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(54) **Rocker movement transducer**

Kipphebelwandler

Transmetteur de mouvement oscillant

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(56) References cited:
GB-A- 2 159 953
US-A- 3 611 068
US-A- 4 655 091

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Description

[0001] The present invention relates to devices known as transducers which provide an electrical signal output or indication, when connected in a circuit, of a mechanical or other physical non-electrical input such as motion or force to provide an interface between a physical or mechanical system and an electrical circuit.

[0002] Devices of this type are employed where it is desired to provide an electrical indication of a physical quantity to be monitored or measured on a continuous or running basis without the need to record values and reset or restart the measuring device. In particular, transducers are employed to provide an indication of motion or continuously varying displacement, particularly user effected movement of a control member where an electrical signal is provided which has the characteristics thereof varied or changed, so as to provide a discrete electrical indication of different positions of the member.

[0003] Known movement or displacement transducers have utilized potentiometers and variable resistors employing wipers moved over stationary resistance material to vary the overall resistance of the device. Typically, the variable resistance device is connected in one leg or arm of a Wheatstone bridge. This electrical bridge arrangement provides the desired electrical sensitivity to small changes in resistance representative of a small displacement of the input member to thereby provide the desired accuracy of measurement or control. Alternatively, a microcomputer can be used with a lookup table of predetermined relationships between the property measured or displacement being tracked and the electrical resistance.

[0004] However, variable wiper type potentiometers have inherent disadvantages in that they are expensive to fabricate and subject to variation in the electrical resistance due to changes in the wiping surfaces and degradation over time in service. Accordingly, it has been desired to provide a motion or displacement transducer which has a high degree of sensitivity to small displacements and which provides a reliable and repeatable electrical signal and which is low in manufacturing cost.

BRIEF SUMMARY OF THE INVENTION

[0005] The present invention provides a motion or displacement transducer which yields, upon connection to an external circuit, an electrical indication which is proportional to the position of a user moveable input member comprising a pivoted rocker provided on the device. The device of the present invention utilizes a variable resistance of the type which is force/pressure sensitive to surface contact and eliminates the need for a wiper.

[0006] It is an object of the present invention to provide a transducer which provides a variable electrical resistance signal in response to user movement of a rocker member on the device.

[0007] It is another object of the present invention to provide a position or movement transducer which utilizes a force/pressure sensitive resistor to provide a variable resistance electrical signal in response to user movement of an input member.

[0008] It is a further object of the present invention to provide a rotary position transducer which outputs an electrical variable resistant signal responsive to user movement of a rocker member and which employs a force/pressure responsive resistor eliminating the need for a wiper.

[0009] The transducer of the present invention employs a force/pressure responsive resistive strip subjected to a variable force by an actuator which is biased against the strip with a normal force proportional to the angular rotation or movement of the input rocker. The normal force is generated by a cam on the rocker; and, in the preferred form of the invention, the cam surfaces are configured such that the bias force is varied proportional to the rocker for movement over the desired range of movement of the rocker. The device may be configured with detent means at selected rotary positions of the rocker to enable the user to move the rocker to a pre-selected position which is tactilely discernible.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is a top or plan view of the transducer of the present invention;
FIG. 2 is a section view taken along section indicating lines 2-2 of FIG. 1;
FIG. 3 is a section view taken along section indicating lines 3-3 of the device of FIG. 2;
FIG. 4 is an enlarged view of the lower portion of FIG. 2 with portions broken away to show the interior components; and,
FIG. 5 is a section view taken along section indicating lines 5-5 of FIG. 4.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Referring to FIGS. 1, 2 and 3, the transducer assembly of the present invention is indicated generally at 10 and includes housing means including an upper body member 11, a middle body member 12, and a lower body member 14, with the body members secured together by suitable fasteners such as screws 16, 18, shown in dashed outline in FIG. 3. A capsule, indicated generally at 20, is attached to the lower body 14 as will be hereinafter described in greater detail. A user actuated member comprising rocker 22 is pivotally mounted in upper body 12 by means of a pivot shaft or pin 24 and has a post portion 26 extending exteriorly of upper housing shell 12. It will be understood that rocker 22 may alternatively be constrained for arcuate rocking or arcuate sliding movement without a fixed pivot pin.

[0012] It will be understood that portion 26 may have gripping surfaces thereon to facilitate manual operation, which surfaces may be formed in a separate cap 28 received over portion 26 of the rocker 22.

[0013] Middle body member 12 has a pair of spaced stanchions 36, 38 which are each apertured with one end of pin 24 secured therein for pivotally supporting rocker 22.

[0014] Upper body member 11 has a bore 42 formed therein in which is slidably received a detent pin or plunger 44 which is biased outwardly of the bore 42 by a spring 46.

[0015] The end of detent plunger 44 is biased against the right hand axial face of rocker 22 and serves to resiliently engage one of a plurality of arcuately spaced detent recesses 47, 48, 49, 51, and 52 formed in rocker 22.

[0016] Rocker 22 has a cam surface 50 formed on the lower end thereof, which is preferably asymmetric about the center one of the detent recesses 49. It will be understood that rocker 22 is intended to be manually grasped by a user at cap 28 and rotated to any one of a plurality of rotary positions through an angular displacement denoted by the Greek character Theta in FIG. 2. In the present practice of the invention the angle Theta has a value of 40 degrees and is subdivided into four segments which are denoted by the five detent recesses as denoted by reference numerals 47, 48, 49, 51 and 52 which in the present practice are spaced angularly equally.

[0017] The position of rocker portion 26 corresponding to each of the detents 47, 48, 49, 51 and 53 is marked by suitable indicators or indices denoted respectively 53, 55, 57, 59 and 61, in FIG. 1. Rocker movement in either a clockwise or counter-clockwise direction is neutralized or returned to center by return springs 45, 43 respectively, which are mounted to lower body 14 by screws 54.

[0018] Referring to FIGS. 1, 3, 4 and 5 the capsule 20 of the assembly 10 is shown as having an outer shell 56 which has an enlarged diameter flange 58 provided around the upper portion thereof adjacent the upper end which flange serves to register the capsule against the undersurface of lower body 14. The capsule shell is retained in the lower body 14 by any convenient expedient, as for example, via twist locking tabs 60, 62 extending outwardly from the upper end of the shell 56.

[0019] The body shell 56 of capsule 20 has attached to the lower surface thereof a circuit board assembly indicated generally at 64 which is secured to the lower surface of the body shell 56 by suitable fastening expedients such as screws 66. It will be understood however, the capsule body shell 56 may alternatively be formed integrally with lower body 14, if desired.

[0020] Referring to FIG. 4, the capsule 20 is shown in detail as having a plunger member 68 slidably received in a bore 70 provided in the shell 56; and, the plunger 68 has a reduced diameter hollow cylindrical portion 72 extending axially downwardly from the upper portion 68. The cylindrical portion 72 of plunger 68 serves as a pilot or guide and has a spring 74 received thereover with the upper end of the spring registered against the undersurface of portion 68; and, the opposite reaction end or lower end of spring 74 is registered against the upper surface of the circuit board assembly 64.

[0021] The spring 74 biases the plunger 68 upwardly to its limit of travel against the undersurface 76 of the upper wall of shell 56. In the present practice of the invention, the spring constant or spring rate of the spring 74 is quite low with respect to the other springs of the assembly and serves only to return the plunger to the upward limit of its travel.

[0022] The plunger 68 has an upwardly extending projection or post 78 which extends exteriorly of the shell 56 through an aperture 80 formed in the upper wall 76. It will be understood that the post 78 is formed integrally with the plunger 76 in the presently preferred practice; and, post 78 has a preferably hemispherical surface 82 formed on the upper end thereof which contacts and follows the cam surface 50 provided on the rocker 22 (see FIG. 1).

[0023] Referring to FIG. 4, the hollow cylindrical portion 72 of plunger 68 has slidably received therein a generally cup-shaped actuator 84 which is limited in its downward or outward travel, with respect to plunger 68, by a barbed annular surface 86 provided on the outer surface thereof. Barbed surface 86 registers against an annular shoulder 88 formed in the interior of the cylindrical portion 72 of plunger 68. It will be understood that the actuator 84 is slotted as denoted by reference numeral 90 about its periphery to permit radial compression of the cylindrical wall thereof to permit assembly of the barbed surface 86 into the interior of the cylindrical portion 72 of the plunger 68.

[0024] A force bias spring 94 is disposed interiorly of the plunger and actuator 84 and has its upper end registered against the undersurface 92 of the upper portion of plunger 68. The opposite reaction end or lower end of spring 94 is registered against the interior of the closed end of actuator 84 to bias the actuator downwardly or in an outward direction with respect to plunger 68.

[0025] The lower surface of the closed end of the actuator 84 has provided thereon an elastomeric pad 96 which is secured thereto by any suitable expedient, as for example, adhesive bonding or double-sided tape.

[0026] In the present practice of the invention the pad 96 has a thickness of about one millimeter and is formed of preferably silicone elastomer and preferably has a hardness of about 65 as measured on a shore "A" scale. The pad 96 serves to provide a resilient load distributing surface for contacting the printed circuit board assembly 64.

[0027] Referring to FIG. 5, the circuit board assembly 64 includes a printed circuit board 98 which has a pair of spaced generally parallel conductive strips 100, 102

provided thereon, each of which terminates in a loop denoted respectively 104, 106. Each of the loops 104, 106 has disposed therein, through an aperture in the board 98, an electrical connector pin denoted respectively 108, 110 which is electrically connected to the loop by a suitable expedient such as, for example, soldering. The pins 108, 110 each extend downwardly through the circuit board 98 and are formed at right angles to extend through an electrical receptacle 112 which is retained on the undersurface of the circuit board by screws 114 passing through the board, and illustrated as having their heads on the upper surface of the board 98. It will be understood that the pins 108, 110 are adapted to connect the device 116 to a circuit (not shown) such as an arm of a Wheatstone bridge circuit by external connection through connector 112.

[0028] Referring to FIG. 5, a force/pressure responsive resistive device 116 in the form of a thin strip which bridges the contacts 100, 102 and is electrically connected therewith. In the present practice of the invention, the device 116 comprises a thin layer or strip of conductive material separated from another thin layer or strip of conductive material with a superposed layer of resistive material thereover such that increased surface contact pressure thereon causes a conductive layer to be pressed thereon and effects decrease in the resistance measured between the strips 100, 102. Such devices are well known in the art and are formed of pressure transducer ink screened on dielectric material to form a thin strip-like resistive device.

[0029] Referring to FIGS. 1 to 4 in operation, rotation of the rocker 22 in either a clockwise or anti-clockwise direction causes the cam surface 50 on rocker 22 to act against the hemispherical surface 82 of post 78 and plunger 68 to move downwardly compressing spring 94 and increasing the bias of the elastomeric pad 96 against the force/pressure sensitive resistive device 116. In the presently preferred practice of the invention, the spring rates or constants of the spring 94 is chosen to be higher than spring 74.

[0030] In the preferred practice of the invention, the extended length of the sub-assembly 85 of plunger 68, actuator 84 and spring 94 is such that when sub-assembly 85 is inserted in bore 70 of shell 56 and circuit board 98 is attached, pad 96 is not pressed against device 116 with any significant force. The user thus tactilely perceives a requirement for increasing force to increase the angular rotation of the rocker; and, can tactilely perceive the various detented positions of recesses 47, 48, 49, 51 and 53.

[0031] The present invention thus provides a reliable, simple to manufacture and relatively low cost rocker position transducer which utilizes a force/pressure sensitive resistive device and eliminates the need for wiping contact.

[0032] The invention has been described and illustrated with respect to a resistive force/pressure responsive device; however, it will be understood that a capacitive force/pressure responsive device could be substituted for the device 116 to achieve the same results where an alternating current electrical signal is employed.

[0033] Although the invention has hereinabove been described with respect to the illustrated embodiments, it will be understood that the invention is capable of modification and variation and is limited only by the following claims.

Claims

1. A rocker actuated position transducer comprising:

(a) housing means defining a pivot surface;
(b) a rocker member disposed for pivotal rocking movement on said pivot surface and having portions thereof extending exteriorly of said housing for user actuation, said rocker member defining thereon a cam surface (50);
(c) a force/pressure responsive strip (116) associated with said housing means, said strip operative to effect a change in electrical circuit properties upon connection to a circuit; and,
(d) means for generating a force on said strip (116) including a follower member (78) biased against said cam surface (50) and a reaction member (84) biased against said strip (116), wherein upon user pivoting of said rocker member, said reaction member varies the force against said strip (116) and said circuit properties.

2. The transducer defined in claim 1, wherein said strip (116) is operative to effect a change in electrical circuit properties selected from the group consisting of resistance and capacitance.

3. The transducer defined in claim 1, wherein said rocker member defines a plurality of spaced detent surfaces; and, said housing means includes plunger member resiliently biased in contact with one of said detent surfaces for selected positions of said rocker.

4. The transducer defined in claim 1, wherein said reaction member and said follower member are disposed in telescoping arrangement with a spring (94) disposed therebetween.

5. The transducer defined in claim 1, wherein said housing means includes a first and second half shell joined together and having said rocker pivot surface therein.

6. The transducer defined in claim 1, wherein said housing means includes a shell having a closure or cover with said pivot surface disposed therein; and,

a capsule releasably attached to said shell, said capsule having said strip (116) and said force generating means therein.

7. A method of producing a variable electrical signal in response to user movement of an actuator:

(a) pivoting a rocker member having a cam surface (50) thereon on a housing;
(b) disposing a force/pressure sensitive strip (116) on the housing and connecting said strip (116) in a circuit;
(c) biasing a cam follower against said cam surface (50) and moving same in response to said pivoting;
(d) varying said bias in response to said pivoting and reacting said bias against said strip (116) and altering the electrical properties of said strip (116) in said circuit.

8. The method described in claim 7, wherein said step of varying said bias includes compressing a spring (94) and said step of reacting includes registering an end of said spring against a plunger and contacting said strip (116) with the plunger.

9. The method described in claim 7, wherein said step of varying said bias includes increasing the bias with progressive pivoting.

Patentansprüche

1. Ein kipparmbetätigter Positionswandler, der Folgendes aufweist:

(a) Gehäusemittel, die eine Schwenkoberfläche definieren;
(b) ein Kippglied, angeordnet für eine schwenkbare Kippbewegung auf der Schwenkoberfläche und mit Teilen davon, die sich außerhalb des Gehäuses erstrecken für die Benutzerbetätigung, wobei das Kippglied eine Nockenoberfläche (50) definiert;
(c) ein auf Kraft/Druck ansprechender Streifen (116) assoziiert mit den Gehäusemitteln, wobei der Streifen eine Änderung der elektrischen Schaltungseigenschaften bei Verbindung mit einer Schaltung bewirkt; und
(d) Mittel zur Erzeugung einer Kraft am Streifen (116) einschließlich eines Folgegliedes (78), welches gegen die Nockenoberfläche (50) vorgespannt ist und mit einem Reaktionsglied (84) vorgespannt gegen den Streifen (116), wobei bei der Verschwenkung des Kippglieds durch den Benutzer das Reaktionsglied (84) die Kraft gegen den Streifen (116) und die Schaltungseigenschaften variiert.

2. Wandler nach Anspruch 1, wobei der Streifen (116) betriebsmäßig eine Änderung der elektrischen Schaltungseigenschaften bewirkt, ausgewählt aus der Gruppe, die aus Widerstand und Kapazität besteht.

3. Wandler nach Anspruch 1, wobei das Kippglied eine Vielzahl von beabstandeten Rastoberflächen definiert, wobei das Gehäuse ein Kolbenglied aufweist, welches elastisch in Kontakt mit einer der Rastoberflächen vorgespannt ist und zwar für ausgewählte Positionen des Kipparms.

4. Wandler nach Anspruch 1, wobei das Reaktions- oder Aufnahmeglied und das Folgeglied in teleskopartiger Anordnung mit einer Feder (94), die dazwischen angeordnet ist, angeordnet sind.

5. Wandler nach Anspruch 1, wobei die Gehäusemittel erste und zweite Halbschalen aufweisen, die miteinander verbunden sind und die eine Kippschwenkoberfläche darinnen besitzen.

6. Wandler nach Anspruch 1, wobei die Gehäusemittel eine Schale aufweisen mit einem Verschluss oder einer Abdeckung mit der Schwenkoberfläche darinnen angeordnet; und ferner mit einer Kapsel, die lösbar angebracht ist an der Schale, und wobei die Kapsel den erwähnten Streifen (116) und die Krafterzeugungsmittel darinnen aufweist.

7. Verfahren zur Erzeugung eines variablen elektrischen Signals ansprechend auf die Benutzerbewegung eines Betätigers oder Aktuators:

(a) Verschwenken eines Kippglieds mit einer Nockenfläche (50) daran auf einem Gehäuse;
(b) Anordnen eines kraft-/druckempfindlichen Streifens (116) am Gehäuse und Verbinden des Streifens (116) mit einer Schaltung;
(c) Vorspannen eines Nockenfolgers gegen die Nockenoberfläche (50) und Bewegung derselben infolge der erwähnten Verschwenkung;
(d) Veränderung der erwähnten Vorspannung, ansprechend auf die Verschwenkung und Zur-Reaktion-Bringen der Vorspannung gegenüber dem Streifen (116) und Änderung der elektrischen Eigenschaften des Streifen (116) in der Schaltung.

8. Verfahren nach Anspruch 7, wobei der Schritt der Veränderung der Vorspannung das Zusammendrücken einer Feder (94) aufweist und der Schritt des Ausrichtens eines Endes der Feder entgegen einem Kolben und das Kontaktieren des Streifens (116) mit dem Kolben umfasst.

9. Verfahren nach Anspruch 7, wobei der Schritt des

Veränderns der Vorspannung die Vergrößerung der Vorspannung umfasst und zwar mit progressiver oder fortschreitender Verschwenkung.

Revendications

1. Transducteur de position actionné par un élément basculant comprenant :

   (a) un moyen de boîtier définissant une surface de pivotement ;
   (b) un élément basculant disposé pour un mouvement de basculement pivotant sur la surface de pivotement et ayant des parties s'étendant vers l'extérieur du boîtier pour un actionnement par un utilisateur, l'élément basculant définissant une surface de came (50) ;
   (c) une bande sensible à une force/pression (116) associée au moyen de boîtier, la bande agissant pour provoquer un changement des propriétés du circuit électrique lors de la connexion à un circuit ; et
   (d) un moyen pour produire une force sur la bande (116) comprenant un élément suiveur (78) sollicité contre la surface de came (50) et un élément de réaction (84) sollicité contre la bande (116), dans lequel, par suite d'un pivotement par l'utilisateur de l'élément basculant, l'élément de réaction modifie la force contre la bande (116) et les propriétés du circuit.

2. Transducteur selon la revendication 1, dans lequel la bande (116) agit pour provoquer un changement de propriétés du circuit électrique choisi dans le groupe comprenant la résistance et la capacité.

3. Transducteur selon la revendication 1, dans lequel l'élément basculant comporte une pluralité de surfaces de détente espacées et le moyen de boîtier comprend un élément de plongeur sollicité de façon élastique contre l'une des surfaces de détente pour définir des positions sélectionnées de l'élément basculant.

4. Transducteur selon la revendication 1, dans lequel l'élément de réaction et l'élément suiveur sont disposés selon un agencement télescopique, un ressort (94) étant disposé entre eux.

5. Transducteur selon la revendication 1, dans lequel le moyen de boîtier comprend des première et seconde demi coquilles reliées l'une à l'autre et contenant la surface de pivotement de l'élément basculant.

6. Transducteur selon la revendication 1, dans lequel le moyen de boîtier comprend une coquille ayant une fermeture ou couvercle, la surface de pivotement étant disposée à l'intérieur, et une capsule liée de façon amovible à la coquille, la capsule contenant la bande (116) et le moyen de génération de force.

7. Procédé de production d'un signal électrique variable en réponse au déplacement d'un actionneur par un utilisateur, comprenant les étapes suivantes :

   (a) faire pivoter un élément basculant portant une surface de came (50) sur un boîtier ;
   (b) disposer une bande sensible à une force/pression (116) sur le boîtier et connecter la bande (116) dans un circuit ;
   (c) solliciter un suiveur de came contre la surface de came (50) et le déplacer en réponse audit pivotement ;
   (d) faire varier la sollicitation en réponse au pivotement et faire réagir la sollicitation contre la bande (116) et modifier les propriétés électriques de la bande (116) dans le circuit.

8. Procédé selon la revendication 7, dans lequel l'étape consistant à faire varier la sollicitation comprend la compression d'un ressort (94) et l'étape de réaction comprend l'alignement d'une extrémité du ressort contre un plongeur et la mise en contact de la bande (116) avec le plongeur.

9. Procédé selon la revendication 7, dans lequel l'étape consistant à faire varier la sollicitation comprend une augmentation de la sollicitation avec un pivotement progressif.

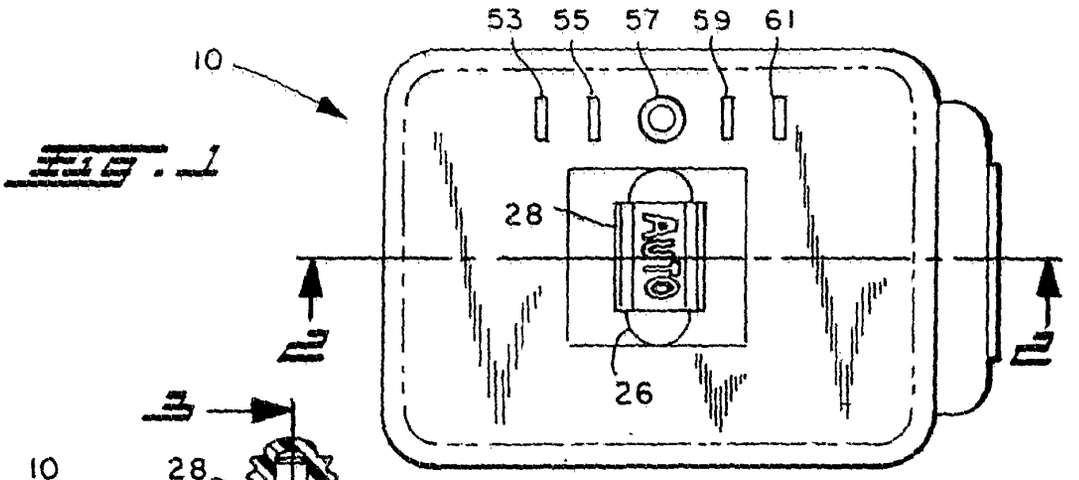

Fig. 1

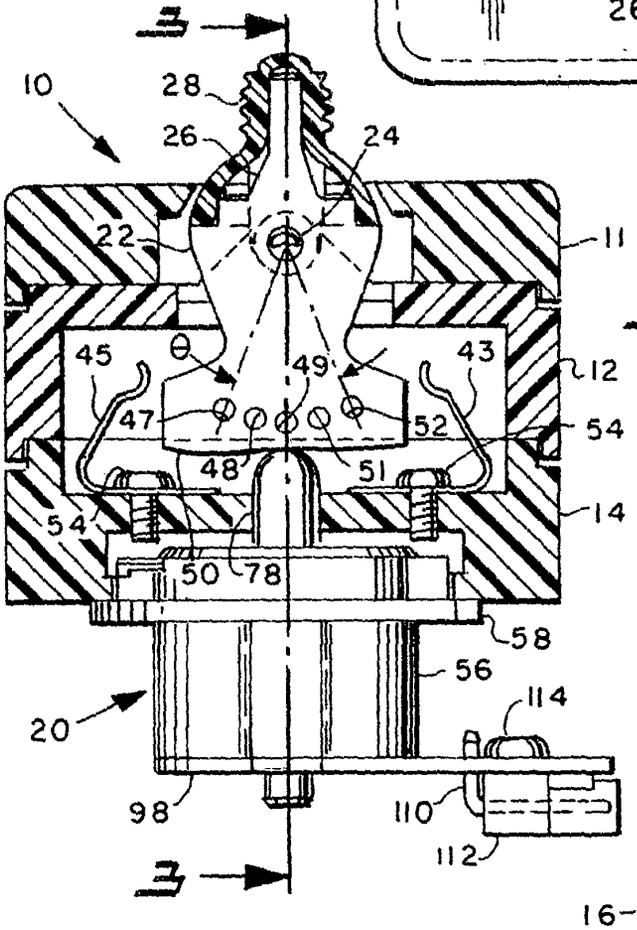

Fig. 2

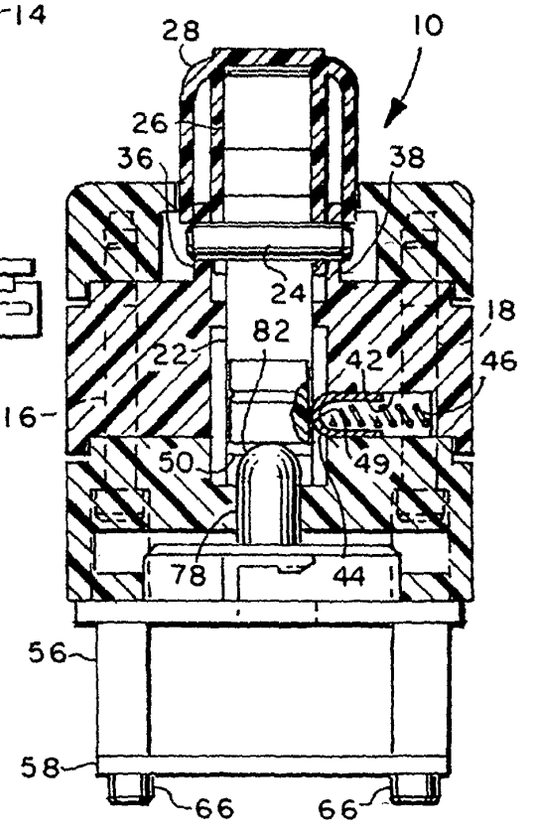

Fig. 3

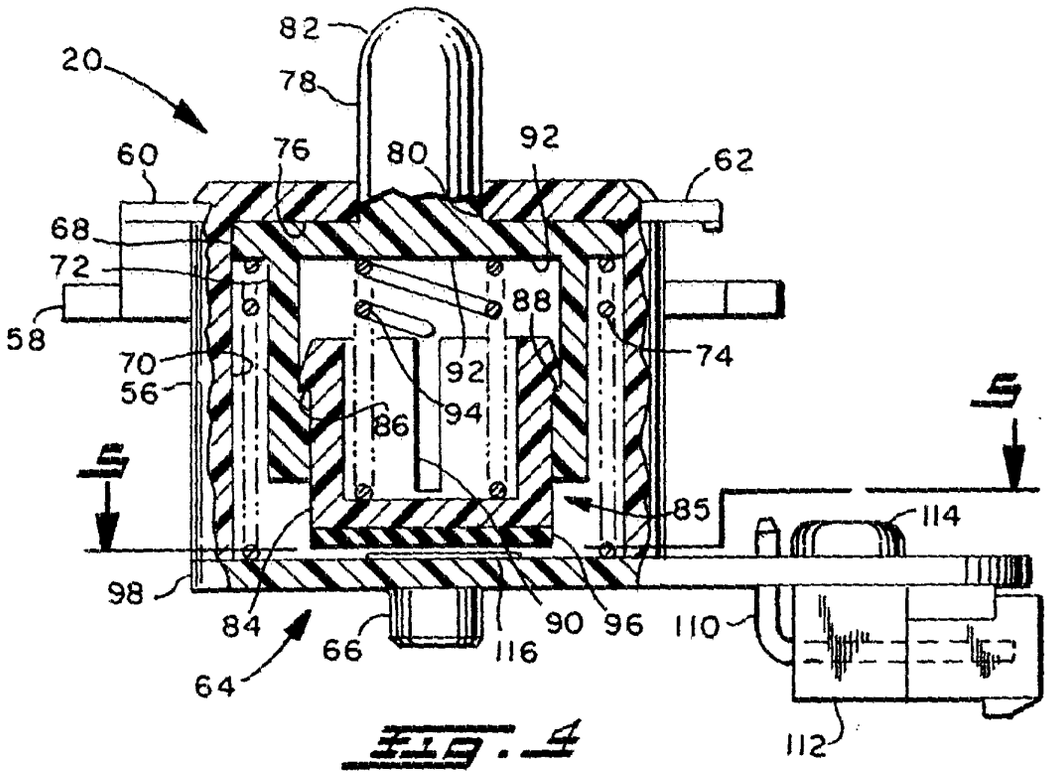
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Fig. 4

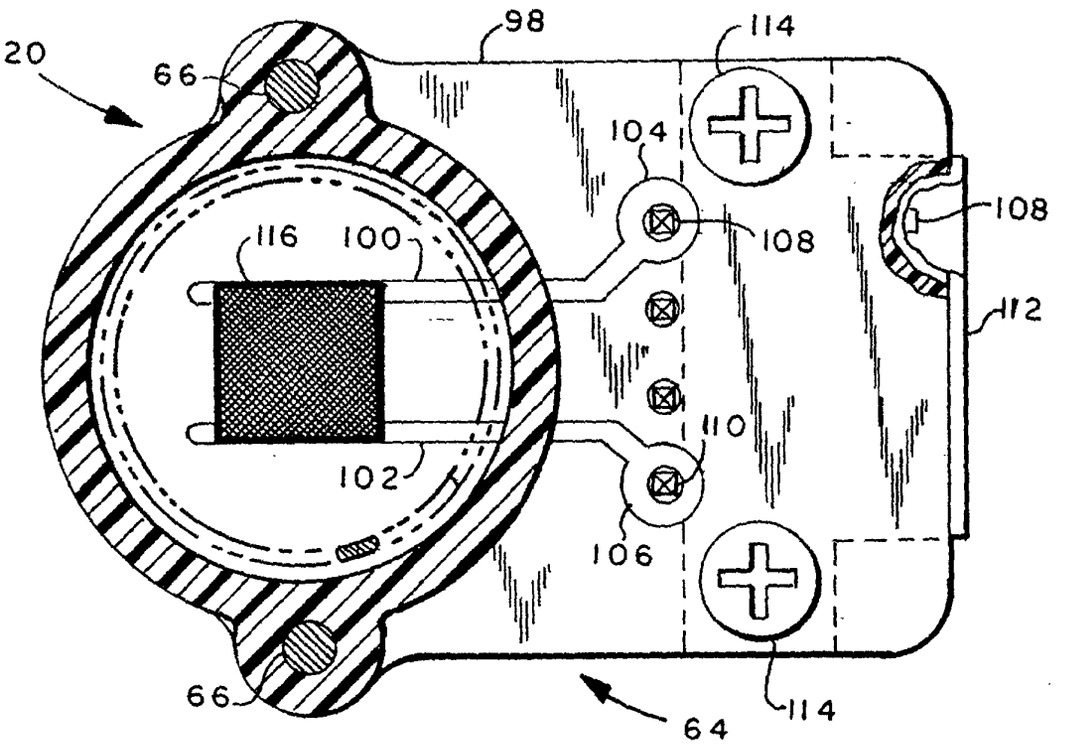
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Fig. 5