

## **Strain Gauge Based Displacement Sensor**

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### **ABSTRACT**

A strain gauge based displacement transducer for measurement of the displacement in the range of 0 to 10 mm is reported. As compared to LVDT this transducer has short body length and is free from electromagnetic effect.

### **1. Introduction**

There exist various transducer for displacement measurement like. Linear variable differential transformer (LVDT), capacitive transducer, potentiometric transducer, resistive transducer, optical transducers etc. The LVDT is most common among these due to its high output for small displacement [1-6]. The drawback of LVDT is that it has larger body length. In this paper a strain gauge based transducer for measurement of displacement in the range of 0–10 mm is described, which has short body length as compare to LVDT.

### **2. Constructional Details**

This transducer has cantilever beam (Fig. 1) in which four foil type strain gauges are bonded on the main sensing element. A sensing shaft moves on the two teflon bushes. When the shaft is in motion, the cantilever beam deflects and there is a change in resistance of the gauges. Gauges  $R_1$  and  $R_3$  are subjected to compression while  $R_2$  and  $R_4$  are subjected to tension. These gauges constitute the four active arms of a measuring bridge. Since these gauges are located at the same section of the beam, they are exposed to the same temperature environment, there by achieving temperature compensation automatically. A high quality spring is also coupled with the shaft to operate the transducer without use of mechanical linkage between the transducer and the object whose displacement is to be measured. The use of the foil type strain gauges gives excellent strain reproducibility, thermal stability, reliability and high accuracy. One of the great advantages of this transducer is that it is not affected by magnetic field like LVDT. It also has short body length.

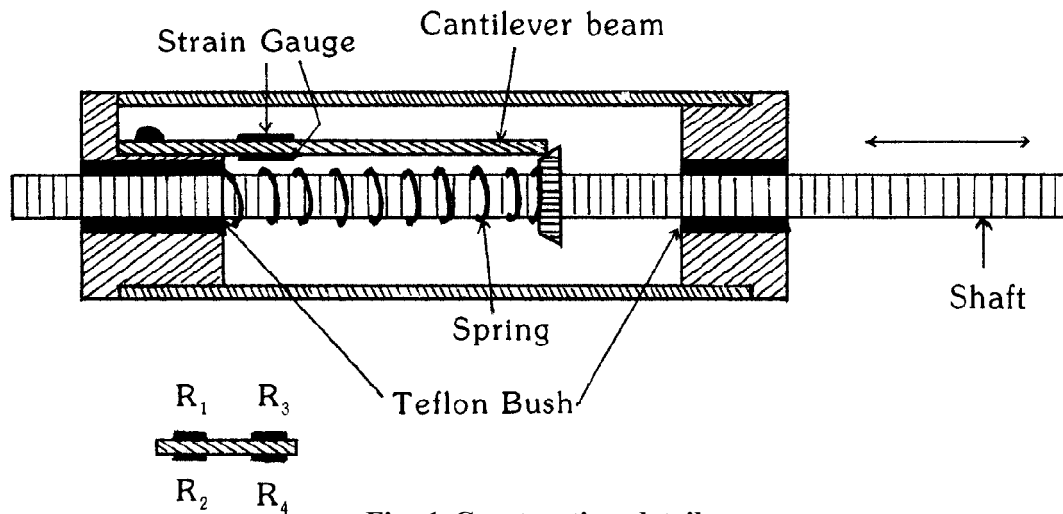


Fig. 1 Construction details

### 3. Electrical Circuits

The measurement of the change in resistance in the gauges is accomplished by electrical circuit using Wheatstone bridge network, as shown in fig. 2. A DC excitation is applied between point A and C of the bridge and the potential difference between the points B and D is given to an instrumentation amplifier (IN114AN). The output of instrumentation amplifier is given to the unity gain inverting summing amplifier, where a dc bias is also added to make any unbalance in the bridge to zero value.

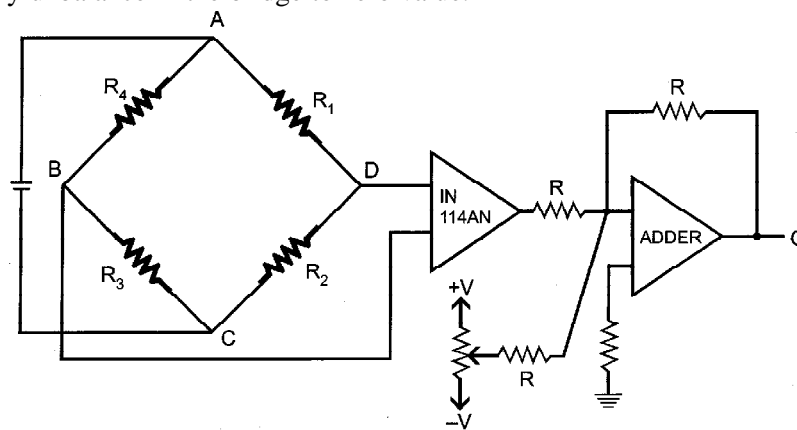


Fig. 2

### 4. Experimental Results

This transducer was fabricated and tested using the circuit show in fig. 2. The 5V DC excitation (noise free) was given. The gain of the amplifier was set around 150. The mechanical movement was measured with a micrometer of accuracy 0.01 mm. The obtained results is shown in Table 1.

**Table 1.**

Displacement of Transducer Core in mm	Output Voltage in mV
0	00.00
1	35.75
2	71.62
3	107.34
4	143.16
5	178.92
6	214.76
7	250.54
8	286.31
9	322.10
10	357.91

## 5. Conclusions

A strain gauge based transducer for displacement measurement of range 0–10 mm has been fabricated and tested. The experimental results show very good linearity with short body length as compared to the LVDT of same range.

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