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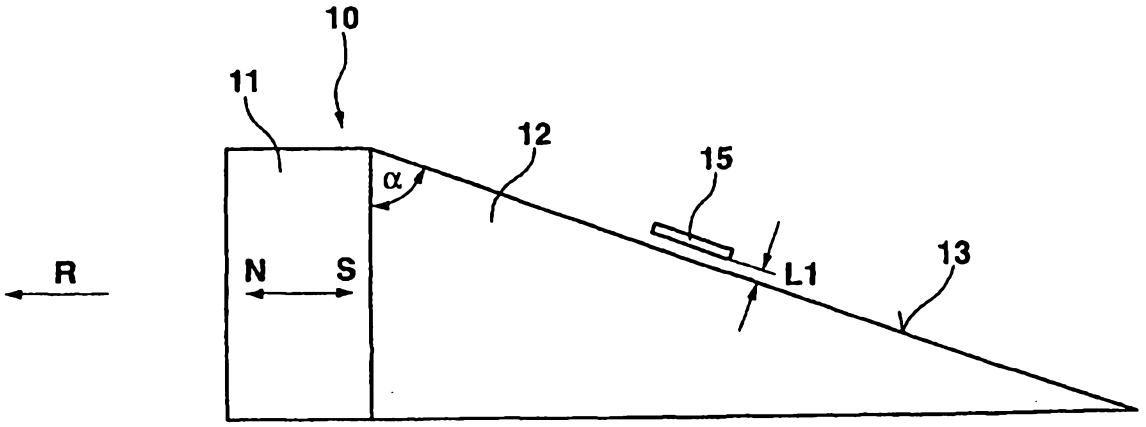
(54) Title: DISTANCE MEASURING DEVICE

(54) Bezeichnung: WEGMESSVORRICHTUNG



(57) Abstract

The invention relates to a distance measuring device (10) in which a magnet (11) is arranged on a flux concentrating part (12) and polarized in the direction of movement R of the distance measuring device (10). The flux concentrating part (12) comprises an oblique oval surface (13) opposite of which, separated by an air gap (L1), an element (15) sensitive to the magnetic field is arranged. During a movement the air gap (L1) changes such that the element (15) sensitive to the magnetic field generates an output signal which is proportional or linear to the direction of movement R of the component to be monitored.

(57) Zusammenfassung

Bei einer Wegmessvorrichtung (10) ist an einem Flussleitteil (12) ein Magnet (11) angeordnet, der in Bewegungsrichtung R der Wegmessvorrichtung (10) polarisiert ist. Das Flussleitteil (12) hat eine schief verlaufende, oval ausgebildete Oberfläche (13), der gegenüber mit einem Luftspalt (L1) ein magnetfeldempfindliches Element (15) angeordnet ist. Bei Bewegung verändert sich der Luftspalt (L1), so dass das magnetfeldemfindliche Element (15) ein Ausgangssignal proportional bzw. linear zur Bewegungsrichtung R des zu überwachenden Bauelements erzeugt.

Distance Measuring Device

Prior Art

The invention relates to a distance measuring device. A sensor for measuring distances having a cylindrical frame constructed of ferromagnetic material is known from DE 29 23 644 C2. A slidable permanent magnet is arranged in the frame, whose movement is transmitted with the aid of a slide and is proportional to the movement of a component. Further, a magnetic field sensitive element is arranged in a gap of the frame and consequently in the closed magnetic circuit generated by the magnet, whose output signal is proportional to the movement of the magnet. The construction requirements of the sensor are considerable, however, and expensive. High friction losses can result through the movement of the magnet. This can falsify the output signal.

Summary of the Invention

According to the present invention there is provided a distance measuring device, consisting of a magnetically conductive flux conducting part, a magnet arranged on one end of said flux conducting part and a magnetic field sensitive element, said flux conducting part having an oblique surface facing and in operating connection with said magnetic field sensitive element, a relative movement resulting between said magnetic field sensitive element and said oblique surface, said magnet being polarised in the movement direction and said oblique surface of said flux conducting part being constructed in an approximately oval shape.

Advantages of the invention

The measurement device of the invention has, over against prior art, the advantage that with low assembly requirements, a linear output signal for distance measuring can be determined. The path to be determined is relatively long and can amount to 10mm. Furthermore, the sensor can, due to the simple construction, be installed in systems such as, for example, exhaust gas recirculation valves, the detection of valve lift, vehicle body suspension or transmission control without a great deal of alteration and assembly being required.

Brief description of the drawings

Embodiments of the invention are depicted in the drawing and are described in the following description.

Figure 1 shows a longitudinal section through a sensor,

Figure 1a a plan view and

Figure 1b a view of the front face.

Figures 2 to 4b show changes in the way of representing the Figures 1 to 1b.

Figure 5 shows a section through the fuel injector for the supply of fuel in an internal combustion engine, in which the lift of the injector needle is to be detected.

Detailed description of the preferred embodiments

In Figure 1 a sensor is indicated with the number 10, which serves to measure the distance of a component not depicted. The sensor 10 consists of a magnet 11, in particular a permanent magnet, which is polarised in the movement direction R and a flux conducting part 12 of magnetically conductive material, for example soft iron. The flux conducting part 12 has a surface 13 inclined to the movement direction R under an angle α. Moreover, the flux conducting part 12 is manufactured in a cylindrical shape, ie. it has, on the transition of the magnet 11 to the flux conducting part 12, a circular cross section. Due to the almost cylindrical form of the flux part 12, the surface 13 is oval, as can be seen in particular in Figure 1a. A magnetic field sensitive element 15 is arranged opposite the oblique surface 13, an air gap L1 dividing the two. Magnetically controlled resistors, magnetic transistors, coils, magneto-resistive elements or a Hall element are examples of magnetic field sensitive elements 15 used. It is important here that the magnetic field sensitive element have as linear a dependence of its output signal as possible on the magnetic induction B. The magnet 11 can, as is recognisable in Figure 1b, also be cylindrically constructed and feature the surface diameter like the flux concentration piece 12. Dependent on the strength of the magnet or the magnetic field necessary, which is used for measurement, the magnet 11a can also have a lesser diameter than the flux conducting part 12. It is also unnecessary, as can be seen from Figure 3b, that the magnet have the shape of the flux conducting part 12. It can also have a square cross section, as shown in Figure 3b, or a rectangular cross section. In the flux conducting part 12 it is

necessary, however, that the surface 13 have an oval shape in order to maintain as linear an output signal as possible.

As is depicted in Figure 4, it is not absolutely necessary that the oblique surface 14 begin directly at the transition from the magnet 11 to the flux conducting part 12. A combination 20 can exist here, as can be seen in Figure 4, before the obliquely-running surface 13 commences. During the movement of the magnet 11 and the flux conducting part 12, which takes place parallel to the component in the movement direction R, the air gap L1 is increased or diminished according to the movement direction. The magnetic field sensitive element 15 is fixed so that the air gap changes with the movement of the magnet 11 and the flux conducting part 12. Because of the size of the air gap L1 changing proportionally to the movement direction R, the magnetic field flowing through the magnetic field sensitive element 15 also changes, so that the induction B generated in the element 15 is changed.

Figure 5 shows a section through a fuel injector 21 for the dosed supply of fuel for an internal combustion motor, for example a diesel motor. An injector needle 22 as a mechanical part not described in any detail here in terms of its function, carries out relatively short elevating motions to open or close a valve seat in the fuel injector 21. The end 23 of the injector needle 22 extends through the stop shoulder of the spring of the injector needle 22 and is connected there with the magnet 11 of the sensor 10. The longitudinal axis of the injector needle 22 is arranged in the movement direction R. The oblique surface 13 of the flux conducting part 12 is allocated to the fixed magnetic field sensitive element 15. The element 15 is connected to an electrical unit 26, which is arranged in the housing of the fuel injector 21.

The claims defining the invention are as follows:

1. A distance measuring device, consisting of a magnetically conductive flux conducting part, a magnet arranged on one end of said flux conducting part and a magnetic field sensitive element, said flux conducting part having an oblique surface facing and in operating connection with said magnetic field sensitive element, a relative movement resulting between said magnetic field sensitive element and said oblique surface, said magnet being polarised in the movement direction and said oblique surface of said flux conducting part being constructed in an approximately oval shape.

2. The distance measuring device according to Claim 1, wherein said magnetic field sensitive element is arranged substantially parallel to said oblique surface.

3. The distance measuring device according to Claim 1 or claim 2, wherein said magnetic field sensitive element is a Hall element.

4. The distance measuring device according to any one of the preceding claims, wherein said flux conducting part, at least in the transition to said magnet, has a round cross section.

5. A distance measuring device substantially as hereinbefore described with reference to the accompanying drawings.

DATED this 3rd day of January , 2003

ROBERT BOSCH GMBH

By their Patent Attorneys:

CALLINAN LAWRIE

Fig. 1

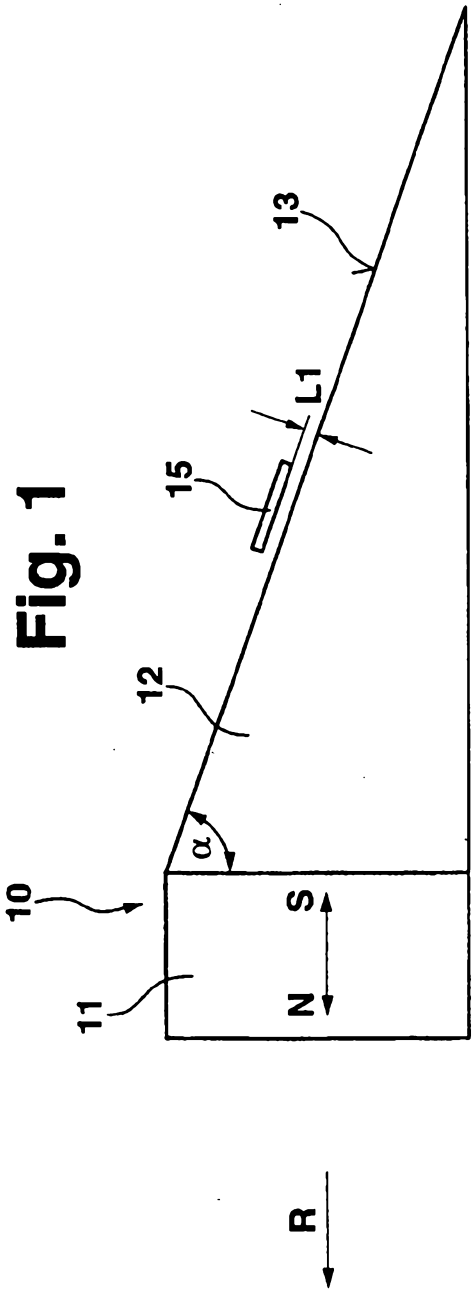


Fig. 1a

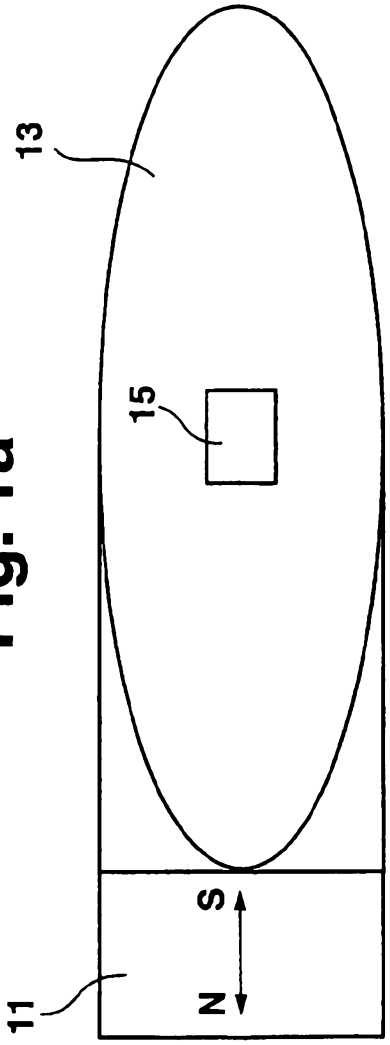


Fig. 1b

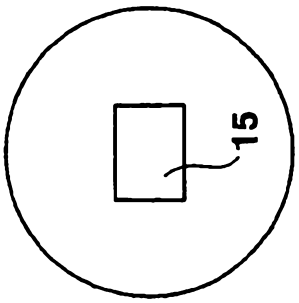


Fig. 2

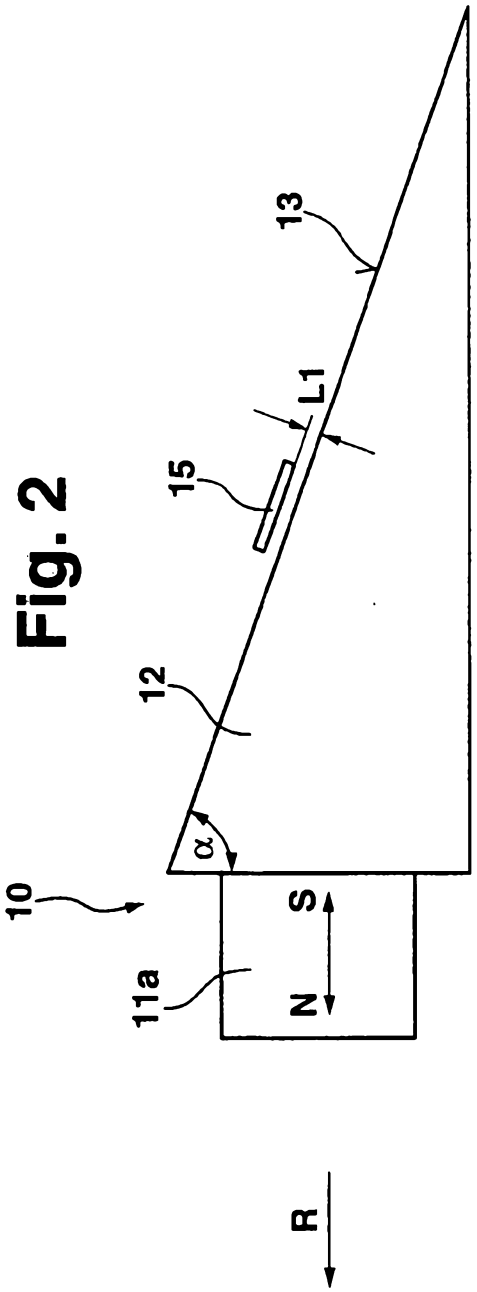


Fig. 2a

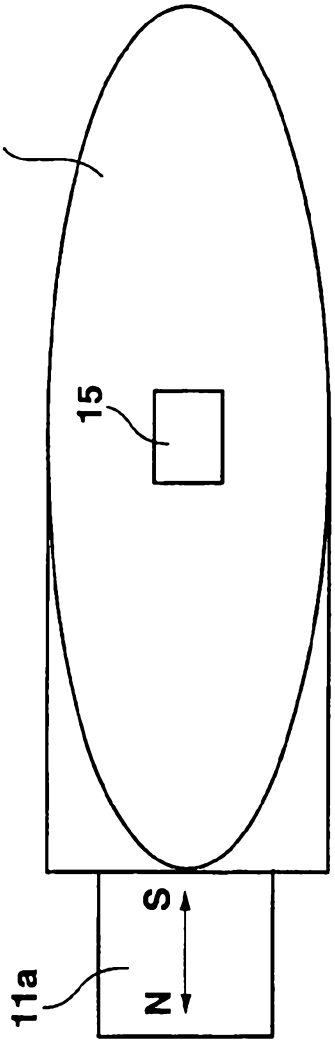


Fig. 2b

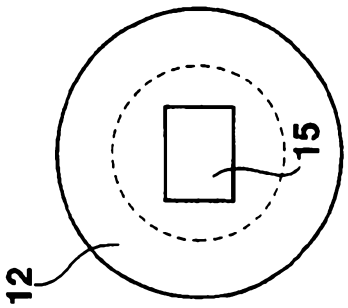


Fig. 3

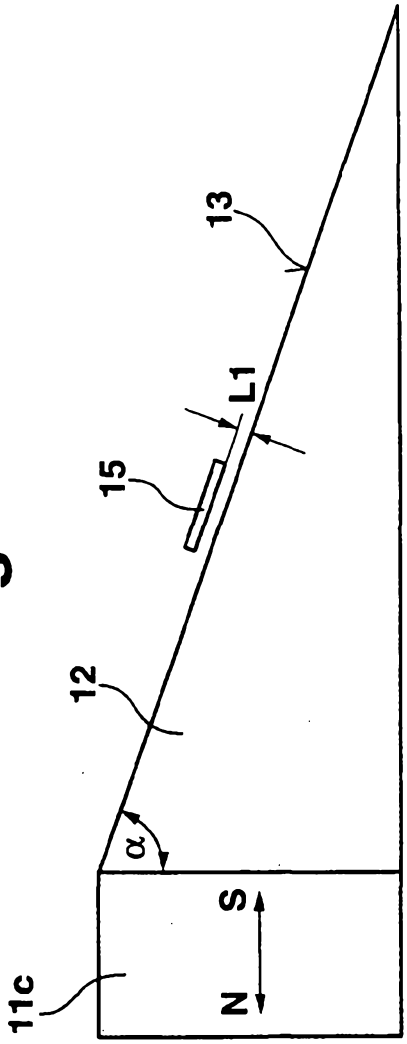


Fig. 3a

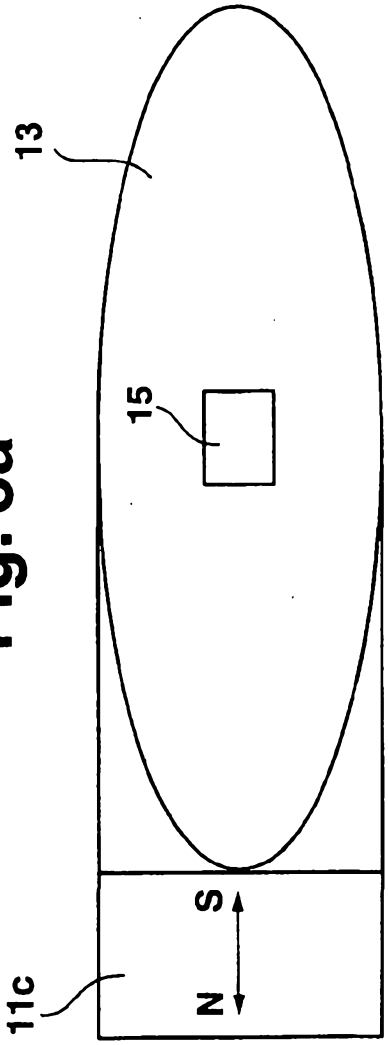


Fig. 3b

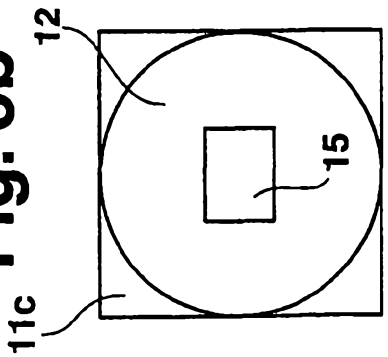


Fig. 4

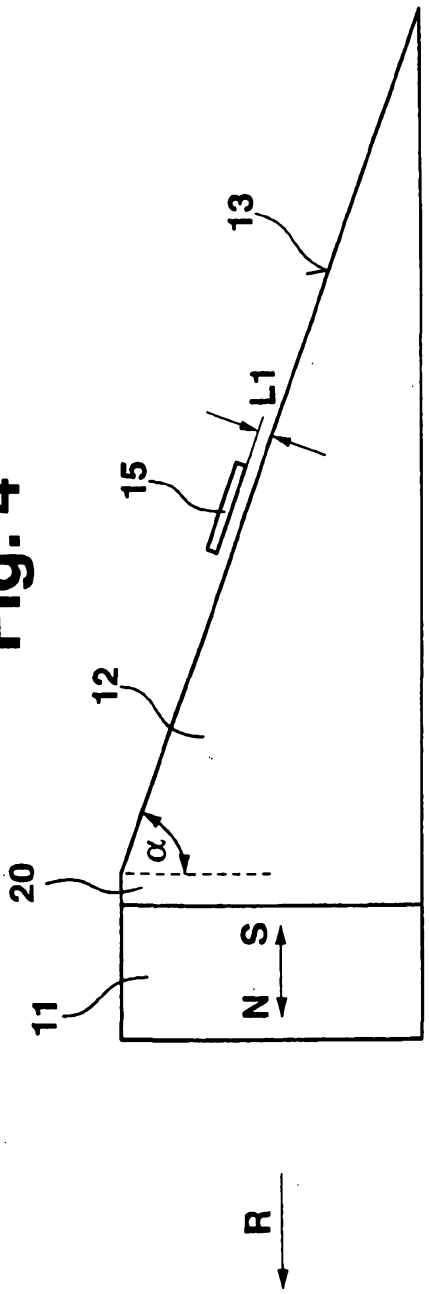


Fig. 4a

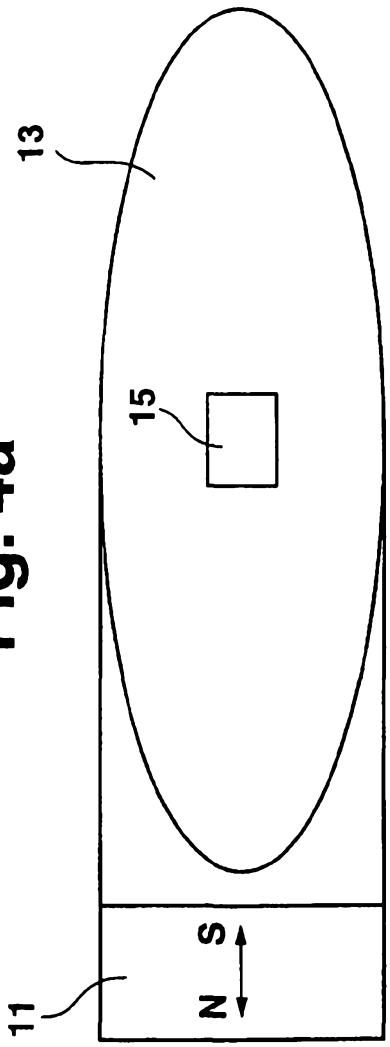


Fig. 4b

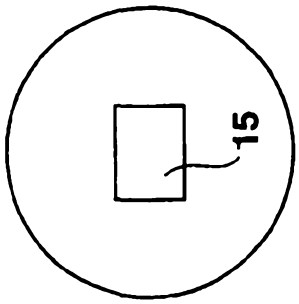


Fig. 5