(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 199721846 B2
(10) Patent No. 712653

(54) Title

Mechanically adjustable wear indicator

(51)[6] International Patent Classification(s)
F16D 066/02

(21) Application No: 199721846

(22) Application Date: 1997.03.13

(87) WIPO No: WO97/47896

(30) Priority Data

(31) Number	(32) Date	(33) Country
9602343	1996.06.13	SE

(43) Publication Date : 1998.01.07
(43) Publication Journal Date : 1998.03.05
(44) Accepted Journal Date : 1999.11.11

(71) Applicant(s)

Volvo Wheel Loaders AB

(72) Inventor(s)

Tord Dahlen; Bengt Vilen; Thomas Andersson

(74) Agent/Attorney

GRIFFITH HACK,GPO Box 1285K,MELBOURNE VIC 3001

(56) Related Art

US 4186822
US 3533491
FR 2206821

OPI DATE 07/01/98 APPLN. ID 21846/97
AOJP DATE 05/03/98 PCT NUMBER PCT/SE97/00428
INTE.
AU9721846

(51) International Patent Classification 6 : F16D 66/02

A1

(11) International Publication Number: WO 97/47896

(43) International Publication Date: 18 December 1997 (18.12.97)

(21) International Application Number: PCT/SE97/00428

(22) International Filing Date: 13 March 1997 (13.03.97)

(30) Priority Data:
9602343-7 13 June 1996 (13.06.96) SE

(71) Applicant *(for all designated States except US)*: VOLVO WHEEL LOADERS AB [SE/SE]; S-631 85 Eskilstuna (SE).

(72) Inventors; and

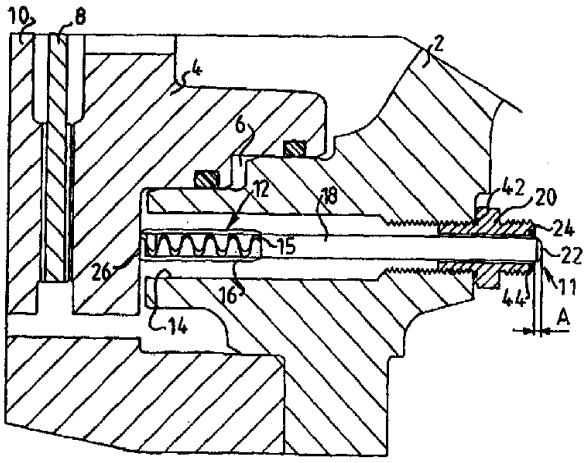
(75) Inventors/Applicants *(for US only)*: DAHLÉN, Tord [SE/SE]; Eskilstunavägen 19C, S-632 39 Eskilstuna (SE). VILÉN, Bengt [SE/SE]; Kärrbäck, S-733 92 Sala (SE). ANDERSSON, Thomas [SE/SE]; Heljestrandsgatan 13B, S-633 44 Eskilstuna (SE).

(74) Agents: HELLBOM, Lars et al.; H. Albihns Patentbyrå AB, P.O. Box 3137, S-103 62 Stockholm (SE).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
In English translation (filed in Swedish).

(54) Title: MECHANICALLY ADJUSTABLE WEAR INDICATOR



1

(57) Abstract

The invention relates to a wear indicator (11) for a vehicle brake, for example. The indicator has an adjustable measuring rod (12) which can be inserted into a cavity (14) in a brake housing (2), so that one end abuts against the brake piston (4) and the other end protrudes from the brake housing. When the brake is engaged, the length of the measuring rod (12) can be calibrated by means of a calibrating cap (27, 30) to a predetermined starting value corresponding to new friction linings.

Mechanically adjustable wear indicator

The invention relates to a wear indicator for friction linings of, for example, the type disclosed in the preamble to the attached claim 1.

A tractor or motorized excavation machinery, for example, an agricultural tractor, a loader, a dumper of an excavator, is often used off road and thus dirt and mud, water or snow can cover the wheels and form thick coatings on the wheels covering the wheel hubs. The law and security considerations dictate that all motor vehicles and in particular heavy vehicles must have well functioning brakes. It is therefore important, despite the heavy coating of dirt on the wheel hubs, to be able to check the wear situation for each friction lining in the vehicle without having to disassemble the brakes or drive to the shop for checking.

Wear indicators based on electrical, electronical or mechanical principles are previously known but are unreliable, and the first two mentioned tend not to function at all under the hard operating conditions described above. Another disadvantage is that the driver is first alerted when the friction lining in question is almost completely worn down, for example by an electrical circuit being broken. In principle, the lining is then worn down to a maximum permissible thickness determined by the manufacturer, which means that the vehicle should no longer be driven until new linings have been installed.

A conventional mechanical method of measuring brake wear is by measuring, through a cavity in the flange of the axle casing and in the brake piston, with a special tool against the countersurfaces and discs of the brake, and comparing these measurements to calculate the thickness of the lining. Since vehicles of this type usually have oil-cooled brakes, the cavity in the axle casing must be replugged after each measurement and transmission oil runs out through the cavity during the measuring process.

Another method of conventional type is making a radial opening in the hub retainer directly in front of the peripheral edge of the brake disc. For the same reasons as discussed above, the opening is normally replugged. The distance between the countersurface and the brake piston in a portion located outside the peripheral edge of the brake disc is measured with a type of feeler gauge, which is inserted through the radial opening. An additional disadvantage of this method is that the radial opening in some vehicles is covered by the wheel rim, which means that the wheel must be taken off prior to each measurement.

A further developed mechanical variant has an easily displaceable rod built into the brake, with the aid of which it is possible to measure the position of the brake piston relative to the brake housing when the brake is engaged. Conventionally, this pin has a fixed length which is a disadvantage as it means that the measured distance varies depending on the tolerances of the components affecting the length of the protruding pin. Such components can be the brake housing, the piston, the discs, the stationary discs and the counter surface. The two previously described methods also have this disadvantage.

An advantage with the wear indicator according to the invention is, however, that it is possible to check, whenever desired, directly at the construction site, the degree of wear of each lining in a reliable manner, by virtue of the fact that an adjustable measuring rod is arranged at each wheel. With the aid of a sliding caliper or some other type of measuring stick it is then simple to measure how far the measuring pin protrudes out from a given measuring plane of the indicator. It is advantageous to specify the limit for worn linings in the operators and repair manuals for the vehicle, making optimum use of the linings possible while main-taining a high level of safety, replacing the linings before they are completely worn down.

The purpose of the present invention is therefore to achieve a wear indicator of the type described by way of introduction in which the disadvantages described above

have been removed or been minimized and the effect of the tolerances of the components has been eliminated.

This is achieved with a wear indicator of the type described by way of introduction which has the features disclosed in the characterizing clause of the attached claim 1.

Additional purposes and features and advantageous further developments and improvements of the invention are disclosed in the dependent claims.

A preferred embodiment of the invention will be described in more detail below in the following description but only as examples, with the aid of the accompanying schematic drawing.

Fig. 1 shows a portion of a fluid cooled friction brake in section with a mounted wear indicator,
Fig. 2 shows on a larger scale a detail of the indicator with a protective cap mounted, and
Figs. 3 and 4 show a calibrating cap and a protective cap, respectively, for the indicator in enlargement.

Tractors and motorized implements usually have encapsuled axles and brakes and in a friction brake 1 of such a vehicle, as a rule, the outer end of the axle casing is made as a brake housing 2 in which a brake piston 4 made in one piece with a pressure plate is displaceably mounted. The piston is displaceable using a hydraulic fluid which is enclosed in an annular chamber 6 enclosed between the housing and the piston. A brake disc 8 provided on both sides with friction material is arranged between the brake piston and a counter-surface 10. For reasons of cost, the thickness of the friction material on each side is only circa 2 mm and the brake is of "wet-brake"-type, which means that both the piston 4 and the brake disc 8 as well as the counter-surface 10 are arranged in a bath of oil, which in turn provides more effective cooling and thus reduces the wear on the friction material. Due to the

thinness of the friction material the requirements as to precision and reliable indication of its current thickness increase so that the lower wear limit will not be exceeded. In order to assure cooling and a continuously effective braking effect, this limit is set so that the cooling grooves remain, which means at least 0.5 mm of thickness, which means that the wear allowance on a new brake until the friction linings must be replaced, will be a maximum of 1.0 mm per side and thus a total maximum wear allowance per wheel brake of 2 mm.

According to the embodiment shown, this is achieved with a wear indicator 11 comprising an easily displaceable adjustable measuring rod 12 which is mounted in a cavity 14 in the brake housing 2, said measuring rod being made in two parts, a tube 16 radially resilient by means of a slot 15 extending along the length of the tube and a pin 18 partially inserted in the tube. The inner diameter is adapted to the outer diameter of the pin in such a manner that the tube is joined to the pin by means of a forced frictional engagement which cannot be overcome without the aid of tools. In the embodiment shown, the slot 14 is toothed (wave-shaped) but other constructions are also possible, for example a straight or helical shape.

On the outside of the brake housing, a threaded nipple 20 is screwed into a corresponding thread in the cavity 14. This nipple has a through-hole which is a guide for the pin 18 of the measuring rod 11, which is inserted into the cavity 14 with the tube 16 facing towards the brake piston 4 and consequently with the free end of the pin 18 extending out of the nipple. The protruding pin end, as is the outer end of the nipple and the free end of the tube, are made with respective measuring planes 22,24,26.

The outer end of the nipple is provided with an external thread on which a flange nut 27 can be screwed. A protective cap 28 or in certain cases a calibrating cap 30 can be mounted as an inset abutting against the annular flange 32 of the flange nut so that the nut when screwed on with the protective cap will protect against the

penetration of impurities and with a calibration cap it can be used to set the starting value of the indicator 11 when the brake has been provided with new brake linings.

For this purpose, the calibrating cap has a calibration cavity 34, the depth A of which determines the permissible wear thickness of the brake. According to this embodiment, when the calibrating cap is mounted, it will permit the measuring plane 22 of the pin end to protrude 2 mm from the measuring plane 24 of the nipple, when the measuring plane of the pin end is in contact with a bottom 36 of the calibration cavity.

The protective cap 28, on the other hand, has a cavity 38, the bottom 40 of which is located at a depth B which corresponds to at least the sum of the permitted wear (2 mm) and the maximum stroke of the brake piston, which is 1 - 2 mm.

In order to prevent both penetration of impurities and leakage of transmission oil, a ring seal 42 and 44, respectively, is arranged between the nipple 20 and the outside of the brake housing 2 and between the outer end 24 of the nipple and the protective cap 28.

Instead of the flange nut described with the inset caps, other types of nuts with fixed insets can be used, e.g acorn nuts, as protective caps or calibrating caps with corresponding cavities as described above.

The wear indicator functions in the following manner. The measuring rod 12 is pre-mounted by pushing the pin 18 a certain distance into the tube 16 but only so far so that, after mounting and engaging the brake and after the nipple 20 has been screwed securely into the brake housing 2, the free end of the pin protrudes somewhat further out than what corresponds to the permitted wear on the brake when the measuring plane 26 of the tube is in contact with the brake piston 4.

The flange nut 27 with the calibrating cap 30 is then screwed securely onto the nipple, and the calibrating cap overcomes the frictional engagement between the components and presses the pin 18 into the tube 16 until the calibrating cap finally is in contact with the measuring plane 24 of the nipple. Since the measuring plane 22 of the pin end in this position abuts against the bottom 36 of the calibrating cap, the length of the measuring rod 12 is now exactly adjusted so that the distance A exactly corresponds to the allowable wear thickness. The nut 27 is screwed off and the calibrating cap is replaced with the protective cap 32 and the seal 42, and these parts are brought into sealing abutment against the outer end of the nipple by means of the nut.

Due to the fact that the depth B of the protective cap permits the measuring rod 12 to follow the reciprocating movements of the brake piston without being clamped between the brake piston 4 and the bottom 40 of the protective cap, the set length of the measuring rod is not changed. It is thus very simple to later check the remaining wear thickness at a work place by removing the protective cap 32, engaging the brake, pressing the measuring rod against the piston and measuring how far the rod protrudes outside the measuring plane of the nipple 20.

With the described wear indicator, it is thus possible, with the aid of a single calibrating cap to precisely calibrate the measuring rods of all the wheel brakes without having to take into account individual variations and tolerances in manufacturing and mounting of the brakes.

Finally, it is also possible to remotely read remaining wear thickness by arranging a compression spring between the nipple 20 and the tube 16 to press the rod against the brake piston and, for example, an electric sensor which continuously senses the protruding length of the rod, and indicate it on an instrument in the operator's cab of the vehicle.

Claims

1. Wear indicator (11) for friction linings of vehicle brakes, for example, comprising a brake housing (2) with brake means (4) movable relative to the brake housing, a counter-surface (10) solidly anchored to the brake housing and at least one friction means (8) provided with a friction lining, said friction means being displaceable by means of the brake means between an inactive position and an engaged position pressed against the counter-surface and the brake means, said wear indicator comprising spacer means (12) arranged in a cavity (14) in the brake housing, said spacer means being displaceable with one end (26) in contact with the brake means (4) and with the other end (22) protruding outside the brake housing a predetermined distance, which is dependent on the distance between the brake means and the counter-surface, **characterized** in that the spacer means (12) has an adjustable length which can be set by means of a calibrating means (27,30) to agree with a predeter-mined starting value (A) when the friction means (8) are in engaged position.

2. Wear indicator according to Claim 1, **characterized** in that the protruding part of the spacer means (12) corresponds to a maximum permissible wear allowance (A) for new friction linings.

3. Wear indicator according to Claim 1 or 2, **characterized** in that the spacer means (12) is made of at least a first (16) and a second (18) part, said parts being displaceable to selectable positions relative to each other, in which the parts are forceably bound to each other.

4. Wear indicator according to one of Claims 1-3, **characterized** in that the first portion of the spacer means (12) is a radially resilient tube (16) and its other portion is a pin (18) with an outer diameter fitted to the inner diameter of the tube, and that the tube can be forced onto the pin and is held thereon by means of frictional engagement created by the resilient force of the tube.

5. Wear indicator according to one of Claims 1-4, **characterized** in that the protruding distance of the spacer means (12) can be set to a selected length by the calibrating means (27,30) having a cavity (34) the depth (A) of which determines this length and that the calibrating means can be abutted against a predetermined plane (24) of the brake housing (2).

6. Wear indicator according to one of Claims 1-5, **characterized** in that the calibrating means (27,30) can be replaced with a protective cap (27,28), which has a cavity (38) the depth (B) of which is greater than the sum of the depth (A) of the cavity in the calibrating means and the stroke of the brake means (4).

7. Wear indicator according to one of the preceding claims, **characterized** in that the brake means is a brake piston (4) and that the spacer means is an adjustable measuring rod (12).

8. Wear indicator according to one of the preceding claims, **characterized** in that the calibrating means is a calibrating cap (27,30).

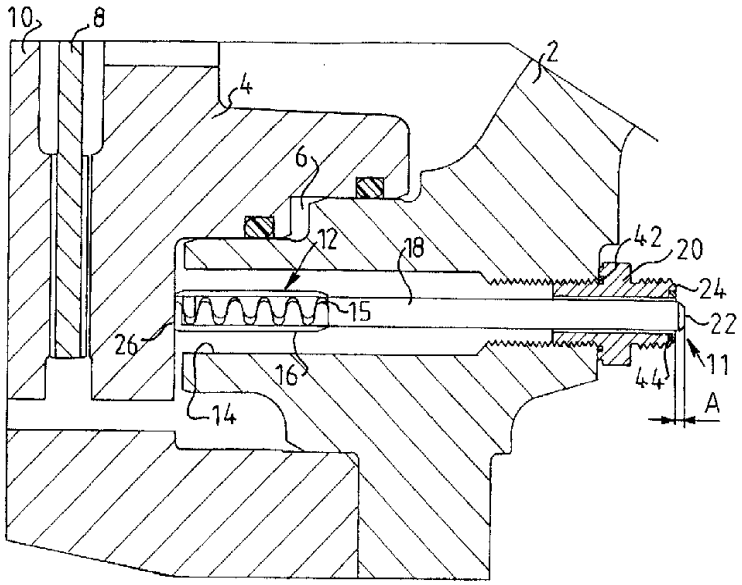


FIG.1

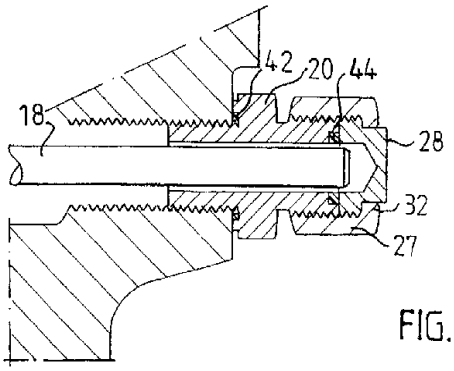


FIG. 2

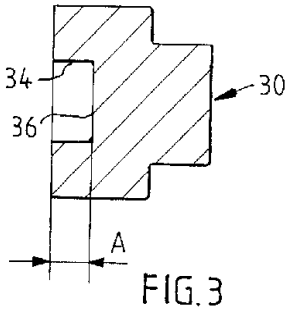


FIG. 3

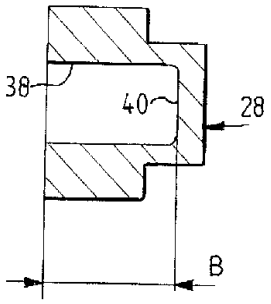


FIG. 4