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Ely

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(54) **POSITION SENSING TRANSDUCER**

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See application file for complete search history.

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 90 days.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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2,867,783 A 1/1939 Wechsung
2,942,212 A 6/1960 Mynall

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FOREIGN PATENT DOCUMENTS

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DE 1 134 848 B 8/1962
DE 35 00 121 A1 7/1986

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OTHER PUBLICATIONS

Patents Act 1977: Search Report under Section 17 for United Kingdom Application No. GB0416614.6, 1 pg., (Oct. 21, 2004).

(Continued)

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(57) **ABSTRACT**

Position sensors to inductively sense a position of a target relative to a number of sensor coils are described. In one embodiment, the target comprises first, second, and third portions positioned on either side of an axis of rotation, such that lateral misalignment between the target and the sensors is compensated between the interaction of the different portions and the sensor coils. In another embodiment, the target comprises first and second portions that are separated along the measurement path such that in a first range of relative positions, the first portion is adjacent to the sensor coils and in a second range of relative positions, the second portion is adjacent to the sensor coils. The first and second portions are asymmetrically arranged relative to the sensor coils such that when each portion is adjacent the same portion of the sensor coils, different signals are induced in the sensor coils.

(58) **Field of Classification Search**

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