United States Patent

[11] 3,588,474

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[21] Appl. No 768,459
[22] Filed Oct. 17, 1968
[45] Patented June 28, 1971
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[32] Priority Oct. 23, 1967
[33] Japan
[31] 42/67815

[54] **READOUT COUNTERS**
6 Claims, 3 Drawing Figs.

[52] U.S. Cl. 235/92, 335/84, 340/379
[51] Int. Cl. G06m 1/274
[50] Field of Search ..... 235/92, 340/379, 307/278, 324/45 (X), 335/84, 179

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ABSTRACT: A readout counter is comprised by a digit wheel having a plurality of magnets corresponding to digits to be displayed and a Hall element excited by a constant current. The magnets have different intensity so that the Hall element provide an output voltage corresponding to the digits.

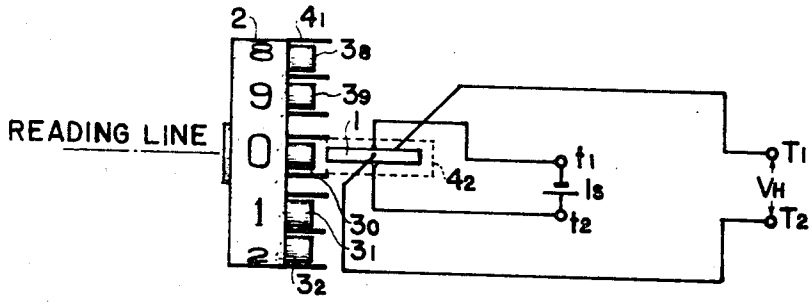


FIG. 1

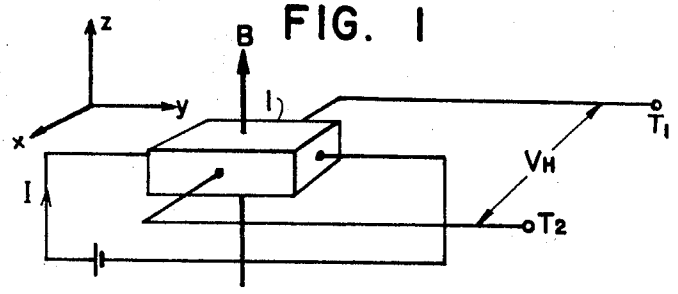


FIG. 2

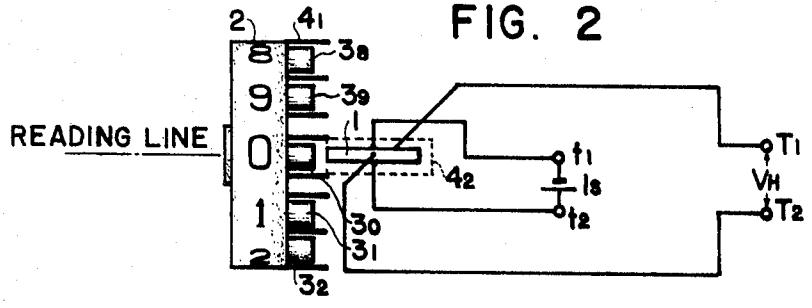
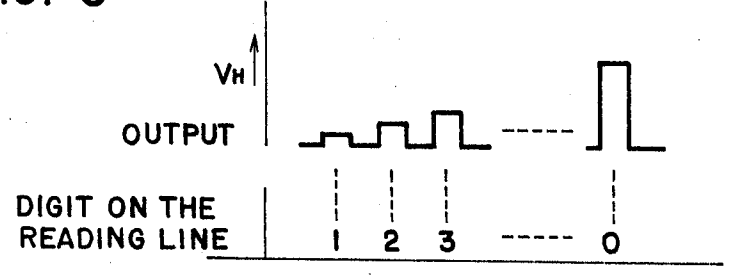


FIG. 3



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READOUT COUNTERS

BACKGROUND OF THE INVENTION

This invention relates to a novel readout counter utilizing a Hall element.

In the conventional counter a digit wheel is utilized which is provided at least two sliding arms on a side surface thereof that slide on a printed circuit or electric contacts on a printed circuit board corresponding to respective digits on the digit wheel when it is rotated. Such a construction, however, is not advantageous in that electric contact between the sliding arms and contacts is not good and in addition it is required to apply a substantial pressure to the sliding arms in order to improve electric contact, thus imposing a large mechanical load to the rotation of the digit wheel.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a novel readout counter having no electrical or mechanical sliding contact.

In accordance with this invention there is provided a readout counter comprising a digit wheel provided with a plurality of magnets corresponding to the digits to be displayed and having different magnetic intensity, a Hall element having two pairs of terminals and disposed such that as the digit wheel is rotated the magnets are successively brought to oppose the Hall element and means to impress a constant current across one pair of terminals of the Hall element whereby an output voltage corresponding to a particular digit opposing said Hall element is produced across the other pair of terminals.

BRIEF DESCRIPTION OF THE DRAWING

The invention can be more fully understood from the following detailed description taken in connection with the accompanying drawing, in which:

FIG. 1 shows a diagram helpful to explain the principle of a Hall element employed in the counter according to this invention;

FIG. 2 shows one embodiment of the readout counter constructed in accordance with this invention; and

FIG. 3 show a waveform to explain the principle of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the accompanying drawing there is shown a Hall element 1 wherein magnetic flux B is applied in the direction of the Z axis and current I is passed in the direction of the y-axis to produce a voltage

$$VH = KIB$$

between terminal T1 and T2, where K represents a constant. Thus, where current I is constant the output voltage is proportional to flux B.

This invention is based on the skillful utilization of the Hall effect and according to this invention permanent magnets 3_1, 3_2,...3_9 and 3_0 corresponding to respective display digits 1, 2,...9 and 0 on the periphery of a digit wheel 2 are provided on one side surface of the digit wheel as shown in FIG. 2. The polarity of these permanent magnets is selected such that alternate magnets have the same polarity. The Hall element 1 is disposed relative to the digit wheel 2 in such a manner that as the digit wheel rotates, permanent magnets 3_1, 3_2,...3_9 and 3_0 come to sequentially oppose one side surface of the Hall element. Thus, by connecting a source of constant current across a pair of terminals of the Hall element an electromotive force VH proportional to the intensity of the magnetic field produced by one magnet just facing the element will be induced across the other pair of terminals T1 and T2 perpendicular to said first mentioned pair. When the permanent magnets are arranged such that their magnetic force increases gradually starting from magnet 3_1 towards 3_0, it will be possible to obtain an output as shown in FIG. 3 which shows the analogue quantity of the output voltage VH where the Hall element is disposed on the reading line of the digits on the digit wheel. Thus, the output voltage is the minimum for digit 1 whereas the maximum for digit 0. By establishing proper correspondence between the values of the output voltage and the display digits it is possible to determine the digit which is displayed by the voltage across output terminals T1 and T2.

For the purpose of description while in the above-described embodiment, permanent magnets were shown as having gradually increasing intensity, it should be understood that this invention is not limited to this particular arrangement and that it is only necessary that 10 magnets should have different intensity. Furthermore, while FIG. 2 shows a counter of one order of magnitude, counters of a plurality of orders can be readily fabricated by using a plurality of digit wheels which are identical to that shown in FIG. 2 and interconnected by a suitable shift means such as pinions interposed between adjacent digit wheels. As shown in FIG. 2, it is advantageous to provide magnetic shields 4_1 around respective magnets to prevent mutual interference thereof and a shield 4_2 around the Hall element to protect it against magnetic influence from magnets other than that opposing it. Further, instead of securing the magnets on one side of the digit wheel they may be embedded in the peripheral surface or in a side surface thereof.

Thus, in accordance with this invention a voltage proportional to the strength of the magnets which are successively brought to face the Hall element is produced across output terminals by passing a constant current through the Hall element so that there is no load imposed upon driving force of the digit wheel due to electrical contact as in conventional readout counters. Further, absence of any mechanical contacts provides accurate and durable readout counters which can be used over a long period. Such readout counters are suitable for use in telemetering and the like.

I claim:

1. A readout counter comprising:
   - a digit wheel provided with a plurality of peripheral magnets corresponding to the digits to be displayed, one each of said magnets being uniquely related to a respective one of said digits by having different magnetic intensity;
   - a fixed Hall element having two pairs of terminals and disposed such that as said digit wheel is rotated said magnets are successively brought to oppose said Hall element;
   - and means to impress a constant current across one pair of terminals of said Hall element whereby an output voltage corresponding to a particular digit opposing said Hall element is produced across the other of said pairs of terminals.

2. The readout counter according to claim 1 wherein said magnets are embedded in the periphery of said digit wheel.

3. The readout counter according to claim 1 wherein said magnets are secured to one side surface of said digit wheel.

4. The readout counter according to claim 1 wherein the strength of said magnets is gradually varied from one to the other.

5. The readout counter according to claim 1 wherein magnetic shields are provided around respective magnets and a magnetic shield is provided around said Hall element said shields adapted to register for each digit position so that the Hall element may be excited by the magnetic force created by the magnet opposing the Hall element.

6. The readout counter according to claim 1 wherein alternate magnets on the periphery of said digit wheel have the same polarity.