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DEVICE FOR MONITORING ROLLER BEARINGS

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(56) Prior Art Documents
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US 4551677
US 4170755

(57) Claim

1. A device for identifying, discerning and monitoring damage on roller raceways or neighbouring areas of the roller rings of roller bearings,

characterised in that at least one sensor is provided within the roller chamber of the bearing between the rollers, said sensor providing monitoring signals representative of a monitored area on the roller raceway or neighbouring areas of the roller rings,

and that a transmitter is provided within the roller chamber to transmit the monitoring signals electromagnetically to an antenna outside of the roller bearing.

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ORIGINAL
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STANDARD PATENT

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Invention Title: Device for monitoring roller bearings

The following statement is a full description of this invention, including the best method of performing it known to me:-

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DEVICE FOR MONITORING ROLLER BEARINGS

The present invention relates to a device for monitoring roller bearings, especially to identify and monitor damage on the roller raceways of roller bearings.

To determine and detect defects and fisures on the roller raceways or adjacent areas of the bearing rings of roller bearings, especially in the case of large size roller bearings employed in off-shore cranes or buoys, it is sensible to provide testing devices which are capable of providing the required information without material destruction and dismantling of the bearing.

According to DE-A1-24 18 056 it is proposed to measure the displacement between the outer and the inner bearing ring of a bearing. Such a displacement occurs on wear of the roller raceways or the rollers of the bearing. The actual displacement is indicative of the degree of destruction or degrading of the roller raceway or rollers. A disadvantage this method has is that fisures or cracks on the roller raceway and/or the transitional edge between the roller raceway and bearing ring shoulder can not be detected.

Heretofore, according to EP A1 0 228 731, it is proposed, that at least one bearing ring is provided with at least one opening into which an ultrasonic probe can be inserted. Material faults can be detected in the bearing ring by using a coupling surface on this other bearing ring. The disadvantage of this configuration is that material faults can only be discerned indirectly, that is, the head of the ultrasonic probe device which is coupled to a coupling surface has firstly to radiate through a part of the bearing ring in order to detect surface defects in the endangered areas of the bearing raceways. Because of this, material enclosures and material structure changes within the bearing ring can provide for a false reading.

Furthermore, the measuring area is restricted in such a way that it is impossible to precisely determine the depth of a fisure or crack in the raceway or hereto adjacent areas of the bearing ring.

As a further disadvantage, all of the prior art monitoring devices require electric connection lines to the sensors or monitoring probes. These lines run through openings or bores in the bearing ring and are coupled by means of plug-in connectors to evaluation devices. With off-shore equipment, especially in the case of large-size roller bearings in buoys which are partially submerged under water, the use of such monitoring devices can often just be accomplished with great difficulty due to possible short-circuits and because of poor accessibility to the bearing rings.

The present invention seeks to provide a device to identify, discern and monitor damages on endangered areas of the roller rings of roller bearings, which is able to ensure a precise measurement of fisures or cracks and notches in the raceways or the edge region between the raceway and ring shoulder of the bearing rings and, on the other hand, can transmit monitoring results without the necessity of providing electric transmission lines, bores herefore in the bearing ring and connectors to evaluation devices.

In one broad form, the present invention provides a device for identifying, discerning and monitoring damage on roller raceways or neighbouring areas of the roller rings of roller bearings,

characterised in that at least one sensor is provided within the roller chamber of the bearing between the rollers, said sensor providing monitoring signals representative of a monitored area on the roller raceway or neighbouring areas of the roller rings,

and that a transmitter is provided within the roller chamber to transmit the monitoring signals electromagnetically to an antenna outside of the roller bearing.

An advantageous further embodiment of the present invention provide that the sensor and accompanying transmitter are operated by batteries which can be provided within the roller chamber of the bearing.

An alternative embodiment is characterised in that energy to operate the sensor and accompanying transmitter

can be provided from outside the roller bearing in an inductive way; therefore, the operational life expectancy regarding power supply to the sensor and transmitter is not limited.

The induction coil can be provided on one of the bearing rings adjacent to the roller chamber of the bearing.

Furthermore, it can be advantageous according to yet a further aspect of the invention to use at least one electromagnetic high frequency coil for the sensor and to provide for such an arrangement as to dispose the coil on the roller raceway areas which are succeptible to wear or to fisures. This embodiment of the invention provides Vis a Vis the prior art ultrasonic probes the advantage of continuous monitoring. In contrast to the prior art ultrasonic probes, the high frequency coils need not necessarily be provided on the bearing ring raceway to be monitored, so that wear due to abrasion effects between the sensor and bearing rollers can be excluded.

The device can further advantageously comprise inductive path measuring sensors outside of the bearing rings to measure the radial and/or axial fluctuation of the play of the bearing, that is, to establish if the initial play tolerances of the bearing change due to wear or defects within the bearing.

The invention has one advantage in that no extra construction space with respect to the normal construction volume of the bearing is needed within or on the roller bearing to accommodate the monitoring device. The monitoring device can be operated regardless and independently of the location and surrounding environment of the roller bearing. A specially conceived access to the bearing/monitoring device is not necessary.

An example of a preferred but non-limiting embodiment of the invention will now be described in greater detail with reference to the accompanying drawings in which:

Fig. 1 shows a monitoring system with adjacent bearing parts;

Fig. 2 shows a systematic arrangement of such a monitoring system in which electromagnetic high-frequency

coils are used for sensors;

Fig. 3 shows an arrangement of an inductive path measuring sensor for measuring the axial displacement of the bearing rings in relation to one another; and,

Fig. 4 shows the arrangement according to Fig. 3 for measuring the radial displacement.

The large-size roller bearing partially and schematically shown in Fig. 1 comprises an outer bearing ring 1 and an inner bearing ring 2, in between which rollers 5 rolling on bearing raceways 3, 4 are arranged. In this embodiment, the rollers are cylindrical rollers. A cage 6 is provided for guidance and separation of the rollers 5 on the raceways which has webs 12 that extend in between the rollers 5. The raceways 3, 4 and to a certain extent the transition edge 7 between raceway 3 and the shoulder of the bearing ring 2 are heat treated and provide a hardened layer 8, 9 in this area. In one or more of the webs 12 of cage 6 there are provided two electromagnetic high-frequency coils 13, 14 for monitoring the build up of notches 10, i.e. in the raceway 3 or fisures and/or cracks 11 in the transition edge 7 between raceway 3 and bearing ring shoulder. The high-frequency electromagnetic fields 15, 16 in the active area of these coils 13, 14 produce within the perpendicular plane of raceway 3 or transition edge 7 eddy currents. This magnetic coupling brings about a dampening of the oscillatory circuit in dependance of the air gap. The resultant changes in amplitude define the intensity of the monitoring signal.

Fig. 2 shows the signal processing unit systematically. For processing and transmitting the signal there are provided: oscillator 17, demodulator 18, signal processing means 19, multiplexer 20, transmitter 21, transmitter antenna 22, receiving antenna 23, receiver 24, a demodulator 25, reverse transformer 26, filter 27 and signal processing means 28. These components can be accommodated together or as single components in one or more of the webs 12 of cage 6. Batteries 29 can be used to supply power to the high-frequency coils 13, 14 being the sensors as well as to the corresponding electronic circuitry including the

transmitter within the cage 6 of the roller bearing. Heretofore, it is sensible to provide adequate provisions and means to ensure that these components can be turned on or off using electric signals.

In the embodiment shown in the figures, the necessary power for operating the electric components is provided from the outside of the bearing. Heretofore, an inductive coil 30 is arranged on the outer bearing ring 1 of the bearing adjacent to th roller chamber defined between the bearing rings 1, 2. The energy fed into coil 30 is inductively transmitted to a secondary coil 31 provided on the cage 6 and subsequently fed to the electronic components provided thereon through rectifier 32.

To complement the measurings within the roller chamber of the bearing, the radial and axial displacement of the bearing rings 1, 2 relative to one another can be measured using inductive distance measuring sensors 33, 34. One possible arrangement of these distance measuring sensors 33, 34 is shown in principle in Figs. 3 and 4. The sensors 33, 34 can be fastened to one of the bearing rings, for example, to the inner bearing ring 2 by means of retaining support 35 or straps 36 and are oriented against corresponding measuring surfaces 37, 37 of the measuring ring 39 of the outer bearing ring 1. Processing of the signals of these distance measuring sensors 33, 34 is accomplished in an analogous way to that of the sensors arranged within the roller chamber of the bearing using an oscillator 17, demodulator 18, amplifier 40, lineator 41, filter 27 and signal processing means 28.

Wilst a particular embodiment of the invention has been hereinbefore described, it should be understood that all variations and modifications to the device, which are obvious to persons skilled in the art should be considered to fall within the scope of the invention as hereinbefore described and as hereinafter claimed.

The claims defining the invention are as follows:

1. A device for identifying, discerning and monitoring damage on roller raceways or neighbouring areas of the roller rings of roller bearings,

characterised in that at least one sensor is provided within the roller chamber of the bearing between the rollers, said sensor providing monitoring signals representative of a monitored area on the roller raceway or neighbouring areas of the roller rings,

and that a transmitter is provided within the roller chamber to transmit the monitoring signals electromagnetically to an antenna outside of the roller bearing.

2. Device according to claim 1 characterised in that the sensor and accompanying transmitter are operated by batteries which are also provided within the roller chamber of the bearing.

3. Device according to claim 1, characterised in that an exterior power supply is provided which supplies energy to operate the sensor and accompanying transmitter from outside the roller bearing in an inductive manner, by means of an induction coil provided on one of the bearing rings adjacent to the roller chamber.

4. Device according to any one of claims 1 to 3, characterised in that the sensor comprises at least one electromagnetic high frequency coil and that the sensor is disposed on roller raceway areas which are succeptible to wear or to fisures.

5. Device according to any one of claims 1 to 4, characterised in that further inductive distance measuring sensors are provided on one of the bearing rings to measure radial and/or axial fluctuations of the play of bearing.

6. A device for identifying, discerning and monitoring damage on roller raceways or neighbouring areas of the roller rings of roller bearings substantially as hereinbefore described in relation to the accompanying drawings.

7. A method for identifying, discerning and monitoring damage on roller raceways or neighbouring areas of the roller rings of roller bearings substantially as hereinbefore described in relation to the accompanying drawings.

DATED this 24th day of August, 1993.

HOESCH AG
By Its Patent Attorneys
DAVIES COLLISON CAVE

ABSTRACT

A device for identifying, discerning and monitoring damage on the roller raceway (3,4) or adjacent areas of bearing rings (1,2) of roller bearings. The device is capable of detecting and precisely measuring cracks and notches in the raceways (3,4) or in the edge region (7) of the raceways (3,4) to the bearing ring shoulder, and, is capable of transmitting the monitoring results, without requiring bores in the bearing rings (1,2), cables and connectors to evaluation devices. Heretofore, there are provided one or more sensors (13,14) within the roller chamber of the bearing between the rollers, the monitoring signals whereof being electromagnetically transmitted to an antenna outside of the roller bearing.

Reference numbers of components

1. Outer ring
2. Inner ring
3. Roller raceway
4. Roller raceway
5. Roller
6. Cage
7. Transition edge
8. Hardened layer
9. Hardened layer
10. Notch
11. Fisure crack
12. (web) stud
13. High frequency coil
14. High frequency coil
15. Field
16. Field
17. Oscillator
18. Demodulator
19. Signal processing means
20. Multiplexer
21. Transmitter
22. Transmitter antenna
23. Receiver antenna
24. Receiver
25. Demodulator
26. Reverse transformer
27. Filter
28. Signal processing means
29. Battery
30. Induction coil
31. Secondary coil
32. Rectifier
33. Distance measuring sensor
34. Distance measuring sensor
35. Retaining support
36. Strap
37. Measuring surface
38. Measuring surface
39. Measuring ring
40. Amplifier
41. Lineator

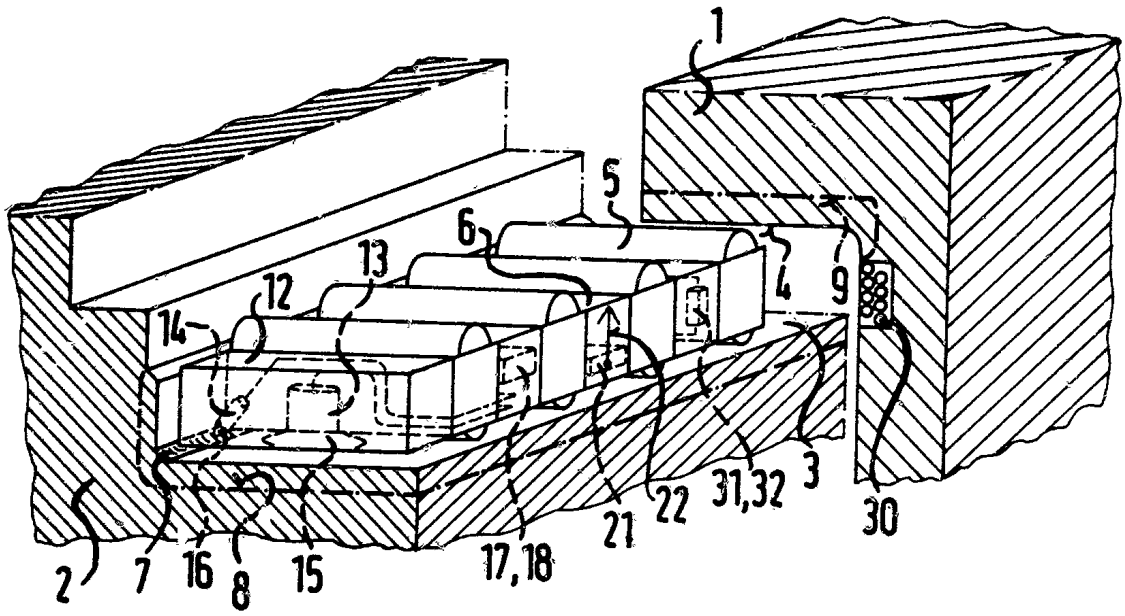

FIG. 1

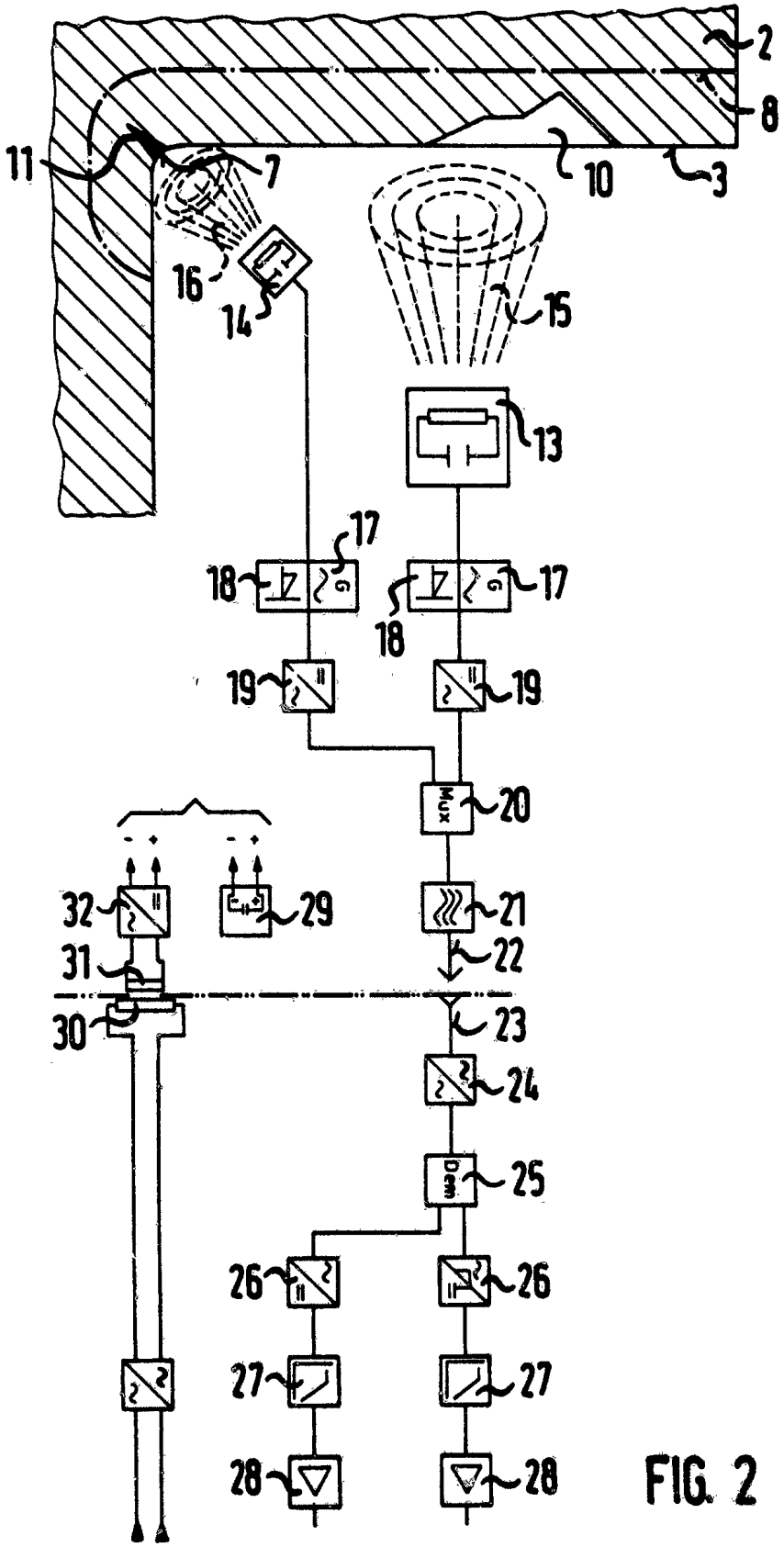
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FIG. 2

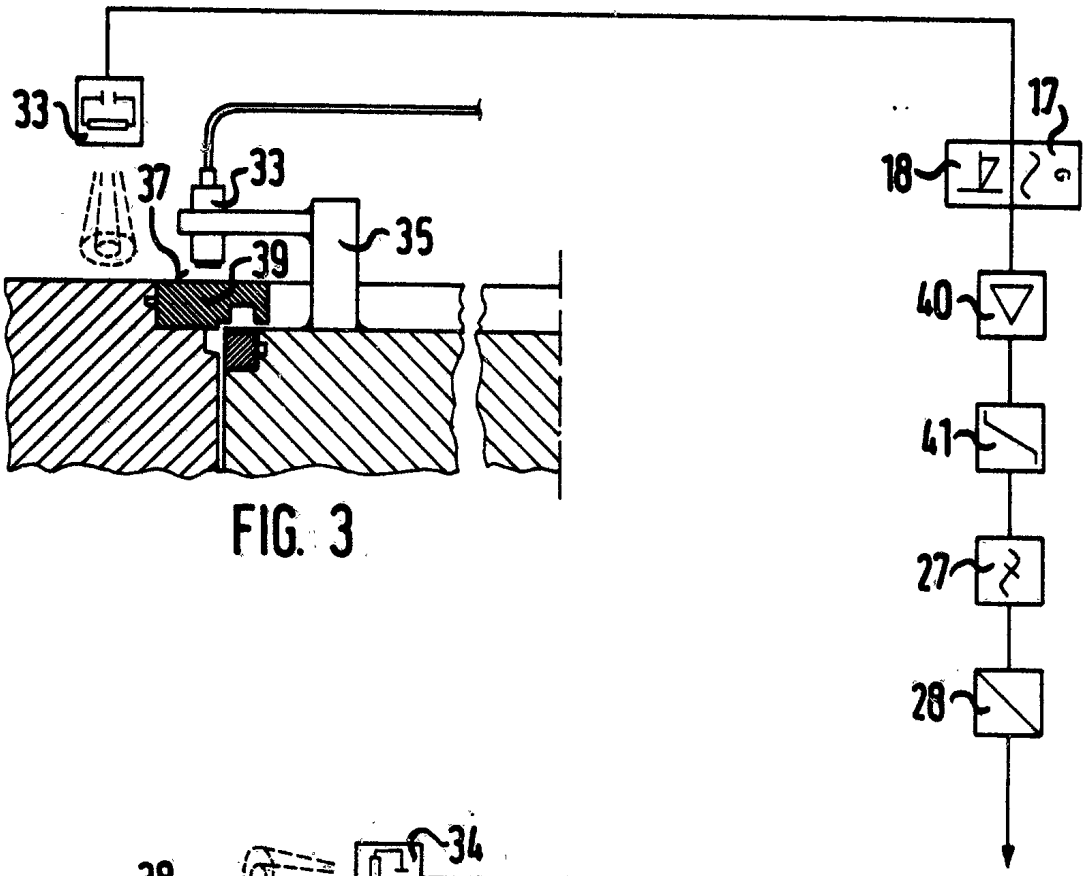

FIG. 3

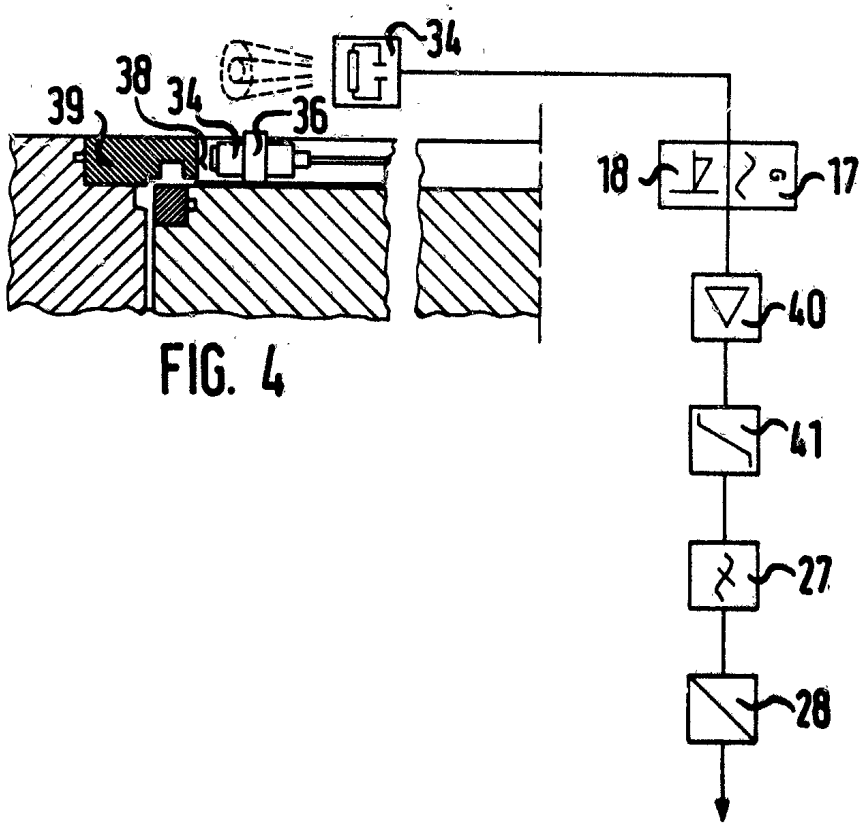

FIG. 4