

Description

The invention relates to force transducers, and particularly to beam assemblies for force transducers.

A typical force transducer generates an output signal which corresponds to an input force. The input force is applied at or near the free end of a leaf spring flexure or beam cantilevered from a fixed support. A force so applied causes a corresponding angular displacement of the beam about the fixed support. The output signal corresponding to the angular displacement of the beam from a null or neutral position is produced by strain gauges bonded to the beam.

An input force applied at or near the free end of a beam of constant cross-sectional area produces a stress which decreases from a maximum at the fixed support. The maximum allowable stress is limited by the material properties of the beam. The average stress, which determines the resolution of the transducer, will necessarily be less than the maximum stress.

United States Patent Specification No. 4,424,717 (EP—A1—77184) discloses a force transducer for producing an output signal in proportion to the magnitude of an input force wherein an equal and opposite force is produced by a beam assembly comprising a compound leaf spring flexure having opposed outer sections, anchored in and cantilevered from a fixed and a movable base respectively, which gradually decrease in cross-sectional area to a thin middle section wherein the movable base is constrained to linear displacement from a null or neutral position by having the force applied along a line normal to and passing through the centre of the thin middle section and transmitted to the movable base through a rigid connection.

In situations in which extreme accuracy is required it is important that the input force be very accurately applied to the centre of the beam. The accurate positioning required to accomplish this can be difficult to attain in the above prior art device wherein the beam assembly is received in a separate, movable base member to which the force is applied.

Also, because of the two-piece construction of the prior art device the outside dimensions of the assembly are relatively large, resulting in a significant empty volume within the assembly. Since the empty volume is filled with oil, and certain performance characteristics of the transducer are dependent on the oil volume, it is advantageous to reduce the empty volume to a minimum.

Because of the foregoing, it has now become desirable to develop an extremely accurately aligned beam assembly for a force transducer.

According to the invention there is provided a transducer to generate an output signal varying in proportion to changes in the magnitude of a force applied thereto and comprising a housing; a beam assembly cantilever mounted within the housing, the beam assembly including a tapered beam portion; and at least one strain gauge

attached to the beam portion and operable to generate an output signal proportional to the strain in the tapered beam portion produced by a force applied to the beam assembly; characterised in that the beam assembly comprises a single substantially cylindrical member having one end anchored to the housing and the other end free, a substantially L-shaped slot is formed in the cylindrical member to define a lever portion and the beam portion, a first force transmitting member is attached to the lever portion and a second force transmitting member is attached to the beam portion.

Such a transducer is an improvement of a force transducer of the kind disclosed in United States Patent No. 4,424,717, particularly in that the beam and the base are formed as a one-piece unit. The combined beam and base formed of a single piece of cylindrical stock preferably has a flat formed along one side thereof to accept the strain gauges, with the slot defining a relatively thin beam portion, and a relatively thick lever portion. One end of the cylinder can be grounded in a fixed base member of the transducer, and transverse holes can be formed in the middle of the cylinder to receive struts forming the force transmitting members of the transducer and connected, for example, to diaphragms.

The invention is diagrammatically illustrated by way of example with reference to the accompanying drawings, in which:—

Figure 1 is an elevation view, shown partly in section, of a transducer according to the invention;

Figure 2 is a fragmentary view, shown partly in section, taken on line 2—2 of Figure 1; and

Figure 3 is a perspective view of a beam assembly of a transducer according to the invention.

Referring to the drawings in which like references designate like or corresponding parts throughout the several views, there is shown a force transducer 10 comprising a cylindrical housing 12, a beam assembly 14 mounted within the housing, a first diaphragm assembly 16 mounted on one side of the housing 12 and operatively connected to the beam assembly 14, a second diaphragm assembly 18, a base member 20 in which the beam assembly 14 is anchored, and nipple 22 which retains the beam assembly within the housing.

The housing 12 is provided with an open end for insertion and removal of the beam assembly 14. The beam assembly is firmly anchored in the base member 20 which is received against a shoulder 24 formed within the housing, and the end of the nipple 22 clamps the base member 20 against the shoulder 24.

Referring particularly to Figure 3, the beam assembly 14 comprises a generally cylindrical member 28, having a flat 30 formed along the full length of one side thereof. A substantially L-shaped slot 32 is formed through the member 28 to define a lever portion 34 and a tapered beam portion 36. The beam portion is configured

similarly to the compound flexure disclosed in United States Patent No. 4,424,717. Specifically, the beam portion 36 is relatively heavy adjacent the ends 38 and 40 of the long leg of the L-shaped slot, tapering toward the middle thereof to a relatively thin middle section 42.

Referring to Figures 1 and 2, strain gauges 44 and 46 are bonded or otherwise adhered to the flat side 30, and have electrical leads extending therefrom and connected to a cable 48 to provide an output signal to a control device 50 in a known manner.

The force transducer illustrated herein can be applied to the measurement of many different conditions such as absolute or differential pressure, liquid level, or other conditions which can be translated into an input force applied to the beam assembly. In the embodiment illustrated, the transducer 10 is being used to measure differential pressures by means of the diaphragm assemblies 16 and 18, which apply forces F1 and F2 respectively to struts 52 and 54 which are threadedly received in the beam assembly 14 and extend through holes formed in the housing 12.

The first diaphragm assembly 16 comprises a cover member 56 attached to a boss 58 on the housing 12 by a plurality of screws (not shown), and a diaphragm 60 attached to the strut 52 and clamped between the cover 56 and the boss 58. A difference between the pressure P1 at a port 62 and the pressure P2 at a port 64 results in a force which is applied to the strut 52 by the diaphragm, resulting in turn in an output signal produced by the strain gauges 44 and 46 which is proportional to the force, as also described in United States Patent No. 4,424,717.

The second diaphragm assembly 18 which is identical to the diaphragm assembly 16, comprises a cover member 66, a boss 68, a diaphragm 70, and pressure ports 72 and 74, and is operable to apply a force F2 to the beam assembly 14 which is proportional to the difference between pressures P3 and P4.

Claims

1. A transducer to generate an output signal varying in proportion to changes in the magnitude of a force applied thereto and comprising a housing (12); a beam assembly (14) cantilever mounted within the housing (12), the beam assembly (14) including a tapered beam portion (36); and at least one strain gauge (44, 46) attached to the tapered beam portion (36) and operable to generate an output signal proportional to the strain in the tapered beam portion (36) produced by a force applied to the beam assembly (14); characterised in that the beam assembly (14) comprises a single substantially cylindrical member (28) having one end anchored to the housing (12) and the other end free, a substantially L-shaped slot (32) is formed in the cylindrical member (28) to define a lever portion (34) and the tapered beam portion (36), a first force transmitting member (52) is attached to the

lever portion (34) and a second force transmitting member (54) is attached to the beam portion (36).

2. A transducer according to claim 1, in which the first (52) and second (54) force transmitting members comprise first and second struts extending from the cylindrical member (28) perpendicular to the longitudinal axis thereof.

3. A transducer according to claim 2, in which the first and second struts extend through the housing (12) for attachment to first (16) and second (18) force producing means.

4. A transducer according to any one of claims 1 to 3, in which the L-shaped slot (32) is formed with the long leg thereof parallel to the longitudinal axis of the cylindrical member (28) and displaced from said axis, and the short leg thereof perpendicular to said axis, the tapered beam portion (36) being formed between the long leg and the adjacent side of the cylindrical member (28).

5. A transducer according to claim 4, in which the cylindrical member (28) has a flat (30) formed on one side thereof adjacent the long leg of the L-shaped slot.

6. A transducer according to claim 5, in which said at least one strain gauge (44, 46) is attached to the flat (30).

Patentansprüche

1. Wandler zum Erzeugen eines Ausgangssignals, welches sich proportional zu Veränderungen der Größe einer darauf ausgeübten Kraft verändert mit einem Gehäuse (12); einem in dem Gehäuse (12) freitragend befestigten Trägeraufbau (14), welcher einen sich verjüngenden Trägerabschnitt (36) aufweist; und mindestens einem Spannungsmesser (44, 46), welcher an dem verjüngten Trägerabschnitt (36) angebracht ist und im Betrieb ein Ausgangssignal erzeugt, welches proportional zu der Spannung in dem verjüngten Trägerabschnitt (36) ist, welche durch eine auf dem Trägeraufbau (14) ausgeübte Kraft hervorgerufen wird; dadurch gekennzeichnet, daß der Trägeraufbau (14) ein einzelnes im wesentlichen zylindrisches Teil (28) aufweist, welches mit einem Ende an dem Gehäuse (12) verankert ist und dessen anderes Ende frei ist, daß ein im wesentlichen L-förmiger Schlitz (32) in dem zylindrischen Teil (28) gebildet ist, so daß ein Hebelabschnitt (34) und der verjüngte Trägerabschnitt (36) definiert wird, daß ein erstes Kraftübertragungsteil (52) an dem Hebelabschnitt (34) angebracht ist und daß ein zweites Kraftübertragungsteil (54) an dem Trägerabschnitt (36) angebracht ist.

2. Wandler nach Anspruch 1, bei welchem das erste (52) und zweite (54) Kraftübertragungsteil erste und zweite Stützen aufweisen, welche sich von dem zylindrischen Teil (28) senkrecht zu dessen Längsachse erstrecken.

3. Wandler nach Anspruch 2, wobei die ersten und zweiten Stützen sich durch das Gehäuse (12) hindurch erstrecken für die Anbringung an ersten (16) und zweiten (18) krafterzeugenden Mitteln.

4. Wandler nach einem der Ansprüche 1 bis 3,

similarly to the compound flexure disclosed in United States Patent No. 4,424,717. Specifically, the beam portion 36 is relatively heavy adjacent the ends 38 and 40 of the long leg of the L-shaped slot, tapering toward the middle thereof to a relatively thin middle section 42.

Referring to Figures 1 and 2, strain gauges 44 and 46 are bonded or otherwise adhered to the flat side 30, and have electrical leads extending therefrom and connected to a cable 48 to provide an output signal to a control device 50 in a known manner.

The force transducer illustrated herein can be applied to the measurement of many different conditions such as absolute or differential pressure, liquid level, or other conditions which can be translated into an input force applied to the beam assembly. In the embodiment illustrated, the transducer 10 is being used to measure differential pressures by means of the diaphragm assemblies 16 and 18, which apply forces F1 and F2 respectively to struts 52 and 54 which are threadedly received in the beam assembly 14 and extend through holes formed in the housing 12.

The first diaphragm assembly 16 comprises a cover member 56 attached to a boss 58 on the housing 12 by a plurality of screws (not shown), and a diaphragm 60 attached to the strut 52 and clamped between the cover 56 and the boss 58. A difference between the pressure P1 at a port 62 and the pressure P2 at a port 64 results in a force which is applied to the strut 52 by the diaphragm, resulting in turn in an output signal produced by the strain gauges 44 and 46 which is proportional to the force, as also described in United States Patent No. 4,424,717.

The second diaphragm assembly 18 which is identical to the diaphragm assembly 16, comprises a cover member 66, a boss 68, a diaphragm 70, and pressure ports 72 and 74, and is operable to apply a force F2 to the beam assembly 14 which is proportional to the difference between pressures P3 and P4.

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lever portion (34) and a second force transmitting member (54) is attached to the beam portion (36).

2. A transducer according to claim 1, in which the first (52) and second (54) force transmitting members comprise first and second struts extending from the cylindrical member (28) perpendicular to the longitudinal axis thereof.

3. A transducer according to claim 2, in which the first and second struts extend through the housing (12) for attachment to first (16) and second (18) force producing means.

4. A transducer according to any one of claims 1 to 3, in which the L-shaped slot (32) is formed with the long leg thereof parallel to the longitudinal axis of the cylindrical member (28) and displaced from said axis, and the short leg thereof perpendicular to said axis, the tapered beam portion (36) being formed between the long leg and the adjacent side of the cylindrical member (28).

5. A transducer according to claim 4, in which the cylindrical member (28) has a flat (30) formed on one side thereof adjacent the long leg of the L-shaped slot.

6. A transducer according to claim 5, in which said at least one strain gauge (44, 46) is attached to the flat (30).

Patentansprüche

1. Wandler zum Erzeugen eines Ausgangssignals, welches sich proportional zu Veränderungen der Größe einer darauf ausgeübten Kraft verändert mit einem Gehäuse (12); einem in dem Gehäuse (12) freitragend befestigten Trägeraufbau (14), welcher einen sich verjüngenden Trägerabschnitt (36) aufweist; und mindestens einem Spannungsmesser (44, 46), welcher an dem verjüngten Trägerabschnitt (36) angebracht ist und im Betrieb ein Ausgangssignal erzeugt, welches proportional zu der Spannung in dem verjüngten Trägerabschnitt (36) ist, welche durch eine auf dem Trägeraufbau (14) ausgeübte Kraft hervorgerufen wird; dadurch gekennzeichnet, daß der Trägeraufbau (14) ein einzelnes im wesentlichen zylindrisches Teil (28) aufweist, welches mit einem Ende an dem Gehäuse (12) verankert ist und dessen anderes Ende frei ist, daß ein im wesentlichen L-förmiger Schlitz (32) in dem zylindrischen Teil (28) gebildet ist, so daß ein Hebelabschnitt (34) und der verjüngte Trägerabschnitt (36) definiert wird, daß ein erstes Kraftübertragungsteil (52) an dem Hebelabschnitt (34) angebracht ist und daß ein zweites Kraftübertragungsteil (54) an dem Trägerabschnitt (36) angebracht ist.

2. Wandler nach Anspruch 1, bei welchem das erste (52) und zweite (54) Kraftübertragungsteil erste und zweite Stützen aufweisen, welche sich von dem zylindrischen Teil (28) senkrecht zu dessen Längsachse erstrecken.

3. Wandler nach Anspruch 2, wobei die ersten und zweiten Stützen sich durch das Gehäuse (12) hindurch erstrecken für die Anbringung a. ersten (16) und zweiten (18) krafterzeugenden Mitteln.

4. Wandler nach einem der Ansprüche 1 bis 3,



12

bei welchem der L-förmige Schlitz (32) mit seinem langen Schenkel parallel zu der Längsachse des zylindrischen Teiles (28) und beabstandet von dieser Achse, und mit seinem kurzen Schenkel senkrecht zu dieser Achse gebildet wird, wobei der verjüngte Trägerabschnitt (36) zwischen dem langen Schenkel und der anschließenden Seite des zylindrischen Teiles (28) ausgebildet ist.

5. Wandler nach Anspruch 4, bei welchem das zylindrische Teil (28) eine ebene Fläche (30) aufweist, welche an seiner an den langen Schenkel des L-förmigen Schlitzes anschließenden Seite gebildet ist.

6. Wandler nach Anspruch 5, bei welchem zumindest ein Spannungsmesser (44, 46) an der ebenen Fläche (30) angebracht ist.

Revendications

1. Transducteur destiné à générer un signal de sortie variant en fonction de modifications de la valeur d'une force qui lui est appliquée et comprenant un logement (12); un ensemble de poutre (14) monté en porte-à-faux dans le logement (12), l'ensemble de poutre (14) comportant un tronçon de poutre s'amenuisant (36); et au moins une jauge de contrainte (44, 46) fixée au tronçon de poutre s'amenuisant (36) et assurant la génération d'un signal de sortie proportionnel à la contrainte engendrée dans le tronçon de poutre s'amenuisant (36) par une force appliquée à l'ensemble de poutre (14); caractérisé en ce que l'ensemble de poutre (14) comprend un seul élément sensiblement cylindrique (28) présentant une extrémité ancrée sur le logement (12) et

l'autre extrémité libre, une fente sensiblement en L (32) est ménagée dans l'élément cylindrique (28) pour définir un tronçon-levier (34) et le tronçon-poutre s'amenuisant (36), un élément de transmission de force (52) est fixé au tronçon-levier (34) et un second élément de transmission de force (54) est fixé au tronçon-poutre (36).

2. Transducteur selon la revendication 1, dans lequel le premier (52) et le second (54) éléments de transmission de force sont une première et une seconde entretoises s'étendant à partir de l'élément cylindrique (28) perpendiculairement à son axe longitudinal.

3. Transducteur selon la revendication 2, dans lequel les première et seconde entretoises traversent le logement (12) pour se fixer à un premier (16) et à un second (18) moyens générateurs de force.

4. Transducteur selon l'une quelconque des revendications 1 à 3, dans lequel la fente en L (32) est façonnée en sorte que sa branche longue soit parallèle à l'axe longitudinal de l'élément cylindrique (28) et décalée par rapport à cet axe et que sa branche courte soit perpendiculaire à cet axe, le tronçon poutre s'amenuisant (36) étant constitué entre la branche longue et le côté voisin de l'élément cylindrique (28).

5. Transducteur selon la revendication 4, dans lequel l'élément cylindrique (28) présente un méplat (30) façonné sur un de ses côtés voisin de la branche longue de la fente en L.

6. Transducteur selon la revendication 5, dans lequel la ou chaque susdite jauge de contrainte (44, 46) est fixée au méplat (30).

