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Monpetit

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[54] **ELECTRICAL TRANSDUCER**

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[52] **U.S. Cl.** .... **73/517 A,** 73/136 A, 338/114

[51] **Int. Cl.** **G01p 15/12,** F02d 35/00

[58] **Field of Search** .... 73/517 R, 517 A, 398 AR, 73/136 A; 338/2, 47, 114; 323/94

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Attorney, Agent, or Firm—Drby & Drby

[57] **ABSTRACT**

An electrical transducer which is responsive to sudden movements to produce an electrical signal, the transducer including an element whose electrical resistance is changed upon the application of a force, such as torsion, with the change in resistance used to operate an electronic circuit.

12 Claims, 4 Drawing Figures

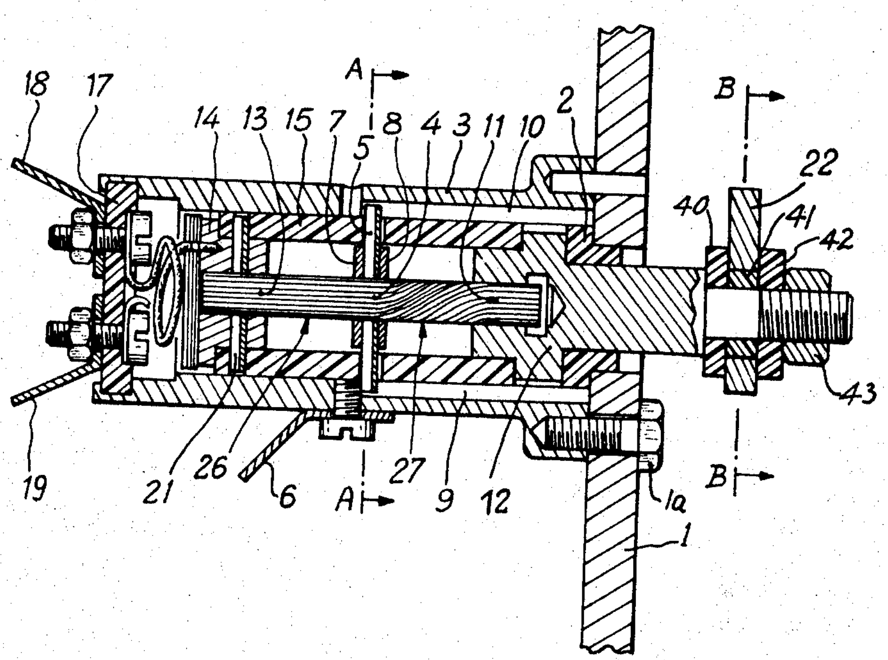

Fig: 1

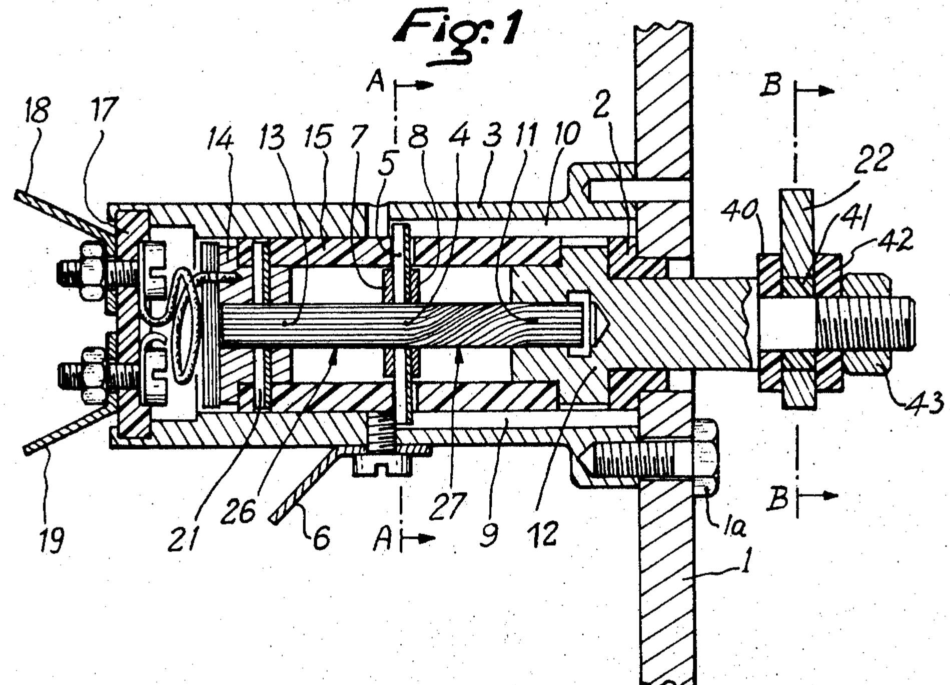
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Fig: 2

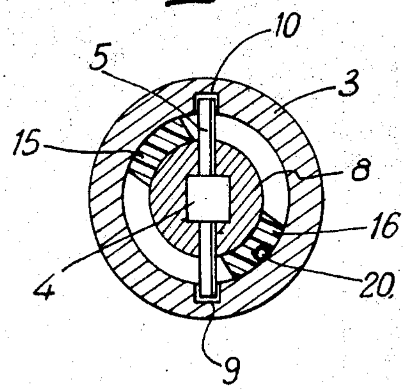
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Fig. 3

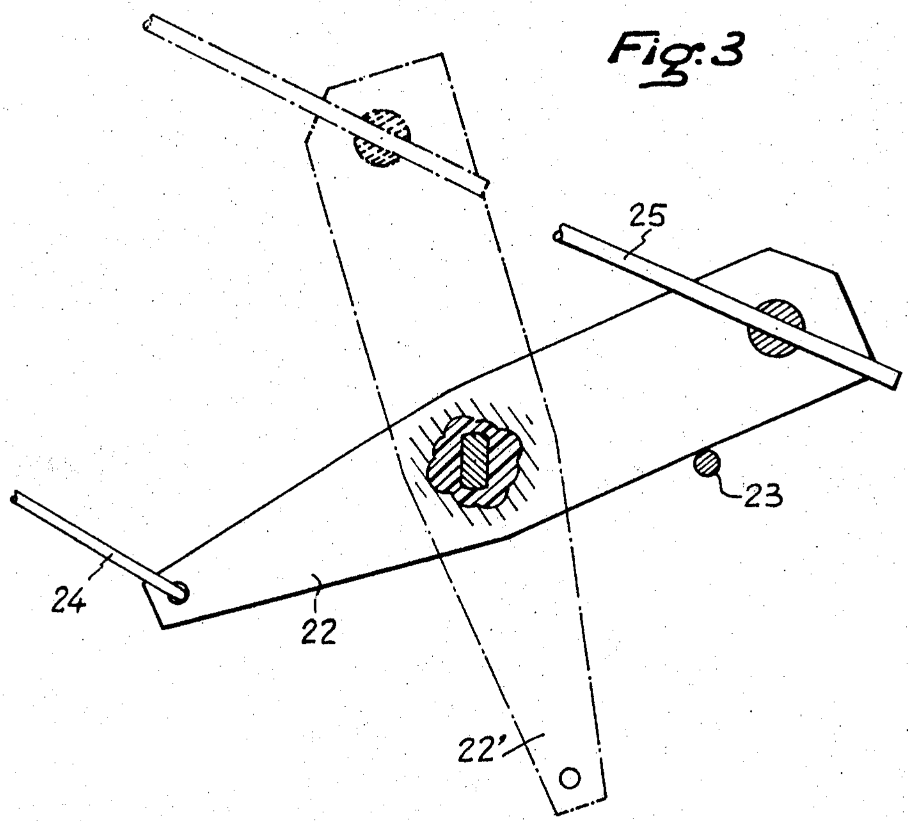
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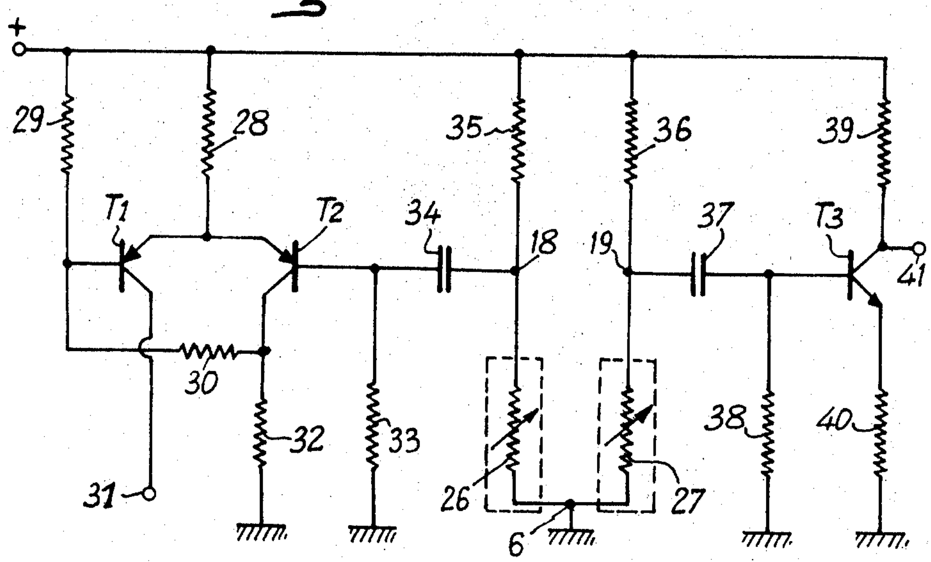
Fig. 4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T2
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37
T3
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ELECTRICAL TRANSDUCER

The present invention concerns a pickup device for detecting sudden movements, and more particularly to an electrical pickup device for detecting sudden movements of a control element of a combustion type engine.

In combustion type engines it may happen that sudden movements of a control element, such as the throttle or accelerator pedal, are not followed quickly enough by an effect at the engine's fuel supply. In particular, in the case of an engine for an automotive vehicle, when an obstacle appears, the driver quickly and completely takes his foot off the accelerator pedal serving as control of the engine, and after appraisal of the situation, he may be led to accelerate abruptly by depressing the pedal quickly. These quick movements at the accelerator pedal have an effect on the quantity of fuel to be supplied to the engine only after a certain time lag. It is desired to reduce the time lag to improve the engine response. To this effect, the purpose of the invention is to provide a transducer responsive to the sudden movements of the control element, or of an element which is mechanically connected to it, and to produce signals to control by an electronic circuit associated with this transducer the fuel supply devices of the engine. In the case of a fuel injection engine, the detection of a release of the control element, for example the throttle, may cause a momentary suppression of the fuel injection, and a supplementary or prolonged injection in fuel in case of sudden acceleration.

The object of the present invention is a transducer for detecting sudden movements. The transducer includes a rubber bar impregnated with carbon and capable of undergoing torsions around its longitudinal axis. The bar is maintained fixed at its middle portion and its two ends are made fast so as to be rotated, simultaneously and in the same direction, by a spindle transmitting the movements to be picked up. In one of its end positions, the bar has a pre-torsion of one of its two halves, in such a way that under the effect of a movement in one direction of the control element (called positive) this pre-torsion diminishes while a torsion appears on the other half, and that under the effect of a movement of the control element in the other direction (called negative) this pre-torsion re-appears and the torsion on the other half diminishes. The detection of sudden movements being effected by the measurement of the rapid increase in electrical resistance of the two halves of the bar under the effect of a sudden torsion.

Other characteristics of the invention will become evident from the following description and from the drawings in which can be seen:

FIG. 1 is a view in longitudinal section of the pickup of movements according to the invention.

FIG. 2 is a view in transverse section at the mid-portion of the pickup along line A-A of FIG. 1.

FIG. 3 is a view in partial transverse section along line B—B of FIG. 1 showing the element for torsional movement of the rubber bar in its two extreme positions.

FIG. 4 is a diagram of an electronic circuit used with the transducer according to the invention.

Referring to the drawing, FIG. 1 shows the cylindrical housing 3 of the pickup assembly mounted on a rigid support 1 by any suitable means such as screws 1a.

The pickup is located within housing 3 and includes a bar 4 of rubber which is impregnated with carbon to make it electrically conductive. Bar 4 is of generally square cross-section and, as shown, is also elongated. The bar 4 is located within a collar formed of two pieces of electrically conductive material 7, 8 and having a suitably shaped center opening. The bar is maintained fixed in its median transverse plane A—A by a cotter pin 5 engaging collar 7, 8 which assures in addition electrical contact with the common, or ground, point of the circuit at 6. Collar 7, 8 avoids tearing of the bar 4 at the cotter pin 5 whose ends are engaged in two diametrically opposite longitudinal grooves 9 and 10 formed on the internal wall of housing 3.

The first, or right-hand, end 11 of the bar 4 is held by a movable spindle 12 of electrically conductive material. Spindle 12 rotates about the longitudinal axis of bar 4 in an insulating bearing 2 mounted in the support 1.

The second, left-hand, end 13 of bar 4 is mounted in a fastener 14 of electrically conductive material. Fastener 14 is in turn mounted on the left end of a cylindrical insulating sleeve 15, which bears against the inner surface of housing 3. Sleeve 15 has transverse cutouts at the cotter pin 5 (FIG. 2) to permit its rotation. The fastener 14, sleeve 15 and end 13 of the bar are held together by a cotter pin 21. Spindle 12 is connected to the righ-hand end of sleeve 15 to rotate the latter. Thus, bar 4 is divided into two parts 26 and 27, held fast at the mid-point 7,8, which can be rotated as the spindle 12 is turned. For example, rotation of spindle 12 is a counter clockwise direction turns bar section 26 in the same direction. Sleeve 15 is rotated in the same direction and also turns fastener 14 and the left-hand section 26 of the bar in the same direction.

The housing 3 is closed by an insulating cover or stopper 17 which supports two electrical terminals 18 and 19. Terminal 18 is connected to fastener 14, that is, the left end 13 of the bar. Terminal 19 is connected to spindle 12 through a wire 20 embedded in a lower portion 16 of the sleeve 15 (FIG. 2).

Spindle 12 is rotated by a control lever 22 which is insulated from the spindle 12 by the washers 40, 41 and 42 and held to a threaded end of the spindle by a nut 43. In FIG. 3, the lever 22 is shown in full lines in a first end position where it rests on an abutment 23. A return spring 24 is connected to the lever at one end and a rod 25 is attached to the other end of the lever and also to the element (not shown) whose movements are to be monitored. Position 22′ of the lever, represented in broken lines, corresonds to its other end position.

As shown in FIG. 1, the bar 4 has its left half 26 at rest, without torsion, while its right half 27 has a pretorsion of about a quarter turn. Thus, in one end position, the left half 26 of the bar is without torsion, and in the other end position the right half 27 is without torsion.

FIG. 4 shows the two halves 26 and 27 of the bar, both connected to the common point 6 and the ends of the respective halves of the bar are each connected to an electronic circuit by their respective electrical terminals 18 and 19. In FIG. 4, the portion of the circuit located to the right of common point 6 serves to deliver a signal representative of a sudden movement of lever 22 in a direction, which can be called negative, the portion located to the left of point 6 to deliver a signal representative of a sudden movement in the opposite direction, called positive. In the case of a fuel supply of a combustion engine, this signal representative of a negative sudden movement of the control element of the engine, the throttle or accelerator pedal, can cause the flow of fuel furnished to the engine to be reduced or temporarily cut off, while the signal representative of a positive sudden movement of the control element can cause the flow of fuel to be increased temporarily.

The portion of the circuit for producing the positive signal comprises two PNP transistors T1 and T2 whose emitters are both connected to the positive power supply terminal through a resistor **28.** The base of transistor T1 is connected on the one hand to the positive terminal through a resistor **29,** and also to the collector of transistor T2 by a resistor **30.** The output terminal **31** of the signal representative of a positive sudden movement is taken off from the collector of transistor T1. The collector of transistor T2 is connected to the common potential point **6** by a resistor **32.**

The base of transistor T2 is connected to the common point **6** by a resistor **33.** Terminal **18** the free end of the left half bar section **4,** is connected to the positive power supply terminal by a resistor **35** and to the base of transistor T2 through a capacitor **34.**

In the portion of the circuit responsive to the negative motion of the control element, terminal **19,** of the free end of the right-hand bar half **27,** is connected to the positive power supply terminal by a resistor **36,** and also to the base of an NPN transistor T3 through a capacitor **37.** The base of transistor T3 is also connected to the common point by a resistor **38.** The collector of transistor T3 is connected to the positive terminal by a resistor **39,** and its emitter is connected to common by a resistor **40.** The output **41** for the signal representative of a negative sudden movement is tapped off from the collector of transistor T3.

For the analysis of the functioning of the circuit, it should be noted that the electric resistance of a bar of rubber impregnated with carbon increases progressively when the bar is subjected to a slow deformation. In the case of the invention, the resistance increases, in case of the application of a slow torsion force until it approaches a given limit. In case of the sudden application of a torsion force, the resistance of the bar increases rapidly up to a value above the aforesaid limit value, then decreases toward this limit value. It is this sudden and great increase of the resistance of the bar that is utilized in accordance with the invention.

In the circuit of FIG. **4,** the bar halves **26** and **27** are each part of a voltage divider circuit with respective resistors **35** and **36.** As the resistance of bar half **26** increases, the voltage applied to capacitor **34** increases. Similarly, as the resistance of resistor **27** increases, the voltage applied to capacitor **37** increases.

The bar **4** is dimensioned so that, for the slow torsions, the variation of resistance of the two halves **26** and **27** does not involve a variation of potential at points **18** and **19** sufficient to change the state of the transistors T2 and T3. For the sudden torsions, on the contrary, the variation of resistance involves a sufficient variation of the potential at points **18** or **19** to assure the change of state of the transistors T2 or T3.

When the circuit is at rest, the transistors T1 and T3 are non-conducting and transistor T2 is conducting. If lever **22** is suddenly subjected to a positive movement, the resistance of bar half **26** increases suddenly. The corresponding increase of potential at terminal **18** is immediately transmitted to the base of **T2,** which blocks, thereby making the transistor T1 conductive. At terminal **31** a current is then available representing the positive sudden movement. The circuit returns to its initial state when capacitor **34** has finished changing its state of charge, according to a time constant defined by resistor **33** and capacitor **34.** The decrease of the potential on the base of T2 then brings about its becoming conducting again and the blocking of T1.

The circuit being at rest, if the lever **22** is suddenly subjected to a negative movement, the torsion which the half **27** of the bar undergoes brings about an increase of the potential at terminal **19.** This potential variation is transmitted to the base of T3 which becomes conducting and will remain so for a time defined by the time constant determined by capacitor **37** and resistor **38.** There is produced at the terminal **41** a voltage signal indicating the negative sudden movement.

In the described example the carbon-impregnated rubber bar is subjected to a torsion about its longitudinal geometric axis. This mode of deformation and the bar type form of the rubber element are not limitative. Likewise, the detection of the sudden movement of a throttle of a combustion engine is only one special application of this pickup.

Lastly, it is quite evident that one can use only one of the halves of the bar and of the corresponding circuit to pick up only the sudden movements in one direction.

In a typical application, such as a fuel injection type system, the signals produced by the circuit of FIG. **4** are applied to a suitable part of the system for controlling the fuel supply. For example, the signals would be applied to the system computer to either increase or decrease the fuel supplied to the engine.

What is claimed is:

1. A transducer device comprising an elongated bar of deformable and resilient material having at least a partially retentive memory said bar including electrically conductive material so as to produce a change in the electrical resistance of said bar upon its deformation, means for holding a point on said bar fixed, means for applying a torsion force to another point on said bar to twist it about its longitudinal axis between said fixed point and said other point to change the resistance of the bar, and first and second electrical connections respectively connected at longitudinally spaced points to the portion of the bar that is twisted across which the change of resistance appears.

2. A transducer as in claim **1** wherein said means for holding the fixed point of said bar divides said bar into first and second zones, one of said first and second electrical connections being connected to said fixed point and the other of said first and second electrical connections connected to another point of one of said zones, a third electrical connection connected to another point of said other zone, the change of resistance of each of said zones respectively appearing across said first and second and said first and third electrical connections.

3. A transducer as in claim **2** further comprising means for applying a torsion force to said bar to simultaneously deform said first and second zones and to change the respective resistances thereof.

4. A transducer as in claim 3 further comprising means connected to said bar to apply a pre-torsion force to one of said first and second zones.

5. A transducer as in claim 2 further comprising an electronic control circuit having first and second amplifier means, means for connecting a respective one of said zones of said bar to a respective one of said first and second amplifier means, and means connected to each of said zones to control the operation of the respectively connected amplifier means in response to the change of resistance of the respective zone.

6. A transducer as in claim 2 wherein said means for applying a torsion force to said bar is connected thereto to simultaneously deform said first and second zones to change the respective electrical resistances thereof, the change of electrical resistance being opposite for each of said zones so that one increases as the other decreases.

7. A transducer as in claim b further comprising means for connecting each said zone as part of a respective voltage divider, the voltage at a fixed point of one divider increasing as the voltage at a corresponding point of the other divider is decreasing in response to a torsion force applied to said bar.

8. A transducer as in claim 1 wherein said means for applying the torsion force includes a mechanical linkage to a portion of a motive device which is responsive to acceleration or deceleration of the motive device to apply the torsion force to said bar.

9. A transducer as in claim 8 further comprising electronic circuit means connected to said first and second electrical connections and responsive to a rapid change in the resistance of the bar for producing a control signal.

10. A transducer as in claim 9 further comprising means for connecting said bar in series with a resistance in said electronic circuit to form a voltage divider across which a change in voltage appears in response to a change of resistance of the bar.

11. A transducer device comprising a piece of elongated deformable material having electrically conductive properties such as to produce a change of electrical resistance of the piece upon its deformation, means for holding an intermediate point of said piece fixed, said holding means dividing said piece into first and second zones, a first electrical connection connected to said intermediate point, a second electrical connection respectively connected to another point of one of said zones, and a third electrical connection connected to another point of the other of said other zone, the change of resistance of each of said zones respectively appearing across said first and second and said first and third electrical connections, means for applying a pretorsion force to one of said zones, rotatable means connected to the free end of said first zone remote from said fixed intermediate point for applying a torsion force to said piece to simultaneously deform said first and second zones and to change the respective resistances thereof, and means connected between the said free end of said first zone and the free end of the second zone remote from said fixed intermediate point to convey the rotary motion imparted to the free end of said first zone to the free end of said second zone.

12. A transducer as in claim 11 wherein one of said first and second zones has a pretorsion force applied thereto so that the torsion force on one of said zones increases as the force on the other zone decreases.

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