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PRESSURE TRANSDUCER

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FIG. 1

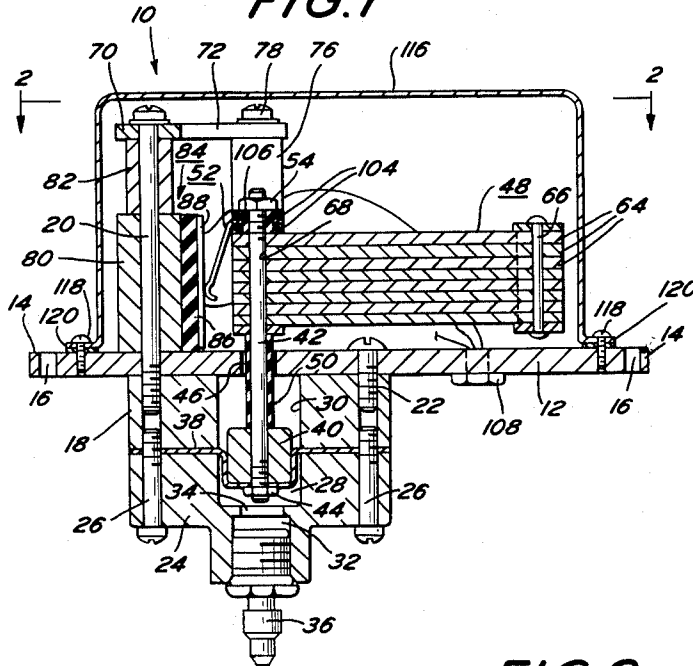


FIG. 2

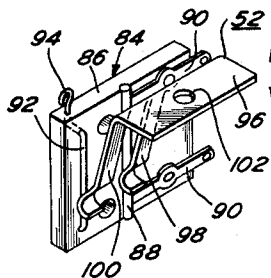
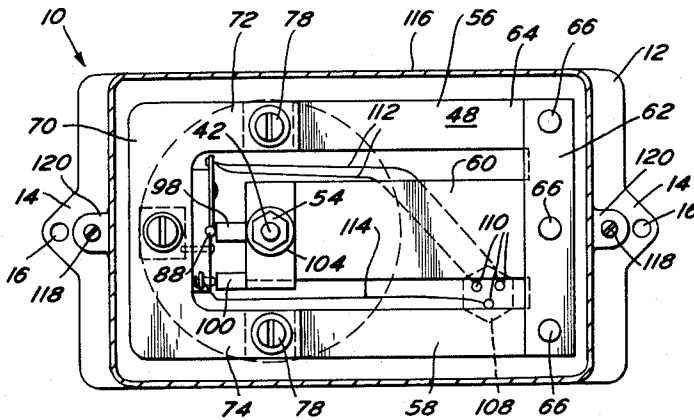


FIG. 3

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PRESSURE TRANSDUCER

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In general, pressure transducers comprise a pressure responsive means, such as a bellows or diaphragm, a variable electrical component, such as a variable resistor or a differential transformer, and a mechanical linkage between the pressure responsive means and the variable electrical component. In the operation of such transducers, a variation in the pressure applied to the pressure responsive means moves the pressure responsive means so as to vary the setting of the variable electrical component through the connecting linkage. The electrical output of the electrical component being a function of the pressure applied to the transducer provides an indication of the pressure.

One problem in such transducers is that the linkage connection between the pressure responsive means and the variable electrical component often includes one or more bearings or pivots which can become worn or broken during the operation of the transducer. Such wear or breakage will cause either complete disruption of the operation of the transducer, or will induce in accuracies in the readout of the transducer. To prevent this, it is desirable to provide a straight, direct drive connection between the pressure responsive means and the variable electrical component. However, the transducers which have heretofore used a straight, direct drive connection between the pressure responsive means and the variable electrical components support the drive connection in one or more bearings. Such bearings create a frictional drag on the drive connection so that the output of the electrical component is not always an accurate indication of the pressure applied to the transducer. Although frictionless bearings could be used, such bearings make the construction of the transducer more complex, and thereby increase the cost of the transducer.

It is an object of the present invention to provide a novel pressure transducer utilizing a straight, direct drive connection between the pressure responsive means and the variable electrical component.

It is a further object of the present invention to provide a pressure transducer having a frictionless straight, direct drive connection between the pressure responsive means and the variable electrical component.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a longitudinal medial sectional elevational view of the pressure transducer of the present invention.

FIGURE 2 is a sectional plan view taken along line 2—2 of FIGURE 1.

FIGURE 3 is a perspective view of the variable electrical component of the pressure transducer of the present invention.

In general, the pressure transducer of the present invention comprises a pressure responsive means including a slack diaphragm secured across a cylinder and secured to a piston within the cylinder. The piston is of a diameter smaller than the diameter of the bore of the cylinder so that there is no friction between the piston and the cylinder. A straight rod is connected between the

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piston and the movable contact of the variable resistor. The movable contact is in sliding engagement with a resistance element. Electrical terminals are provided for the resistance element and the moving contact. A spring is connected to the rod to provide a force against which the pressure being measured must act. The spring is of a type which permits movement of the rod only in a direction along the axis of the rod. Since the spring permits only longitudinal movement of the rod, no bearings are necessary to support the rod. Thus, there is provided a frictionless straight, direct drive between the pressure responsive means and the variable electrical component of the transducer of the present invention.

Referring to the drawing, the pressure transducer of the present invention is generally designated as 10.

Transducer 10 comprises a flat, rectangular base plate 12 having a pair of mounting ears 14 extending from its ends. Each of the mounting ears 14 has a hole 16 therethrough. A cylinder 18 is secured to the bottom surface of the base plate 12 by bolts 20 and 22. A cylinder cover 24 is secured to the bottom of the cylinder 18 by bolts 26. Cylinder cover 24 has a bore 28 in its top surface which is of the same diameter and is in alignment with the bore 30 of the cylinder 18. An inlet passage 32 is provided in the bottom surface of the cylinder cover 24, and is connected to the bore 28 of the cylinder cover by an opening 34. A fitting 36 is secured within the inlet passage 32. The fitting 36 is adapted to be connected to a mating fitting on a pipe, tube, etc. to permit the transducer 10 to be connected to the source of pressure to be measured.

A slack diaphragm 38 extends across the mating ends of the cylinder bore 30 and cover bore 28 with the periphery of the diaphragm being clamped tightly between the mating ends of the cylinder 18 and the cover 24. By a "slack" diaphragm it is meant a diaphragm of an impervious material which has sufficient flexibility to permit it to be flexed by a minimum force. A piston 40 is provided within the cylinder bore 30, and is seated on top of the diaphragm 38. The piston 40 is of a diameter smaller than the diameter of the cylinder bore 30 so that the piston does not contact the wall of the cylinder bore. A connecting rod 42 extends through the piston 40 and the diaphragm 38. A nut 44 is threaded on the bottom end of the connecting rod 42, and clamps the diaphragm 38 to the piston 40. The connecting rod 42 extends upwardly along the axis of the cylinder bore 30, through a hole 46 in the base plate 12, and projects beyond the top surface of the base plate. A spring member, generally designated as 48, is mounted over the base plate 12, and is connected to the connecting rod 42 in a manner which will be explained later. Spring member 48 is of a type which will allow movement of the connecting rod 42 along only the longitudinal axis of the connecting rod. A spacer sleeve 50 is provided around the connecting rod 42 between the spring member 48 and the piston 40. The outer diameter of the spacer sleeve 50 is smaller than the diameter of the hole 46 in the base plate 12 so that the spacer sleeve can pass freely through the hole 46. A resistor contact member, generally designated as 52, is mounted on the connecting rod 42 over the spring member 48. A nut 54 is threaded on the top end of the connecting rod 42. The nuts 44 and 54 clamp the diaphragm 38, piston 40, spacer sleeve 50, spring member 48, and resistor contact member 52 tightly together on the connecting rod 42.

As shown in FIGURE 2, the spring member 48 is an E-shaped spring having a pair of outer arms 56 and 58, and an inner arm 60 all connected together at a base 62. As shown in FIGURE 1, the spring member 48 is made up of a plurality of relatively thin, flat leaf springs 64 mounted in stacked relation, and secured together at the

base 62 of the spring member by rivets 66. The widths of the arms 56, 58 and 60 of the spring member 48 are such that the total stiffness of the outer two arms 56 and 58 is equal to the stiffness of the inner arm 60.

The spring member 48 extends over and is substantially parallel to the base plate 12. The connecting rod 42 extends through a hole 68 in the free end of the inner arm 60 of the spring member 48. A supporting bracket 70 is mounted on the base plate 12 in a manner which will be explained later, and has a pair of arms 72 and 74 extending over the free ends of the outer arms 56 and 58 respectively of the spring member 48. A separate spacer block 76 is provided between each of the bracket arms 72 and 74 and the top surfaces of the spring arms 56 and 58. A separate bolt 78 extends through each of the bracket arms 72 and 74, the spacer block 76 and the spring arms 56 and 58 so that the free ends of the spring arms 56 and 58 are secured to the supporting bracket 70. Thus, the ends of the outer arms 56 and 58 of the spring member 48 are secured to the base plate 12, the end of the inner arm 60 of the spring member is secured to the connecting rod 42, and the base 62 of the spring member is free floating.

A resistor mounting block 80 is seated on the base plate 12 adjacent to but spaced from the end of the inner arm 60 of the spring member 48. A spacer member 82 is seated on the resistor mounting block 80, and the supporting bracket 70 is seated on the spacer member 82. The bolt 20 extends through the supporting bracket 70, spacer member 82 and resistor mounting block 80 to secure the supporting bracket and resistor mounting block to the base plate 12.

A variable electrical resistor, generally designated as 84, is mounted on the surface of the resistor mounting block 80 facing the spring member 48. Resistor 84 comprises a rectangular support plate 86 of an electrical insulating material, such as a plastic. A straight resistance element 88 is secured to a face of the support plate 86. Resistance element 88 comprises a base of an electrical insulating material having a resistance material on the surface thereof. The resistance material may be a film of any well known resistance material, such as carbon, a metal, etc., coated on the surface of the base, or a resistance wire helically wound around and along the base as a core. A pair of terminals 90 of an electrical conductive metal are secured to the support plate 86 with one end of the terminals electrically connected to the opposite ends of the resistance element 88, and the other ends of the terminals projecting beyond an edge of the support plate 86. A collector wire 92 of an electrically conductive metal is mounted on the support plate 86 spaced from and parallel to the resistance element 88. The collector wire 92 is provided with a terminal 94 at one end which projects beyond an edge of the support plate 86. The resistor 84 is mounted on the mounting block 80 with the longitudinal axis of the resistance element 88 being parallel to the longitudinal axis of the connecting rod 42 (see FIGURE 1).

As shown in FIGURE 3, resistor contact member 52 comprises a plate 96 of an electrically conductive metal having a pair of spaced, parallel arms 98 and 100 projecting from an edge thereof. The contact plate 96 is seated over the inner arm 60 of the spring member 48 with the connecting rod 42 extending through a hole 102 in the contact plate. The contact arms 98 and 100 project from the contact plate 96 beyond and across the end of the inner arm 60 of the spring member 48. The free end of the contact arm 98 slidably engages the resistance element 88, and the free end of the contact arm 100 slidably engages the collector wire 92. Contact member 52 is electrically insulated from the spring member 48 and the connecting rod 42 by a pair of insulating washers 104 on opposite sides of the contact plate 96, and an insulating sleeve 106 extending around the con-

necting rod 42 and through the hole 102 in the contact plate.

A terminal plug 108 extends through and is secured to the base plate 12. Terminal plug 108 is provided with three terminal pins or sockets 110 which are insulated from each other and from the base plate 12. Each of the resistor element terminals 90 is electrically connected to a separate one of the terminal pins 110 by a separate wire 112. The collector terminal 94 of resistor 84 is electrically connected to the third terminal pin 110 by a wire 114.

A protective cover 116 is provided over the spring member 48, resistor 84, and their supporting elements. The cover 116 is secured to the base plate 12 by screws 118 extending through mounting ears 120 and threaded into holes in the base plate.

In the use of the transducer 10 of the present invention, the transducer is connected to the source of pressure to be measured by means of a pipe, tube or the like connected to the fitting 36. Thus, the pressure to be measured is applied to the bottom of the piston 40 through the diaphragm 38. As the pressure to be measured varies the piston 40 will be moved longitudinally in the cylinder 18. Increases in the pressure to be measured will move the piston 40 upwardly against the stiffness of the spring member 48, and decreases in the pressure will move the piston 40 downwardly under the action of the spring member. Movement of the piston 40 moves the contact member 52 through the connecting rod 42. Thus, variations in the pressure to be measured varies the position of the point of contact between the contact arm 90 and the resistance element 88 so as to vary the electrical output of the resistor 86. The electrical output of the resistor 86 can be measured by suitable instrumentation connected to the terminals 110. By pre-calibrating the resistor 86, the pressure being measured can be directly determined by the instrumentation connected to the transducer 10.

As previously stated, the spring member 48 is of a type which permits movement of the connecting rod 42 only longitudinally of the axis of the connecting rod. Thus, the connecting rod 42 has no supporting bearings so that there is no frictional drag on the movement of the connecting rod. Therefore, the electrical output of the transducer 10 provides an accurate indication of the pressure being measured. Also, the connecting rod 42 provides a straight, direct connection between the piston 40 and the resistor contact member 52 so that there is no linkage or linkage bearings to become worn or broken during the operation of the transducer 10. Therefore, the transducer 10 of the present invention will have a long operating life.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. A pressure transducer comprising a flat base plate, a cylinder secured to one side of said base plate, said cylinder having a bore the longitudinal axis of which is perpendicular to said base plate, a slack diaphragm secured to said cylinder and extending across said cylinder bore, a piston seated against said diaphragm, the outer diameter of said piston being smaller than the diameter of the cylinder bore, a straight connecting rod secured to the diaphragm and piston, said connecting rod extending through said cylinder bore and projecting through an opening in said base plate, an electrical resistor mounted on the other side of said base plate, said resistor having a straight resistance element extending parallel to said connecting rod and a pair of terminals electrically connected to opposite ends of the resistance element, a resistor contact member mounted on said connecting rod and slidably engaging said resistance element, a terminal

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electrically connected to said contact member, an E-shaped spring mounted over and extending substantially parallel to the outer side of the base plate, the inner arm of said spring being secured to the connecting rod and the outer arms of the spring being secured to the base plate, said spring permitting movement of said connecting rod only longitudinally of the axis of the connecting rod, and means for applying the pressure to be measured to said diaphragm and said piston.

2. A pressure transducer in accordance with claim 1 in which the resistor includes a collector member of an electrically conductive metal mounted parallel to the resistance element, and the contact member includes a pair of contact arms, one of said contact arms slidably engaging the resistance element and the other contact arm slidably engaging the collector member.

3. A pressure transducer in accordance with claim 1 in which the spring means comprises a plurality of stacked

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E-shaped springs extending substantially parallel to the base plate, the arms and the bases of said springs being rigidly secured together, the inner arms of said springs being secured to the connecting rod and the outer arms of the springs being secured to the base plate.

4. A pressure transducer in accordance with claim 3 in which the stiffness of the inner arms of the springs is equal to the total stiffness of the outer two arms of the springs.

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