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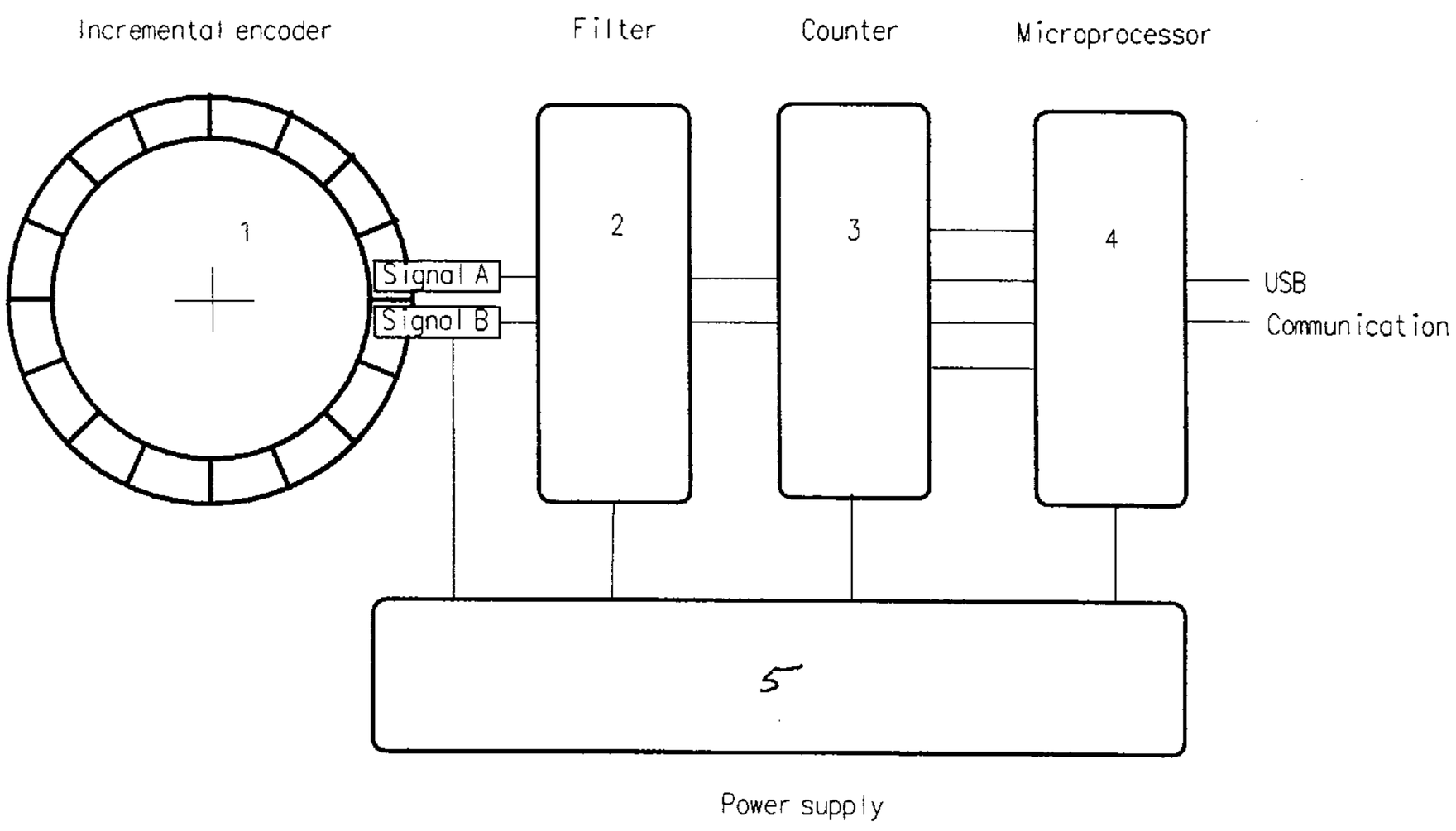
(54) **ENCODEUR OPTIQUE A COMMUNICATION ABSOLUE ET DOTE D'UN SYSTEME INCREMENTIEL DE LECTURE**

(54) **OPTICAL ENCODER WITH ABSOLUTE COMMUNICATION AND INCREMENTAL READING SYSTEM**



(57) The present invention relates to a device that incorporates all of the features of an incremental encoder, plus the necessary circuitry to count the pulses from the encoder, and the circuitry to communicate the results to a user-friendly application environment on a personal computer, in a single compact housing. The output from the incremental encoder is converted to an absolute output using a hardware counter which reads a 2 wire pulsed quadrature signal and which outputs a binary parallel latched signal. This output is subsequently converted in a microprocessor to either a high resolution position signal, or it is converted to a speed measurement, based on a precise clock in the microprocessor. The microprocessor also handles the conversion of the position or speed measurement to a signal which is transmitted to a host computer using a high speed serial communication protocol. The nature of the output can be controlled from the host computer, typically a personal computer, and can be easily modified by the user to change features such as the maximum position count of the encoder before the reading returns to zero, or the time interval which is to be used in the calculation of the speed of the device, or the calibration of the units in which the output is displayed. The device itself is self-contained and does not have any user-serviceable parts. All diagnostics and configuration and calibration are performed on the host computer. The communication protocol used is the Universal Serial Bus, which is fast, and which does not require any technical expertise of any sort on the part of the user. The device incorporates all of the features one would typically find in an absolute encoder, but the mechanical design is that of an incremental encoder, and it is therefore very simple to manufacture, and flexible in design.

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ABSTRACT

Patent Application No: 2,232,399

Optical Encoder with Absolute Communication and Incremental Reading System

The present invention relates to a device that incorporates all of the features of an incremental encoder, plus the necessary circuitry to count the pulses from the encoder, and the circuitry to communicate the results to a user-friendly application environment on a personal computer, in a single compact housing. The output from the incremental encoder is converted to an absolute output using a hardware counter which reads a 2 wire pulsed quadrature signal and which outputs a binary parallel latched signal. This output is subsequently converted in a microprocessor to either a high resolution position signal, or it is converted to a speed measurement, based on a precise clock in the microprocessor. The microprocessor also handles the conversion of the position or speed measurement to a signal which is transmitted to a host computer using a high speed serial communication protocol. The nature of the output can be controlled from the host computer, typically a personal computer, and can be easily modified by the user to change features such as the maximum position count of the encoder before the reading returns to zero, or the time interval which is to be used in the calculation of the speed of the device, or the calibration of the units in which the output is displayed. The device itself is self-contained and does not have any user-serviceable parts. All diagnostics and configuration and calibration are performed on the host computer. The communication protocol used is the Universal Serial Bus, which is fast, and which does not require any technical expertise of any sort on the part of the user. The device incorporates all of the features one would typically find in an absolute encoder, but the mechanical design is that of an incremental encoder, and it is therefore very simple to manufacture, and flexible in design.

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SPECIFICATIONS

Patent Application No: 2,232,399

Optical Encoder with Absolute Communication and Incremental Reading System

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic view of the circuitry in the encoder. The view includes the following elements:

1 - incremental encoder disk with many radial lines drawn on it.

2 - electronic filter which produces two square wave outputs in quadrature.

3 - electronic counter producing a set of parallel outputs of binary numbers.

4 - microprocessor producing a serial communications output to a cable.

5 - power supply.

Figure 2 is a schematic view of the software in the system. The view includes the following elements:

6 - software in the encoder microprocessor **4**. This software is written in assemby language and converts the signal from the parallel output hardware counter **3** to a serial communications signal.

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7 - driver software resident in the host personal computer. This software is not part of the encoder but represents an essential link between communication hardware and application software in the computer.

8 - configuration software in the personal computer which communicates with the microprocessor **4** and specifies its mode of operation. This software determines the nature of the data to be received from the encoder, whether it be position data or speed data. It also represents a link between the arriving data from the encoder and the application software **9** using the data.

9 - application software which uses the data. The application software could actually be part of the configuration program or it could be written by a third-party vendor.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will now be described with reference to the Figures. The device consists of four basic elements:

An incremental encoder consisting of a housing containing an optical disk **1** with many radial lines drawn on it, an optical grid which matches a portion of the disk and which is used to collimate the light from an array of light emitting diodes, which is sensed by a series of photocells on the other side of the disk. The disk is attached to a rotating shaft and indicates the position of the shaft. The photocells produce two trains of output pulses, Signal A and Signal B, which are in quadrature so that they are phase-shifted by 90 degrees.

An electronic filter **2** which converts Signal A and Signal B into true square-wave pulses suitable for counting by an electrical hardware counter **3**

which counts the pulses of light from the photocells, determines the direction of movement, and increments or decrements the parallel output binary counter.

A programmable microprocessor **4** which reads the hardware counter and accumulates the count to as many bits as desired, with the option of turning back to zero at any arbitrary specified count, or of reporting the number of counts that have elapsed in a precise specified time interval, where the time interval can be specified or changed at any time during normal operation. The microprocessor also contains the hardware necessary to communicate the results over a 4-wire Universal Serial Bus communication link to a personal computer, where two of the wires are used for communication of the position or speed data, and the other two wires are used for transmission of power to the device from the power supply **5**. The microprocessor also contains enough information to allow a personal computer connected to the Universal Serial Bus cable to automatically identify the device as an optical encoder, and to automatically identify the manufacturers' name, product name, and serial number of the device. The microprocessor contains the software element **6**.

A programmable microprocessor **4** which reads the hardware counter and accumulates the count to as many bits as desired, with the option of turning back to zero at any arbitrary specified count, or of reporting the number of counts that have elapsed in a precise specified time interval, where the time interval can be specified or changed at any time during normal operation. The microprocessor also contains the hardware necessary to communicate the results over a 4-wire Universal Serial Bus communication link to a personal computer, where two of the wires are used for communication of the position or speed data, and the other two wires are used for transmission of power to the device from the power supply **5**. The microprocessor also contains enough information to allow a personal computer connected to the Universal Serial Bus cable to automatically identify the device as an optical encoder, and to automatically identify the manufacturers' name, product name, and serial number of the device. The microprocessor contains the software element **6**.

CLAIMS

1 - An absolute encoder for measuring either position or speed of a rotating shaft, comprising:

an incremental encoder with a rotating element suitable for performing a shaft position or velocity measurement, which emits a series of square-wave electrical pulses.

a hardware counter which counts the pulses from the encoder and accumulates them into a latched binary parallel electrical output of a fixed number of bits.

a microprocessor which reads the output of the counter and converts it into either an absolute position measurement of arbitrarily high value or into a speed meaurement based on the number of counts received in a precise time interval.

computer code in the microprocessor which allows the output to be configured so that the position measurement will return to zero at a specified count and the speed measurement will be taken over a time interval specified by the user.

electrical communications hardware in the microprocessor suitable for performing serial communications at high speed to a personal computer.

computer code in the microprocessor suitable for performing an automatic unique identification of the device to the computer to which it is attached, and for automatically initiating communications as soon as the device is physically connected to the communications cable.

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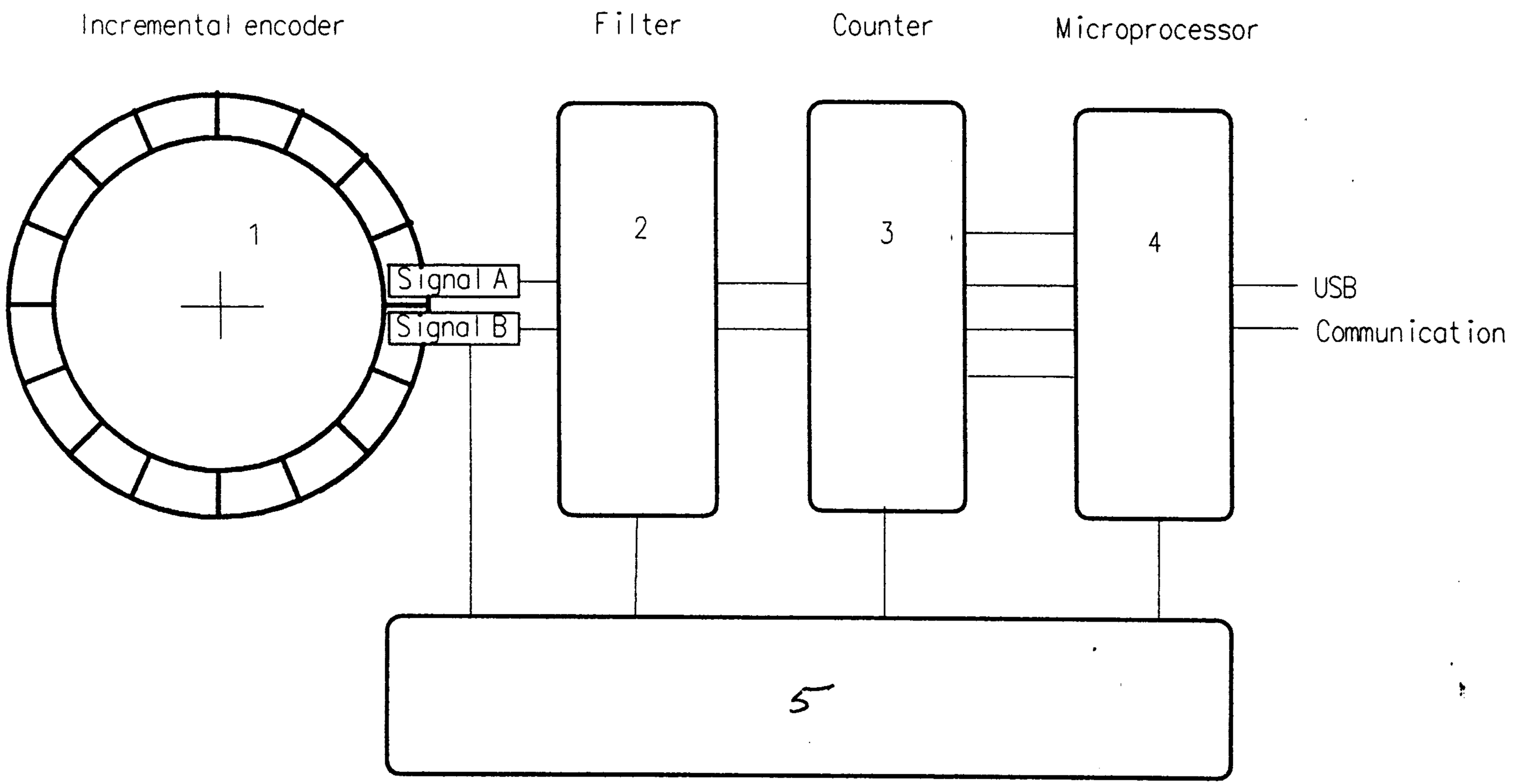
Principle of encoder with communication Figure 1



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Systemfunction Figure 2