United States Patent [19]

Kiyono

[11] **3,900,816**

[45] **Aug. 19, 1975**

[54] **ELECTROMAGNETIC DRIVEN VARIABLE RESISTANCE DEVICE**

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[22] Filed: **Oct. 29, 1974**

[21] Appl. No.: **518,950**

[30] **Foreign Application Priority Data**

Oct. 30, 1973 Japan 48-121980

[52] **U.S. Cl.** **338/116**; 338/103; 338/189

[51] **Int. Cl.** **H01c 13/00**

[58] **Field of Search** 338/103, 107, 116, 189

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[57] **ABSTRACT**

An electromagnetic driven variable electrical resistance device has a variable resistor mounted onto the front side of a case and provided with a rotatable shaft to which a drive-gear is attached. A pair of solenoids are mounted onto the bottom panel portion of the case. A pair of movable driving-pawl members are pivotally supported by the recess portions of an E-shaped spacer attached to the case and are biased by a pair of spring means and held in an upper limit position by a T-shaped stopper plate. A wide blade portion of each driving-pawl member is positioned above each solenoid respectively. The T-shaped stopper plate has a central projecting blade-portion borne by the rotatable shaft of variable resistor. Each of the movable driving-pawl members is twisted. The E-shaped spacer is made of non-metallic material and has a thin central flap-portion and a pair of thick side flap-portions.

6 Claims, 9 Drawing Figures

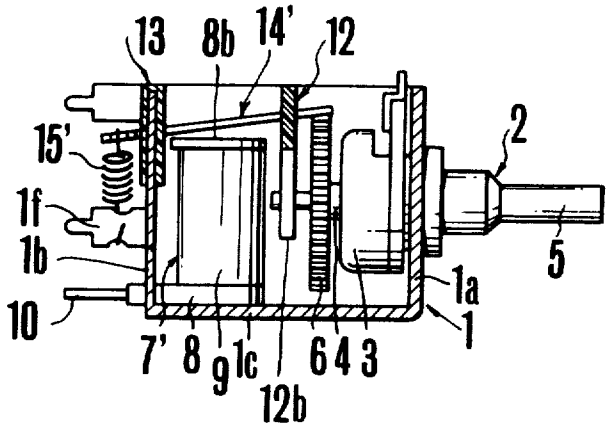


FIG. 1

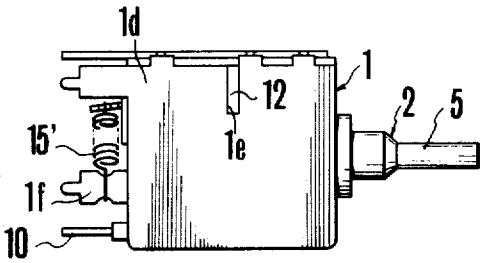


FIG. 2

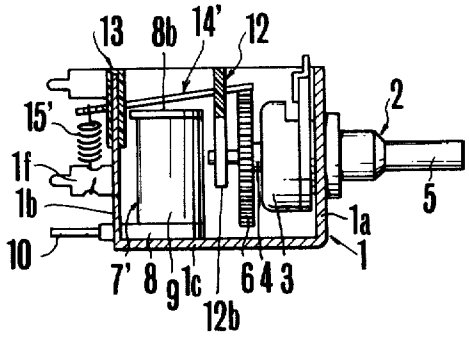


FIG. 3

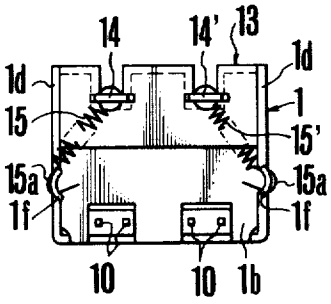


FIG. 4

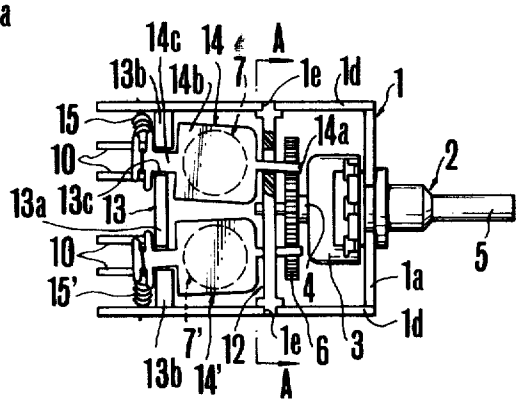


FIG. 5

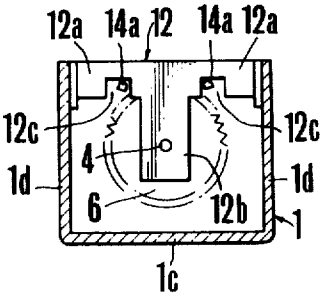


FIG. 6

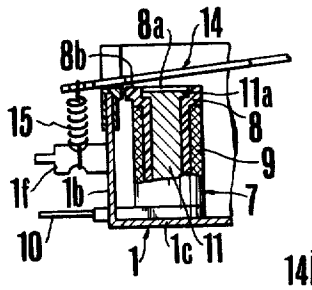


FIG. 7

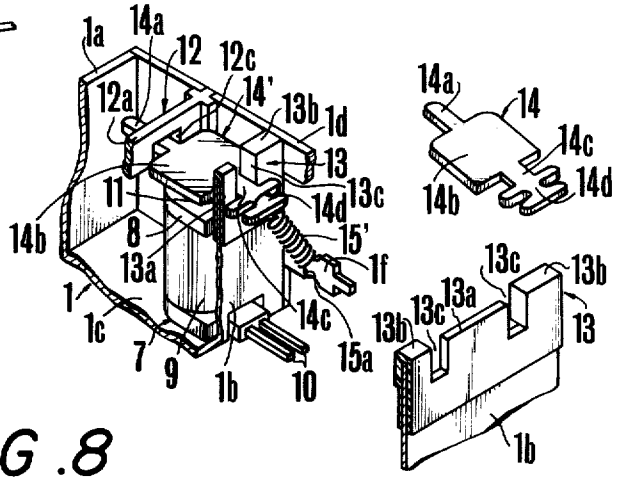


FIG. 8

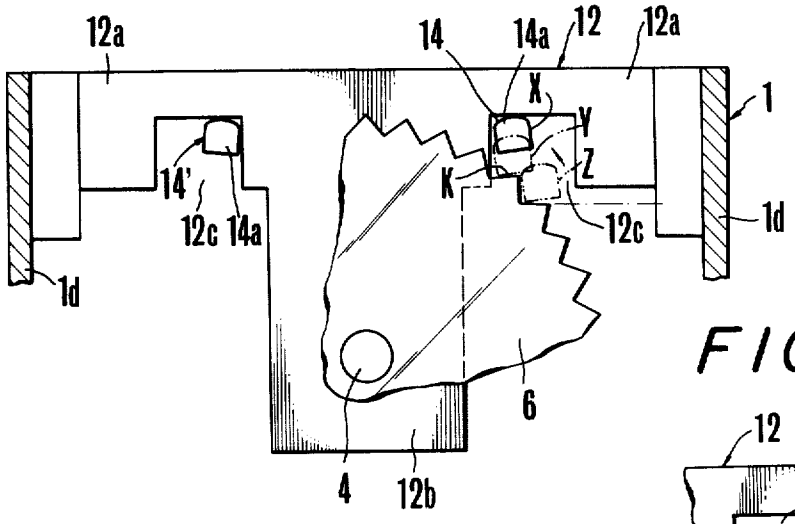
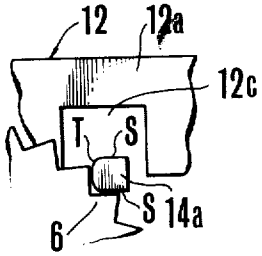


FIG. 9



ELECTROMAGNETIC DRIVEN VARIABLE RESISTANCE DEVICE

This invention relates to a variable resistance device, and more particularly to a variable resistance device adapted for remote control and driven by an electromagnetic mechanism.

Recently, in television and radio receivers, it has been desirable to make one or more adjusting means operable by remote control, e.g., the sound volume control. Consequently, there has arisen a need for a variable resistance device which can be operated remotely as well as manually. A currently popular remote control system makes use of pulsative control signals typically transmitted by ultrasonic means. Therefore it is required that such a variable resistance device have a mechanism discretely driven by remote control means, and be able to complete the reciprocating action necessary for each discrete drive-step, accurately at a considerably high speed, and in accordance with each remote control pulse-signal. Furthermore, to facilitate efficient production and easy mounting, the variable resistance device must be of a simple and compact construction.

An objective of this invention is to provide an electromagnetic drive-variable resistance device able to fulfill the above-described requirements. In detail, a further objective of this invention is to provide an electromagnetic driven variable resistance device having an electromagnetic gear-drive mechanism in which the reciprocating action of driving-pawl members is completed smoothly at high speed in accordance with each of remote control pulse-signals.

According to this invention, an electromagnetic driven variable resistance device comprises a case, a variable resistor mounted onto the front face of the case, a drive-gear attached to the rotatable shaft of the variable resistor, a pair of solenoids mounted onto the bottom panel portion of the case, a pair of movable driving-pawl members of magnetic material which are pivotally mounted in the recess portions of E-shaped spaces and have a wide blade portion positioned above each solenoid respectively. A T-shaped stopper plate, for position-limitation of the movable driving-pawl members, is attached to the case. The drive-gear is rotated intermittently when either of the movable driving-pawl members is moved to strike a tooth of the drive-gear by the driving-pawl-portion thereof.

Furthermore, according to this invention, the T-shaped stopper plate has a central projecting blade-portion which is borne by the rotatable shaft of the variable resistor so as to secure a predetermined movement-distance of the movable driving-pawls.

Still further, according to this invention, the driving pawl-portion of each of the movable driving-pawl members, which engages with the drive-gear, is twisted so that the driving pawlportion contacts with a tooth of the drive-gear by a lessened contact-area on the way of returning-action thereof, that causes a decrease in friction and therefore results in the smooth returning-action of the driving-pawl member.

Still further, the E-shaped spacer is made of non-metallic material so as to decrease operational noise and is made to have a thin center flap-portion and a pair of thick side flap-portions so as to permit the movable driving-pawl members to return to a correct position for the next driving-action thereof.

FIGS. 1 to 8 illustrate a preferred embodiment of the electromagnetic driven variable resistance device according to this invention:

FIG. 1 is a side view thereof;

FIG. 2 is a partially sectional side view thereof;

FIG. 3 is a rear view thereof;

FIG. 4 is a top plan view thereof;

FIG. 5 is a sectional view thereof taken along lines A, A in FIG. 4;

FIG. 6 is a sectional view of a part thereof for illustrating the relationship between the solenoid and the movable driving-pawl member;

FIG. 7 is a perspective view thereof, partially broken away, for illustrating the mounting-state of the movable driving-pawl member; and

FIG. 8 is a schematic diagram for illustrating the operation thereof.

FIG. 9 illustrates another embodiment of the electromagnetic driven variable resistance device according to this invention.

Referring now to FIGS. 1 to 8, in which there is shown an embodiment of the electromagnetic driven variable resistance device according to this invention, a case 1 having a rectangular shape which is constructed of sheet metal which is bent into the form shown. Variable resistor 2 is mounted onto the face panel-portion 1*a* of case 1 and comprises a cover 3, in which a resistance element and a sliding tap (not shown) are mounted, and a rotatable shaft 5 which has a projecting portion 4 projecting rearwardly through cover 3. The value of the resistance of variable resistor 2 is varied by rotating the shaft 5. Drive-gear 6 is fixedly mounted onto projecting portion 4 of rotatable shaft 5, so that the gear 6 rotates along with shafts. The drive gear 6 is made of, for example, synthetic plastic resin.

A pair of solenoids 7 and 7′ are mounted onto the bottom panel-portion 1c of case 1 and are parallel to the rear panel-portion 1*b* of case 1.

As shown in FIGS. 6 and 7, each solenoid 7, 7′ is comprised of an iron core 11, a cylindrical bobbin 8 of synthetic plastic resin and a wire coil 9 wound onto the bobbin. The pair of winding-ends of coil 9 are respectively connected to a pair of terminals 10 and 10 fixed into bobbin 8. The top flange-portion 11a of iron core 11 is received in the expanded opening-portion 8*a* at the upper end of bobbin 8, as shown in FIG. 6, and the top thereof is slightly lower than the upper edge 8*b* of bobbin 8.

As can be seen in FIG. 5, a T-shaped stopper plate 12 of synthetic resin, which comprises central projecting blade-portion 12*b* and a pair of wing-portions 12*a* and 12*a*, is attached into case 1 by fitting the ends of wing-portions 12*a* and 12*a* into slots provided in both sides of panel-portions 1*d* and 1*d* of case 1 and by inserting projecting portion 4 of rotatable shaft 5 of variable resistor 2 into the hole of central projecting blade-portion 12*b*.

An E-shaped spacer 13 of rubber or other resilient material is attached to case 1 such that the spacer 13 covers the upper portion of rear face panel-portion 1*b* of case 1 as shown in FIG. 7. Central flap-portion 13*a* thereof is formed thin and a pair of side flap-portions 13*b* and 13*b* are formed thick, and therebetween a pair of recess-portions 13*c* and 13*c* are provided.

As shown in FIG. 7, movable driving-pawl members 14 and 14′ are formed, for example by stamping, from

a plate of magnetic material, such as a steel metal plate. Each driving pawl **14**, **14'** has a driving-pawl-portion **14***a*, a wide blade-portion **14***b*, neck-portion **14***c* and spring-retaining portion **14***d*. Each of the movable driving-pawl members **14** and **14'** is positioned above each of solenoids **7** and **7'**. The neck-portion **14***c* thereof being put into recess-portion **13***c* of spacer **13** and driving-pawl-portion **14***a* being positioned in recess-portion **12***c*, so that the pawl-end of driving-pawl-portion **14***a* is set at the position engageable with a tooth of drive-gear **6** and wide blade-portion **14***b* thereof is set at the opposite position to iron core **11** of the corresponding solenoid. Coil springs **15** and **15'** are connected between springretaining portion **14***d* of the corresponding driving-pawl member and projection **1***f* provided at the side edge of side panel-portion **1***d* of case **1**, respectively. Accordingly, each of the movable driving-pawl members **14** and **14'** is pivotally biased around recess-portion **13***c* as a pivot, that is; spring-retaining portion **14***d* is pulled obliquely down toward side panel-portion **1***d* of case **1** by coil spring **15** with neck-portion **14***c* acting as a fulcrum, and driving-pawl-portion **14***a* lifted obliquely upwards and held in an upper limit position by the corner of recess-portion **12***c* of stopper plate **12**. Projections **1***f* and **1***f* of case **1** are formed to have a curved face-portion with a curvature nearly equal to that of ring-hooks **15***a* and **15***a*, to prevent deformation of ring-hooks **15***a* and **15***a*.

Furthermore, as shown in FIG. **8**, driving-pawl-portion **14***a* of movable driving-pawl member **14** is slightly twisted in the counter-clockwise direction and that of movable driving-pawl member **14'** in clockwise direction. This decreases friction when driving-pawl-portion **14***a* is removed from drive-gear **6** after driving engagement therewith, thereby securing a more stable rotation of drive-gear **6** and reducing the possibility of improper operation.

In the following description, the operation of the above-described electromagnetic driven variable resistance device embodying this invention will be made clear. It will be assumed that the invention is used for sound-volume control in a television or radio receiver. That is, sound-volume is adjusted manually by rotating rotatable shaft **5** and remotely by supplying current pulses into solenoid **7** or **7'**.

In the manual operation mode, or during non-operating intervals in the remote operation mode, driving-pawl-portions **14***a* and **14***a* of movable driving-pawl-members **14** and **14'** are at position X in FIG. **8** so that drive-gear **6** is freely rotatable. Rotatable shaft **5** can be rotated for manual sound control. In this state, assuming that a current pulse is supplied to solenoid **7** for remote control, solenoid **7** is thereby magnetized and will attract movable driving-pawl member **14** downwards and pivotally move it against coil-spring **15** with neck-portion **14***c* acting as a fulcrum, so that driving-pawl-portion **14***a* thereof falls vertically and then engages a tooth of drive-gear **6** as shown by position Y in FIG. **8**. At this position, since driving-pawl-portion **14***a* is slightly twisted, the lower face thereof goes in face-contact with the inclined surface K of the tooth. Then, movable driving-pawl member **14** is further pulled down by solenoid **7** thereby moving driving-pawl-position **14***a* to position Z shown in FIG. **8**, to rotate drive-gear **6** one step. Thus, rotatable shaft **5** is slightly rotated by the one-step-rotation of drive-gear **6** in the clockwise direction so that sound-volume is slightly increased.

In the above-described operation, driving-pawl-portion **14***a* falls non-vertically from position Y to position Z in FIG. **8**, that is, its movement defines a circle, with neck-portion **14***c* acting as a fulcrum, in accordance with the rotation of drive-gear **6**. When driving-pawl-portion **14***a* moves to position Z, wide blade-portion **14***b* of movable driving-pawl member **14** strikes the upper edge **8***b* of bobbin **8** and driving-pawl-portion **14***a* is thereby stopped from further falling movement. At this position, driving-pawl-portion **14***a* is in line-contact with the tip of a tooth of drive-gear **6** on the side face thereof, as shown in FIG. **8**.

As soon as the current pulse supplied to solenoid **7** comes to extinction, the magnetic force of solenoid **7** ceases and driving-pawl-portion **14***a* is lifted by the biasing force of coil-spring **15** in the direction shown by the arrow in FIG. **8** and returns to position X. Accordingly, if a series of current pulses are supplied to solenoid **7** so as to intermittently excite it, driving-pawl-portion **14***a* of movable driving-pawl member **14** will rotate drive-gear **6** step by step, so that sound-volume is gradually increased.

On the other hand, if current pulses are supplied to solenoid **7'**, driving-pawl-portion **14***a* of movable driving-pawl-member **14'** will rotate drive-gear **6**, and thereby rotate shaft **5**, in the counter-clockwise direction step by step, so that sound-volume is gradually decreased.

Turning now to FIG. **9**, in which there is shown another embodiment of this invention, driving-pawl-portion **14***a* of each of movable driving-pawl members **14** and **14'** is twisted to an angle of 90° such that smooth face T thereof, which is not corresponding to sections S and S made by stamping, comes in contact with the tip of a tooth of drive-gear **6** when returning from driving engagement thereof.

As described above, according to this invention, since stopper plate **12** has a central projecting blade-portion **12***b* which is borne by projecting portion **4** of rotatable shaft **5**, the distance from rotatable shaft **5** to recess-portion **12***c* of stopper plate **12** will be a fixed length and consequently it will be possible to secure a uniform path of operation of movable driving-pawl members **14** and **14'** in the manufacture of the invention to insure stable step by step rotation of drive-gear **6** therein.

Furthermore, since driving-pawl-portion **14a** is so twisted as to make line or smooth contact with a tooth of drive-gear **6** when returning from driving engagement thereof, friction therebetween will be greatly decreased and the returning action of driving-pawl-portion **14***a* will cause no rotation of drive-gear **6**. This insures a reliable rotation of drive-gear **6**. Additionally, since E-shaped spacer **13** for pivotally supporting movable driving-pawl members **14** and **14'** has central flap-portion **13***a* formed thin and both side flap-portions **13***b* and **13***b* formed thick, each of movable driving-pawl members **14** and **14'** can be biased so that driving-pawl-portions **14***a* thereof will move toward the center when returning to its upper-limit position, as can be seen in FIGS. **1** and **8**. This will also insure reliable action in each succeeding rotation-step of drive-gear **6**.

In addition, since stopper plate **12**, bobbin **8** and spacer **13** are made of non-metallic material, it will be possible to decrease operational noises.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described above and as defined in the appended claims.

What is claimed is:

1. An electromagnetic driven variable resistance device comprising

a case having side walls,

a variable resistor provided with a rotating shaft and mounted onto one side-face of said case,

said shaft being rotatable to vary resistance value of said resistance device,

a drive-gear rotatably mounted on said rotating shaft,

a pair of electromagnetic solenoids mounted to said case and having electrical terminals,

a pair of movable driving-pawl members made of magnetic material each of which is pivotally mounted in relationship to said solenoid and positioned above said solenoids and able to engage a tooth of said drive-gear so as to rotate said drive-gear,

a stopper plate attached to said case for position-limitation of said pair of movable driving-pawl members, and

a spacer being attached to said case for pivotally supporting said pair of movable driving-pawl members,

said stopper plate and said spacer being made of non-metallic material.

2. A variable resistance device as set forth in claim 1, wherein

said stopper plate has a central projecting blade-portion which is born by said rotating shaft of said variable resistor.

3. A variable resistance device as set forth in claim 1, wherein

said movable driving-pawl member is twisted at the driving-pawl-portion thereof which engages with a tooth of said drive gear.

4. A variable resistance device as set forth in claim 1, wherein said spacer being an E-shaped.

5. A variable resistance device as set forth in claim 4, wherein

said E-shaped spacer has a thin central flap-portion and a pair of thick side flap-portions.

6. A variable resistance device as set forth in claim 4, wherein

said solenoid has a bobbin of non-metallic material which projects out over the top of the solenoid-core thereof.

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