spindle 4. The conical surfaces of the cavity 50 and the shank 52 are kept in mutual contact by the axial loading achieved by a screw 54 extending along the longitudinal axis A of the spindle 4.

The door 46 has a screw plug 56 which closes a hole 58 through which the head of the screw 54 is accessible through a further hole 60 formed in a plate 62 fixed to

the sleeve 48. In order to open the door 46, the screw 54, whose head reacts against the plate 62, is unscrewed, causing the sleeve 48 to move away from the spindle 4 and thus opening the door 46. When the door 46 is open, the shaving blade 6 is accessible and can therefore be removed and replaced extremely easily and quickly.

The opposite end of the spindle 4 from the end 10 carrying the radial bearing 8 is connected directly to the shaft 64 of a brushless direct-current electric motor 65 by means of a coupling 66. The direct connection of the motor 65 to the spindle 4 eliminates play in the kinematic mechanisms of the transmission which is usually interposed between the motor and the spindle.

CLAIMS

1. A gear-shaving machine, characterised in that it includes a fixed support structure (2) with a hydrostatic unit for supporting a spindle (4) carrying a shaving blade (6), the hydrostatic support unit including:

- a first radial hydrostatic bearing (8) arranged at one end (10) of the spindle (4),

- a pair of radial hydrostatic bearings (12) arranged on a part of the spindle (4) which is on the opposite side of the shaving blade (6) from the end (10) carrying the first bearing (8),

- an axial hydrostatic bearing (16), and

- an oleodynamic unit for supplying pressurised lubricating fluid to the bearings,

the first radial bearing (8) being carried by a door (46) which is articulated to the fixed support structure (2) about an axis (B) perpendicular to the longitudinal axis (A) of the spindle (4) but not incident thereon.

2. A machine according to Claim 1, characterised in that the spindle (4) is rotated by an electric motor (65) whose shaft (64) is coaxial with the spindle and is connected thereto.

3. A machine according to Claim 1, characterised in that each of the radial hydrostatic bearings (8, 12) comprises three sectors (24), each of which has a

cylindrical surface (26) facing the spindle (4) and a spherical seat (28) in the surface of the sector (24) opposite the cylindrical surface (26), the spherical seat (28) being engaged by a bearing member (32) which has a spherical head (30) of a shape corresponding to that of the seat (28) and which is connected to a pressurised-oil supply duct (38).

4. A machine according to Claim 1, characterised in that the axial hydrostatic bearing (16) comprises a pair of rings (17) fixed to the support structure (2) and having respective end surfaces (18) facing the opposite end faces (20) of a flange (22) formed on the spindle.

5. A machine according to Claim 1, characterised in that the first radial bearing (8) rotatably supports a sleeve (48) having a conical cavity (50) which mates with a conical shank (52) at the end (10) of the spindle (4), the sleeve (48) being fixed to the spindle (4) by means of a screw (54) extending along the longitudinal axis (A) of the spindle (4).

1/2

FIG. 3

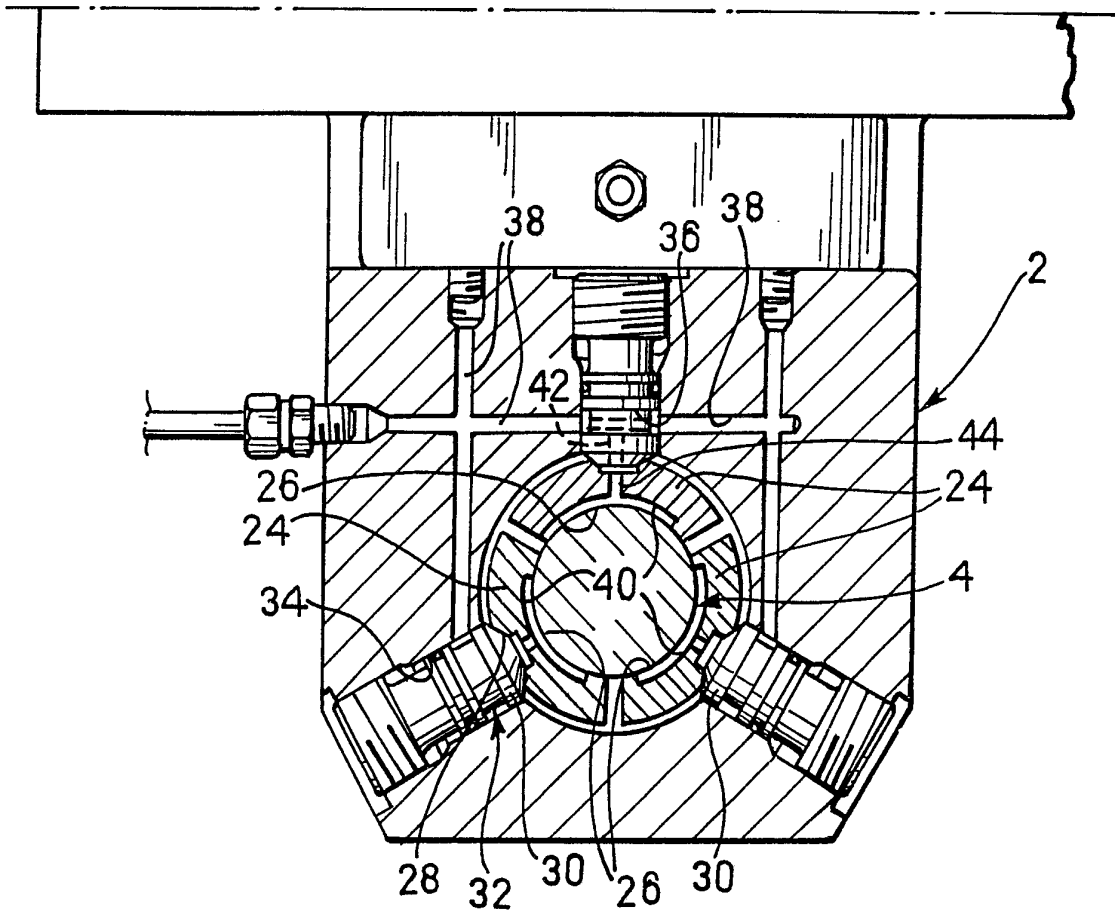
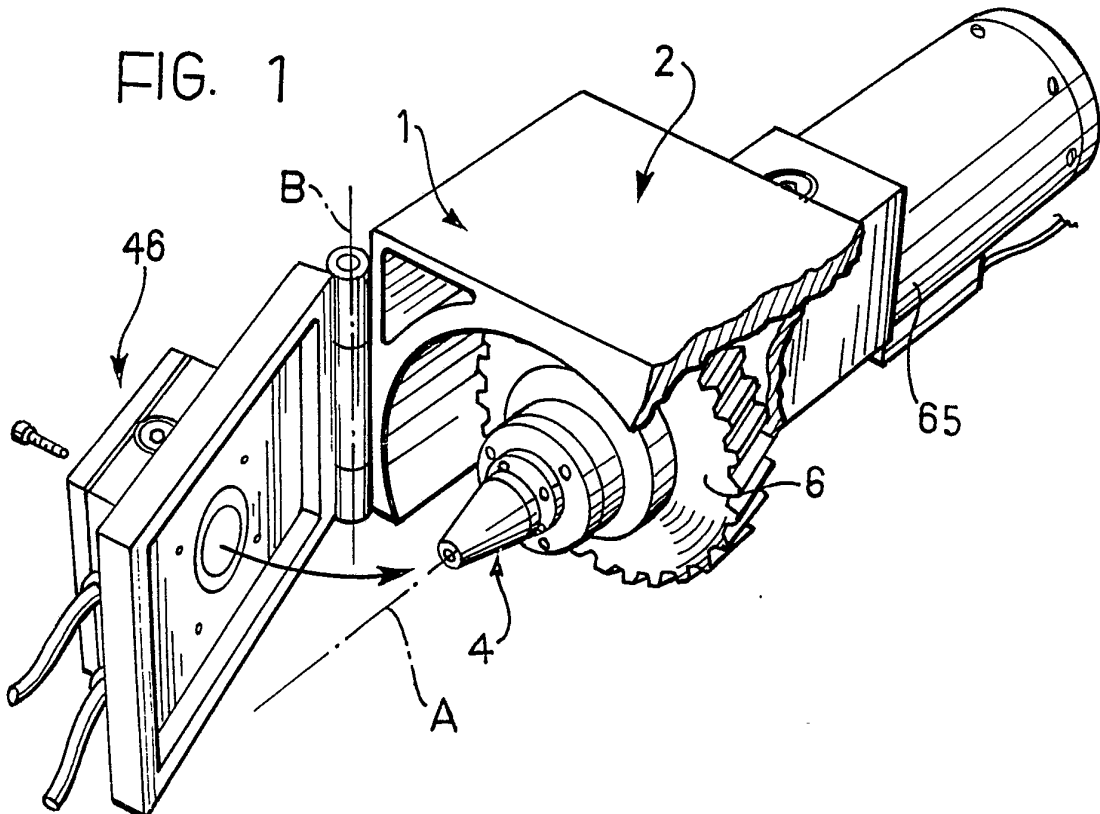


FIG. 1



2/2

FIG. 2

