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Kucharski, Jr.

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[54] **MULTITURN ADJUSTMENT POTENTIOMETER RATCHETING MECHANISM**

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[52] **U.S. Cl.**..... **74/405,** 74/10.85, 74/435

[51] **Int. Cl.**.. **F16h 35/18,** F16h 57/00, F16h 55/04

[58] **Field of Search**..... 74/405, 10.85, 435, 74/425

[56] **References Cited**

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[57] **ABSTRACT**

A ratcheting mechanism for use in a worm gear actuated potentiometer which utilizes a worm gear having a circumferential portion of the teeth thereof removed, i.e., a blank area, a worm screw having threads for engaging the teeth of the worm gear, and a ratcheting structure including a stop member and a resilient member. One of the two ratcheting structure members is attached to a housing or other nonmovable structure and the other is attached to the worm gear at locations such that the resilient member will engage the stop member whenever the threads of the worm screw engage a tooth of the worm gear adjacent the blank area so as to provide ratcheting.

6 Claims, 7 Drawing Figures

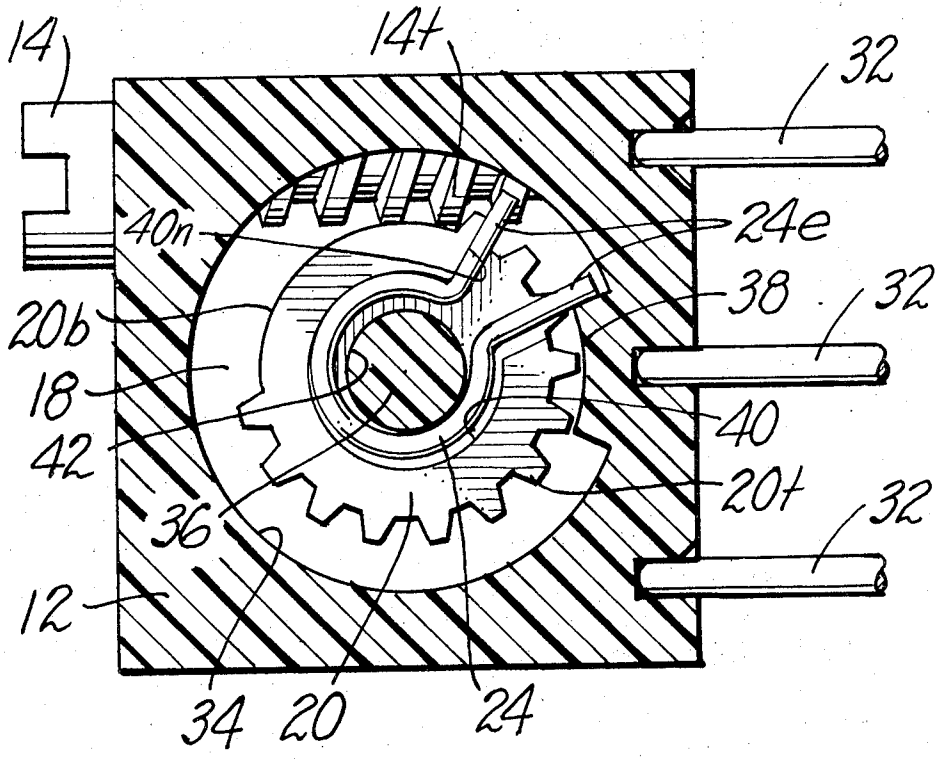


FIG. 1.

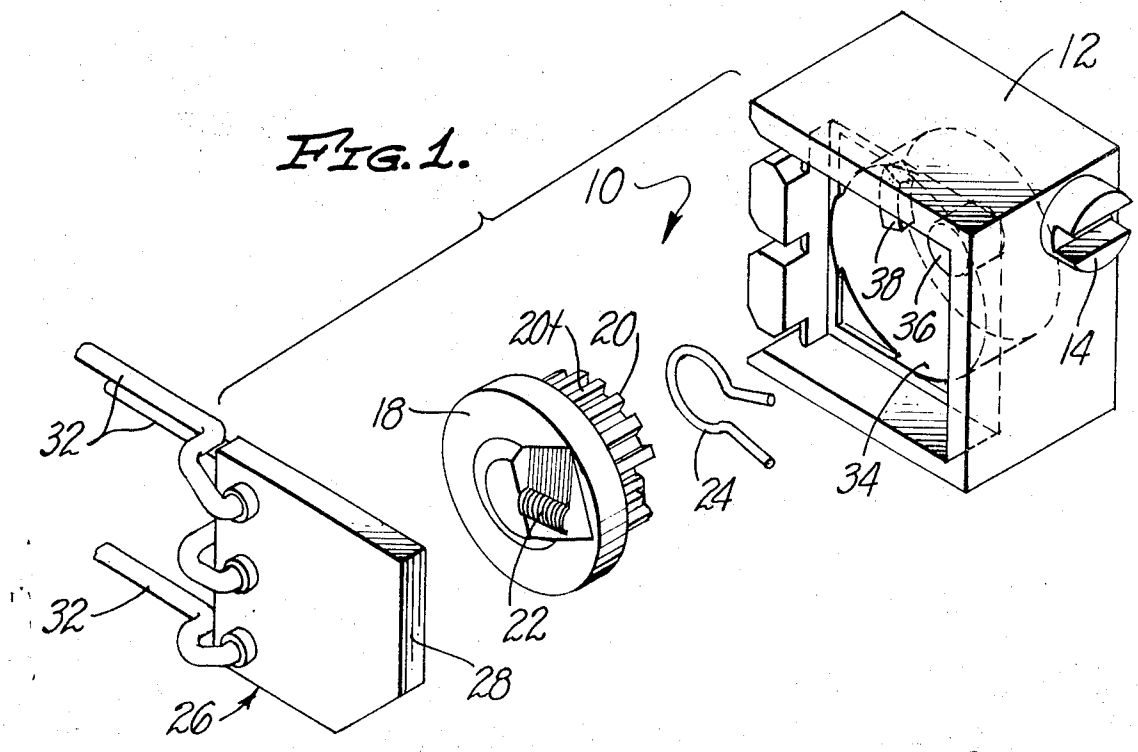


FIG. 3.

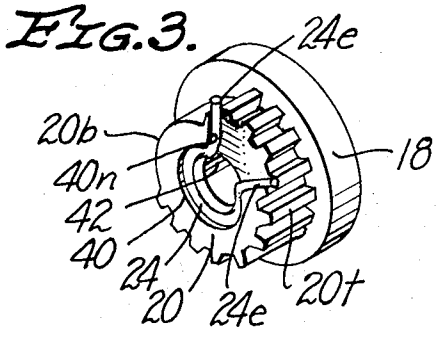


FIG. 4.

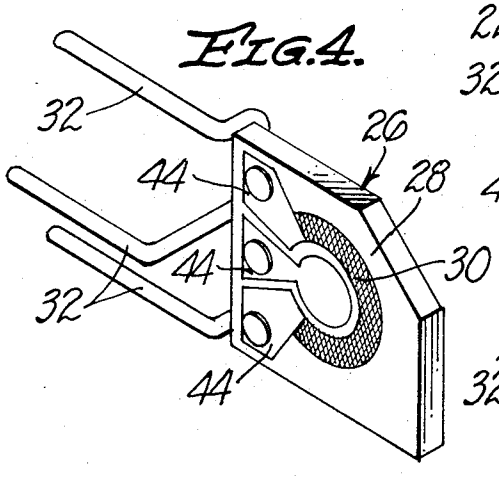
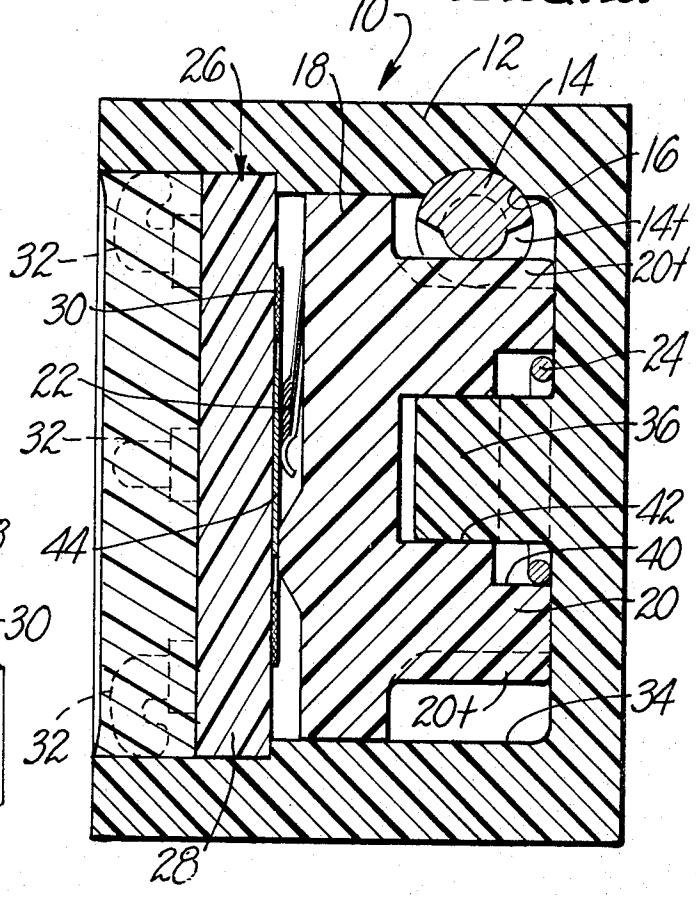


FIG. 2.



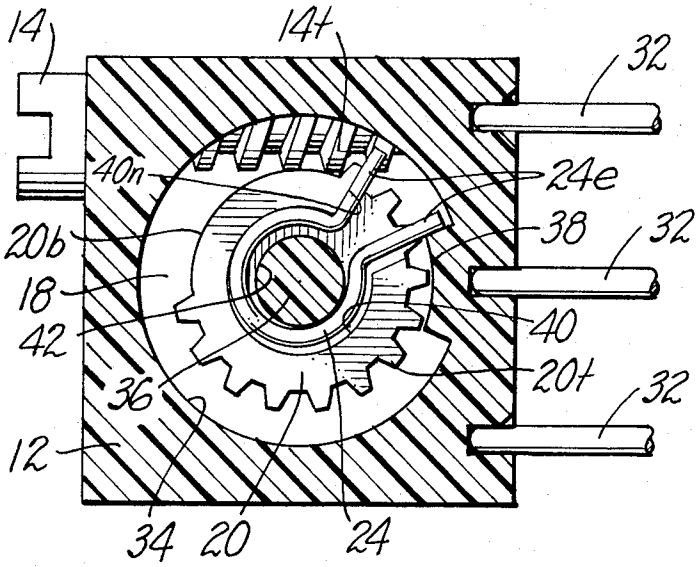


FIG. 5.

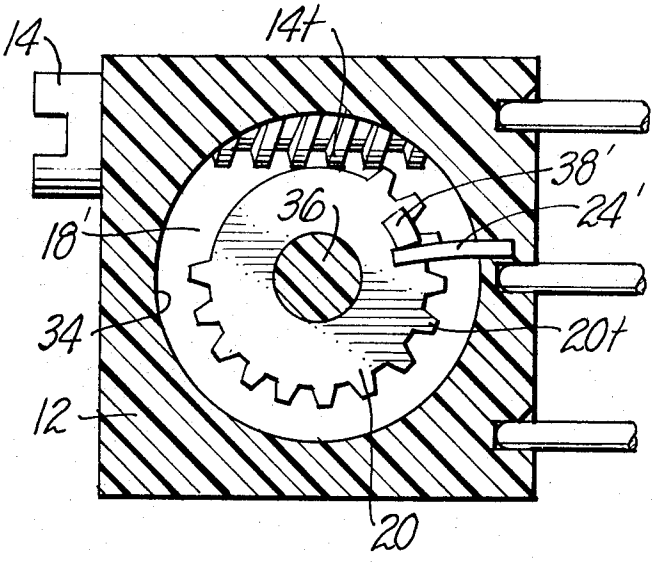


FIG. 6.

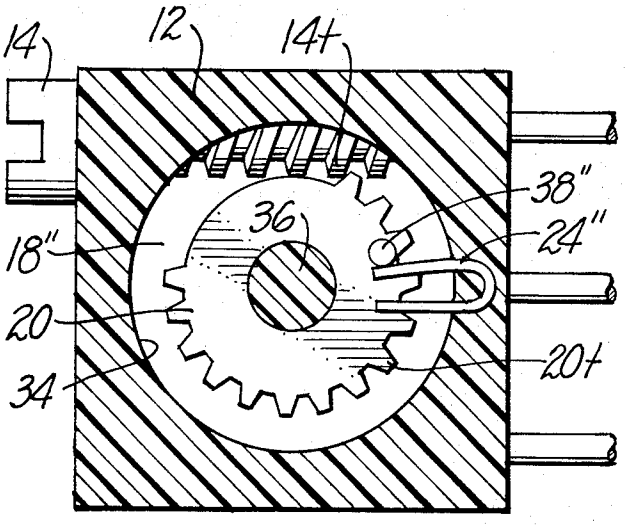


FIG. 7.

MULTITURN ADJUSTMENT POTENTIOMETER RATCHETING MECHANISM

BACKGROUND OF THE INVENTION

The subject invention relates to the field of variable resistance devices, and, more particularly, to ratcheting mechanisms for worm gear actuated potentiometers.

Worm gear actuated potentiometers are generally square in cross section, typically with sides of one-quarter to one-half inch. Due to the use of the worm gear type drive mechanism, high adjustment accuracy is provided in a unit having a very small space. Many turns of the worm screw are necessary in order for the resistance element contact, which is generally connected to the worm gear, to rotate through the prescribed limits, generally about 320°.

If no stop is provided for the drive mechanism, the contact may be permitted to be rotated through an indefinite number of revolutions in either direction. In that case, the potential division may drop suddenly from a maximum to a minimum or open circuit zero condition (or vice versa) incident to continued worm screw rotation. Such operation, or the possibility of such operation, is in many circuits extremely undesirable. Therefore, in many prior art worm gear actuated potentiometers, stop means are employed to positively preclude rotation of the rotary contact through a complete revolution or beyond either end of the resistance element. Since the interior mechanism of such potentiometers is not visible to the person adjusting the device, continued worm gear rotation during an adjusting operation brings into action the stop means, after which further rotation of the worm gear in the same direction must result in damage, for example stripping of teeth from the worm gear or threads of the worm screw, unless some form of clutch or ratcheting means are provided. In many instances a clutch means in the form of a plate-like friction clutch interposed between the worm gear and the contact is used. However, this is highly undesirable in that there is a possibility that the clutch means will slip when the contact is not at the end of the resistance element thereby failing to effect desired rotation of the contact and nullifying the adjustment effort. In some prior art devices, ratcheting mechanisms have been utilized in which a portion of the teeth of the worm gear have been cut away to form a blank area and a resilient member having two short, extending strips is located in the blank area so as to engage the threads of a worm screw when the worm gear teeth are rotated out of engagement with the threads of the worm screw and the worm gear's rotation has been terminated by means of a stop mechanism. While such an arrangement overcomes the disadvantages of a typical clutch arrangement, it has some disadvantages in that it requires a separate stop mechanism in addition to the ratcheting mechanism; the ratcheting mechanism is somewhat unreliable and unpredictable, particularly after repeated usage, due to the use of short, strip shaped resilient members; and the device may be difficult and expensive to manufacture.

SUMMARY OF THE INVENTION

Thus, it is an object of the subject invention to provide an improved ratcheting mechanism for a worm gear actuated variable resistance device;

Another object of the subject invention is to provide an improved ratcheting mechanism for a worm gear actuated variable resistance device which is simple and inexpensive to manufacture and assemble;

Yet another object of the subject invention is to provide an improved ratcheting mechanism for a worm gear actuated variable resistance device which provides integral stop and ratcheting functions;

And a further object of the subject invention is to provide a ratcheting mechanism for a worm gear actuated variable resistance device which is predictable and reliable.

The above-mentioned objects are satisfied in the subject invention in which the ratcheting mechanism includes a worm gear having a portion of the teeth cut away to form a blank area, a stop member and resilient ratcheting member with one of these members being rigidly attached to the housing for the variable resistance device or other nonmovable structure and one of them being fixed to the worm gear. The locations of the two members are such that when the tooth adjacent the blank area on the worm gear disengages the threads of the worm screw, the rotation of the worm gear is stopped while the resilient member is engaging the stop member and biases this tooth back toward the threads to permit the worm screw threads to engage the teeth of the worm gear if the direction of rotation of the worm screw is reversed. The subject matter which is regarded as the present invention is particularly pointed out and distinctly claimed in the concluding portion of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention, however, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a exploded view of a potentiometer incorporating the subject invention;

FIG. 2 is a cross section of the potentiometer shown in FIG. 1;

FIG. 3 is an isometric view of a rotor incorporating a worm gear and ratcheting member in accordance with the subject invention;

FIG. 4 is an isometric view of a resistance element assembly;

FIG. 5 is a cross sectional view of the potentiometer shown in FIGS. 1 and 2 showing the ratcheting mechanism in accordance with the subject invention;

FIG. 6 is a cross sectional view similar to that shown in FIG. 5 showing another embodiment of ratcheting mechanism in accordance with the subject invention; and

FIG. 7 is a cross sectional view similar to that shown in FIGS. 5 and 6 showing yet another embodiment of ratcheting mechanism in accordance with the subject invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The subject invention is an improved ratcheting mechanism for use in a variable resistance device such as a potentiometer. As best shown in FIGS. 1 and 2, device 10 includes a housing 12; a worm screw 14; a rotor 18 including a worm gear portion 20 and a resistance element contact 22; a resilient ratcheting member 24; and a resistance element assembly 26 including a substrate 28 of an electrically insulative material such as

a ceramic, a resistance element 30, and termination leads 32.

Housing 12 is preferably of a nonconducting material such as plastic, has a substantially cylindrical cavity 34 therein for receiving rotor 18 and a hole 16 therein for receiving worm screw 14. An integral post 36 is provided at the bottom of cavity 34 which acts as a shaft around which rotor 18 rotates. On the bottom surface of cavity 34 an integral stop member 38 is located. Of course, stop member 38 need not be integral with housing 12 as long as it is fixed relative thereto.

Rotor 18 is preferably formed of a plastic material with worm gear portion 20 integral therewith. Worm gear 20 has a plurality of teeth 20*t* regularly spaced about the circumference thereof with the exception of a blank portion 20*b* of the circumference on which no teeth are located. Two concentric apertures 40 and 42 are provided in the axis of rotor 18. The smaller, inner aperture 42 extends further into rotor 18 and has a diameter slightly larger than that of post 36. Aperture 42 is adapted to permit insertion of post 36 therein when the unit is assembled and allows rotor 18 to be rotated thereabout. Aperture 40 includes a notch portion 40*n* which gives it a keyhole shape. Aperture 40 is used to retain resilient ratcheting member 24 which is formed of spring wire bent into a cotter pin configuration generally conforming to the shape of aperture 40. Ratcheting member 24 includes two elongated extending portions 24*e* which extend substantially radially out from rotor 18 and are adapted to engage stop member 38. The use of a ratcheting member formed of spring wire with long extending portions adapted to flex after contact with the stop member gives the mechanism much greater reliability and predictability than mechanisms which rely on strip shaped resilient members having relatively short flexing portions.

The resistance element assembly 26 includes insulative substrate 28 on which resistance element 30 has been applied. Resistance element 30 is preferably a cermet material, but alternatively may be any resistance material known in the art, such as metallic film or composition. Resistance element 30 is in the form of a portion of an annulus with the ends thereof being connected to strips of highly conductive termination material 44. Another strip of termination material 44 extends into the center of annular resistance element 30. All three strips of termination material are connected to termination leads 32 by any conventional means well known in the art, such as swaging, soldering, etc.

On the side of rotor 18 opposite worm gear 20, resistance element contact 22 is located. Contact 22 may be a single, strip like member of one or more wires. In the preferred embodiment shown, a plurality of contiguous, yet independently flexing wires are utilized. Contact 22 is located such that when the device is assembled a portion of it contacts resistance element 30 and a portion of it also contacts the center termination strip which acts as a collector. Contact 22 may be directly attached to the rotor, as shown, such as by heat staking or gluing. Alternatively, the contact 22 may be connected to an intermediary member which is attached to rotor 18.

Of course, any other contact/resistance element construction may be utilized as is well known in the art. For example, a resistance element could be located on the rotor and a fixed contact suitably located in relation thereto.

The operation of the ratcheting mechanism of the subject invention can best be understood by reference to FIG. 5. For adjustment of the device, worm screw 14 is rotated with the threads 14t thereof engaging the teeth 20*t* of worm gear 20 so as to cause rotation of rotor 18 about post 36. Rotation of rotor 18 causes contact 22 to move along resistance element 30 so as to change the resistance value between the appropriate leads of the device. Stop member 38 and ratcheting member 24 are positioned such that when worm gear 20 has been rotated in one direction to just before the desired limit of its travel with threads 14*t* of worm screw 14 no longer completely engaging worm screw teeth 20*t*, an elongated portion 24*e* of the ratcheting member has engaged a portion of stop member 38. This allows worm screw 14 to continue to be rotated in the same direction without causing rotation of rotor 18 and hence contact 22 past their desired limits of travel. However, if the direction of rotation of worm screw 14 is reversed, the action of ratcheting member 24 against stop 38 biases a tooth of worm gear 20 into engagement with worm screw threads 14*t* thereby allowing rotation of rotor 20 in the opposite direction. When rotor 20 is rotated in the opposite direction to just before its desired limit by rotation of the worm screw, the same action of one of the ratcheting member portions 24*e* against stop member 38 permits worm screw 14 to be rotated without forcing rotor 18 past its limit while still permitting engagement of the worm gear with the worm screw when the worm screw is rotated in the opposite direction.

In FIGS. 6 and 7, two additional embodiments of ratcheting mechanisms in accordance with the subject invention are shown. The housing 12, worm screw 14, resistance element assembly 26 may be substantially the same as that shown in the above-mentioned embodiment. Also, in both of these additional embodiments the rotors 18′ and 18″ may be quite similar to rotor 18 in that they may include these same contact 22, worm gear 20 and aperture 42. However, in these embodiments, an aperture such as aperture 40 is neither needed nor provided.

In both of these embodiments, stop members 38′ and 38″ are provided on the face of rotors 18′ and 18″, respectively, and the resilient ratcheting members 24′ and 24″ are each attached to housing 12.

In the embodiment shown in FIG. 6, an elongate resilient ratcheting member 24′, preferably of spring wire, having a single extending portion is provided. This member 24′ is rigidly attached at one end to the housing by any appropriate means, such as heat staking, molding, or gluing. Stop member 38′ is circumferentially elongate and is rigidly attached to the surface of rotor 18′. For convenience, stop member 38′ could be molded into the rotor or, if desired, it could be attached by any desired means. The size, shape and location of stop member 38′ and ratcheting member 24′ are such that the desired ratcheting action takes place when rotor 18′ is rotated to either of its desired limits.

In FIG. 7, a very similar embodiment is shown which utilizes a resilient ratcheting member 24″, preferably of spring wire, having two radially extending portions which are used to engage stop member 38′. Ratcheting member 24″ is rigidly attached preferably at or about its midsection to housing 12 to provide extending por-

tions of substantial length. Stop member 38'' is suitably positioned relative to ratcheting member 24'' and of a shape and size so as to permit the desired ratcheting action to take place.

Of course, the two members comprising the ratcheting mechanism may be located at any desired position on or connected to the rotor and a fixed member adjacent thereto, such as the housing. For example, in another embodiment, a resilient member may extend in an axial direction from the rotor and a stop member be suitably positioned on the portion of the housing adjacent the end surface of the rotor such that resilient member engages a surface thereof when the desired rotational limit or the rotor is reached. One of the members could alternatively be attached to the resistance element structure instead of the housing.

The advantages of the ratcheting mechanism of the subject invention are numerous. It is simple, has very few parts, and can be manufactured and assembled quickly and inexpensively. The action provides a positive stop for rotation of the rotor in both directions. The worm screw may continue to be rotated after the rotor is stopped without any functional damage to the components and without affecting the electrical characteristics of the device. On reverse rotation of the worm screw, the worm gear teeth positively engage the threads of the worm screw. Due to the lack of a clutch, there is always positive engagement between the worm screw and worm gear when the rotor is between its desired limits. The ratcheting member structure provides a reliable and predictable biasing action which is necessary to a useful and effective ratcheting mechanism.

It is obvious that modifications may be made to the embodiments shown and described which are within the true scope and spirit of the subject invention. Thus, the subject invention is to be limited only by the appended claims.

What is claimed is:

1. A ratcheting mechanism for a worm gear actuated variable resistance device comprised of:

a. A rotatable worm gear for providing relative movement between a resistance element and a resistance element contact, said worm gear having a circumferential portion of its teeth removed to form a blank circumferential area thereon;

b. A worm screw having threads for engaging the teeth of said worm gear whereby rotation of said worm screw causes rotation of said worm gear when the worm screw threads engage the teeth of said worm gear;

c. A ratcheting structure comprised of two members, a stop member and an elongate, resilient ratcheting member, one of said members being fixedly connected to said worm gear and the other of said members being fixed to a nonmovable portion of said device, wherein said members are located such that said resilient ratcheting member engages said stop member whenever the worm screw teeth engage a tooth of said worm gear adjacent the blank area, to permit continued rotation of said worm screw without causing rotation of said worm gear and to bias the worm gear toward engagement of its teeth with the worm screw threads when its direction of rotation is reversed.

2. A ratcheting mechanism as in claim **1** wherein said resilient ratcheting member is fixedly attached to said worm gear and said stop member is fixed to a housing for said device.

3. A ratcheting mechanism as in claim **1** wherein said resilient ratcheting member includes at least one long, extending portion formed of spring wire capable of flexing on contact with said stop member.

4. A ratcheting mechanism as in claim **3** wherein said ratcheting member is of a cotter pin shape and said worm gear includes a keyhole shaped aperture on the face thereof for retaining said ratcheting member.

5. A ratcheting mechanism as in claim **1** wherein said ratcheting member is fixed at one end to a housing for said device and said stop member if fixedly connected to said worm gear.

6. A variable resistance device including a ratcheting mechanism as in claim **1** further comprising a rotor, wherein said worm gear is integral with said rotor on one side thereof and a resistance element contact is fixedly attached to said rotor on the side opposite the worm gear.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,768,325 Dated October 30, 1973

Inventor(s) Lawrence Kucharski, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, Line 6, "more particularly" should read --in particular--.

Column 2, Line 37, "a exploded" should read --an exploded--.

Column 4, Line 66, "38'" should read --38''--.

Column 6, Line 36, "if" should read --is--.

Signed and sealed this 12th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334

UNITED STATES PATENT OFFICE
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FORM PO-1050 (10-69)

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