(12) UK Patent Application (19) GB (11) 2 270 383 (13) A

(43) Date of A Publication 09.03.1994

(21) Application No 9218430.8

(22) Date of Filing 29.08.1992

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(51) INT CL^5
G01B 7/06

(52) UK CL (Edition M)
G1N NAFG N1D1 N4C N7N
U1S S2193

(56) Documents Cited
GB 2107807 A **GB 1518165 A** **GB 1341814 A**
GB 1168056 A **US 4646001 A**

(58) Field of Search
UK CL (Edition L) **G1N NAFG**
INT CL^5 **F16D 66/02 , G01B 7/06**

(54) Electronic wearaway sensor

(57) An electronic wearaway sensor is incorporated in a solid core of the same material as the rest of the wear surface so as to wear away at the same rate as the surface to be monitored. The sensor shown has a number of parallel resistive elements 4 on a cylindrical core 1. As the given surface wears away, the resistive elements are progressively removed, thus increasing the total resistance value of the sensor. As described the resistive elements are formed by laser cutting an aluminium layer 3 formed over a ceramic insulating layer 2 on the core 1. The resistive bands are both insulated and protected by a outer ceramic layer 6. The device may be self powered 4-20mA and is intrinsically safe. The passive signal produced is small and therefore an electronic amplifier and interface buffer circuit are housed in the chamber 7 at the base of the unit through which the signal exits via the connector 8. The signal produced permits constant electronic readout of percentage wear and a set point alarm signal.

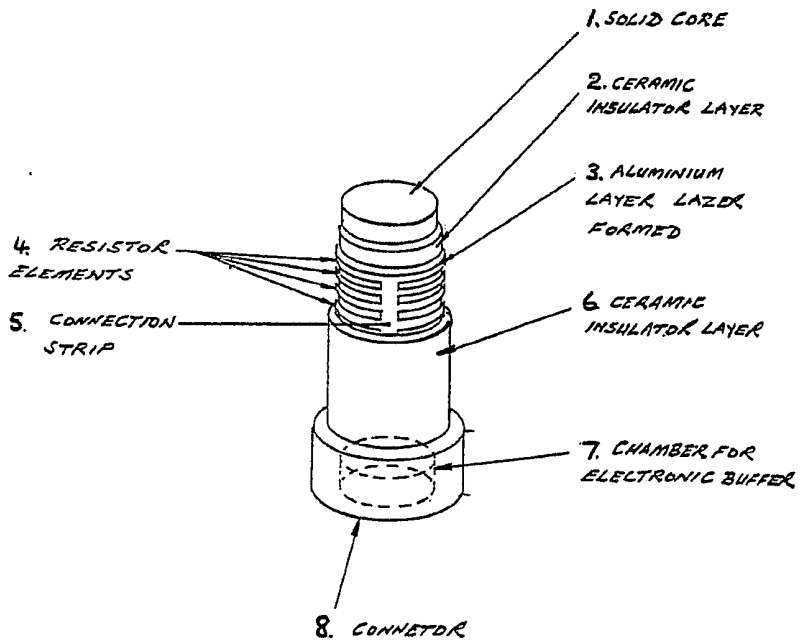

FIGURE 2

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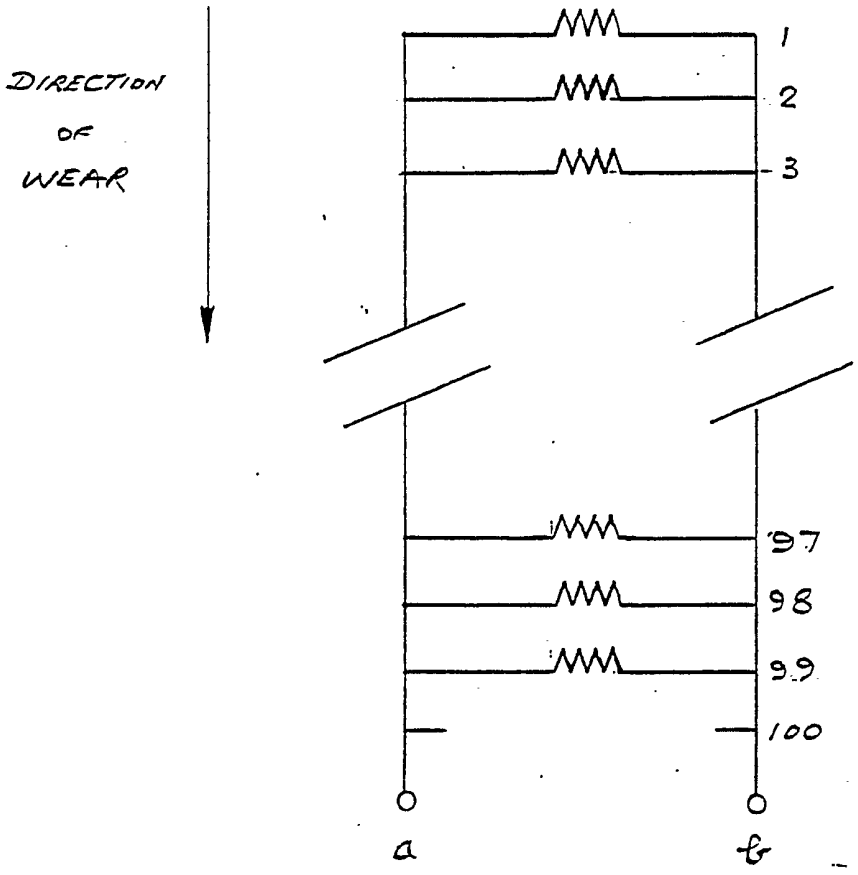


FIGURE 1

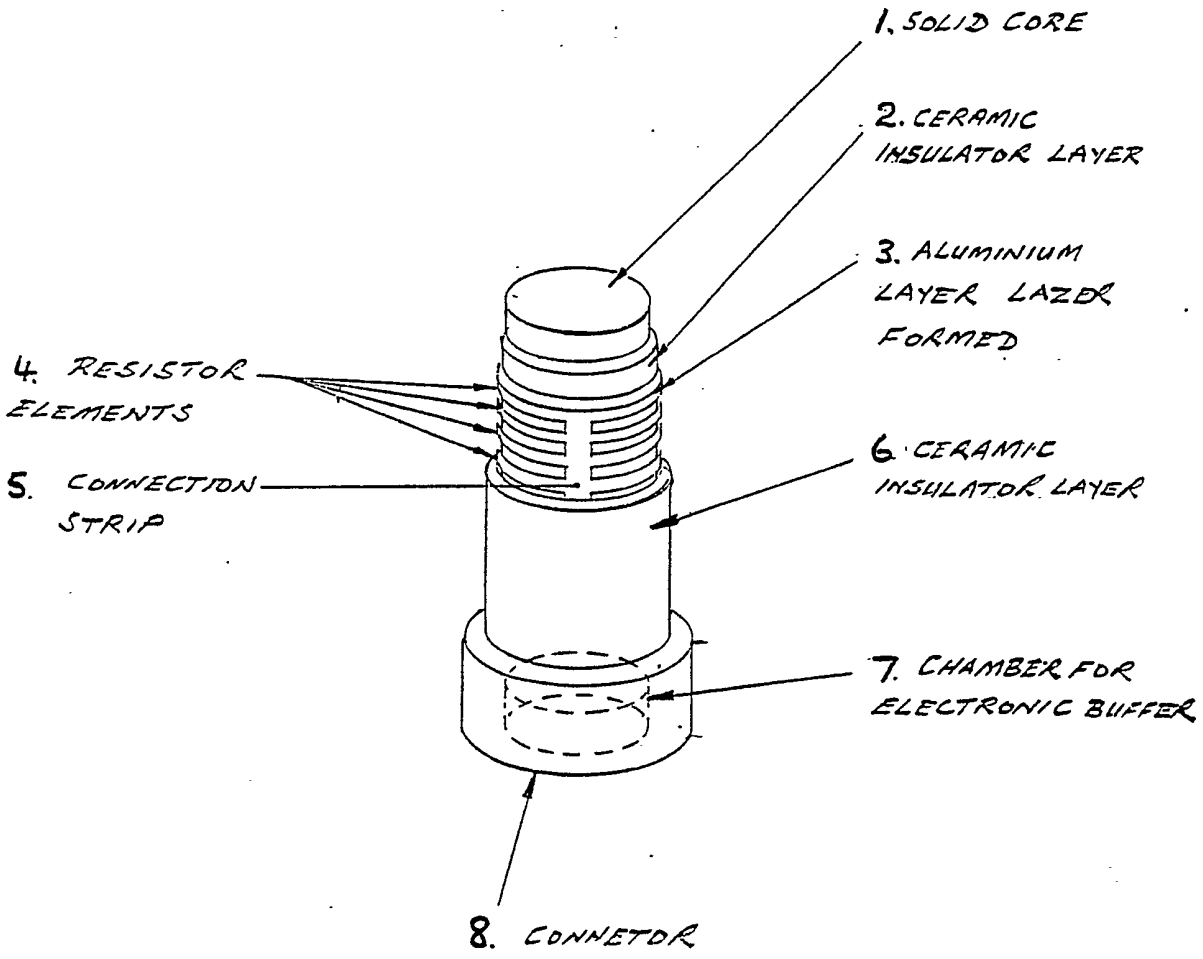
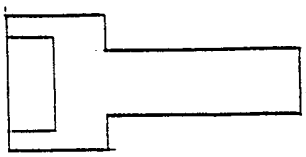
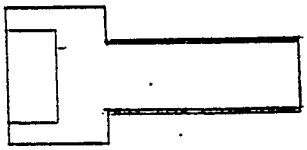

1. SOLID CORE
2. CERAMIC INSULATOR LAYER
3. ALUMINIUM LAYER LAZER FORMED
4. RESISTOR ELEMENTS
5. CONNECTION STRIP
6. CERAMIC INSULATOR LAYER
7. CHAMBER FOR ELECTRONIC BUFFER
8. CONNETOR

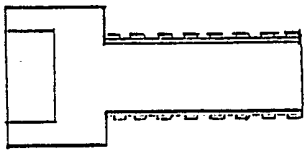
FIGURE 2



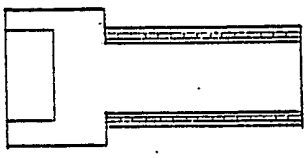
SOLID CORE



INSULATOR LAYER ADDED
CERAMIC



ALUMINIUM LAYER ADDED
RESISTOR NETWORK.



SECOND INSULATOR LAYER ADDED
CERAMIC

BUILD UP OF SENSOR FIGURE 3

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ELECTRONIC WEARAWAY SENSOR

This invention relates to an embedded wearaway sensor.

A considerable amount of research has been carried out into the problem of how to measure the life of wear surfaces in an environment which is extremely hostile. The device or devices must be able to operate reliably over a wide range of temperature and be capable of withstanding high pressures and loadings.

In order to monitor the actual thickness of a given material it is proposed to embed a sensor which can be worn away at the same rate as a given material.

Several methods may be employed to produce a sensor that will provide a change of electrical output as its length is reduced.

Two such methods which can be applied are based on the resistive and capacitive principles.

The following description is indicative of the principle and applied embodiment of a resistive wearaway sensor.

Figure 1. shows a number of resistors connected in parallel. Having measured the total resistance across a. and b., it will be found that as each resistive element 1,2,3 is removed by process of wear, the total resistance value will be increased accordingly. On reaching the point that the 99th element is worn away the device indicates that the material has reached the end of its useable life. A number of discreet measurement steps may be produced dependant on the required resolution and length to be measured.

Figure 2. illustrates incorporation of the resistive elements within a solid core 1. of the same material as the rest of the wear surface. The sensor is therefore neither harder nor softer than the surrounding material thus ensuring that it wears at the same rate.

The core is covered in a fine layer of ceramic 2. to act as an insulator.

The next layer is sprayed aluminium 3. which is lazer cut to produce resistive bands or elements 4. connected by two strips 5. The second strip is at 180° to the first and therefore not illustrated.

The aluminium is both protected and insulated by an outer layer of ceramic or similar 6. The signal produced is passive and very small therefore an electronic amplifier and interface buffer circuit is incorporated in a chamber at the base of the unit 7. The signal exits via a connector 8. fitted into the base.

The above sensor is resistive, however, if two layers of aluminium are employed a capacitive sensor is produced by the same method.

Figure 3. illustrates the build up of the sensor.

The device is self powered, can be operated at 4-20mA and is intrinsically safe.

The size and construction of the sensor is adaptable to a very wide range of applications.

The signal produced permits constant electronic readout of percentage wear and set point alarm signal.

The sensor will operate reliably over a wide temperature range and withstand high pressures and loadings.

Technology now available, enables construction compatible with virtually all sizes of component. The smallest limit, wherein a sensor conforming with the configuration illustrated in figure 2. using a solid core, is likely to be indicated by the structure of the material or as discussed, of a softer material should the area of wear be significantly larger than the sensor diameter. It is envisaged that, if required, the overall length of the sensor could be attained at approximately $\frac{1}{2}$inch. Further reduction in length is possible by producing the sensor in two halves, the chamber 7. and connector 8. being a separate unit which could be externally situated when the sensor is in a stationary component.

The structural potential of the material comprising the core would present the main limiting factor regarding the diameter of the sensor, subject to which a diameter of 30 microns may possibly be achievable.

It is theoretically possible, using technology currently available, to produce a wearaway sensor in wafer form of a thickness down to approximately 0.01 of an inch and successfully inplant the device to monitor a wear surface.

It is possible that the resistive material 3. in figure 2. could be replaced by an alternative conductive layer, should a specific application demand, for instance, operation at very high temperature.

The insulative layer 3. in figure 2. could also, if operating conditions dictate, possibly be replaced by an alternative insulative material of acceptable properties.

CLAIMS

1. An electronic wearaway sensor.

2. An electronic wearaway sensor as claimed in Claim 1. which can be embedded in a solid core of the same material as the wear surface to be monitored.

3. An electronic wearaway sensor as claimed in Claim 1. or Claim 2. which will permit constant electronic readout of percentage wear and set point alarm signal.

4. An electronic wearaway sensor as claimed in Claim 2. or Claim 3. which may be self powered 4-20mA, intrinsically safe and will operate over a wide temperature range at the same time withstanding high pressures and loadings.

5. An electronic wearaway sensor the configuration of which is described herein and with reference to Figures 1-3 of the accompanying drawings.

Examiner's report to the Comptroller under Section 17 (The Search report)	GB 9218430.8
Relevant Technical Fields (i) UK Cl (Ed.L) G1N (NAFG) (ii) Int Cl (Ed.5) G01B 7/06; F16D 66/02	Search Examiner M G CLARKE Date of completion of Search 22 November 1993
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-5

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2107807 A	(MORGANITE)	1
X	GB 1518165	(BURMEISTER ETC)	1,2
X	GB 1341814	(COMPUTAS)	1,2
X	GB 1168056	(TELEDYNE)	1
X	US 4646001	(ASS. TO MORGANITE)	1-3

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).