Feb. 15, 1966 J. WEISS 3,235,047

DRIVING MECHANISM

Filed July 17, 1963 2 Sheets-Sheet 1

Fig. 1.

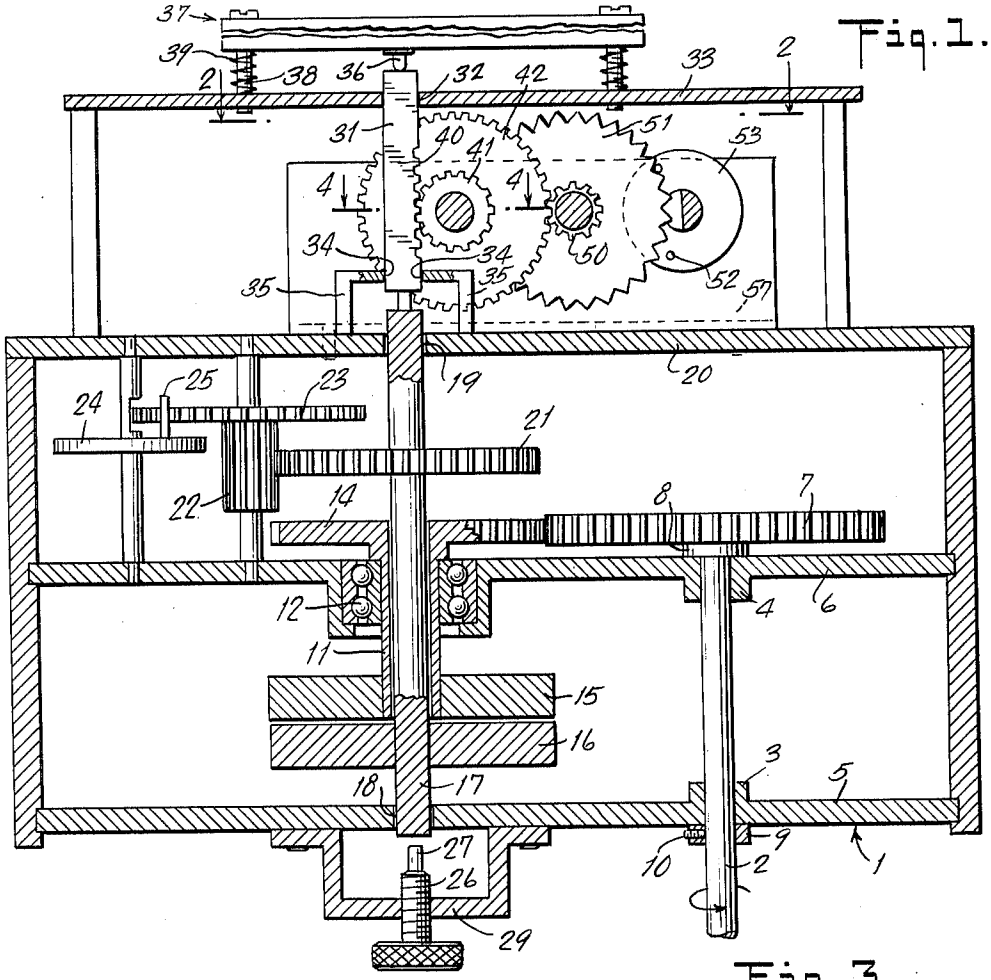
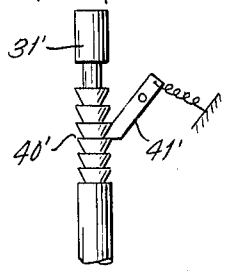


Fig. 3.



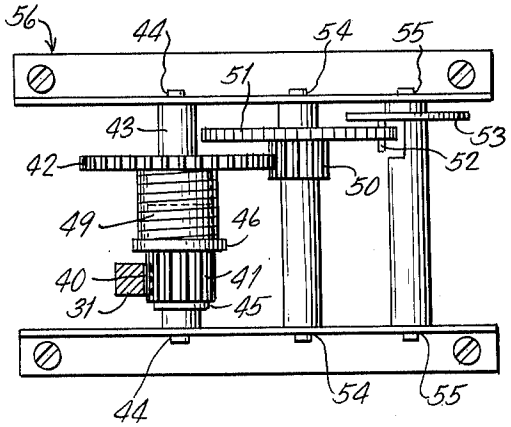


Fig. 2.

INVENTOR.
JOSEPH WEISS

BY Kwarciński & Nolan

ATTORNEYS

Feb. 15, 1966 J. WEISS 3,235,047

DRIVING MECHANISM

Filed July 17, 1963 2 Sheets-Sheet 2

Fig. 4.

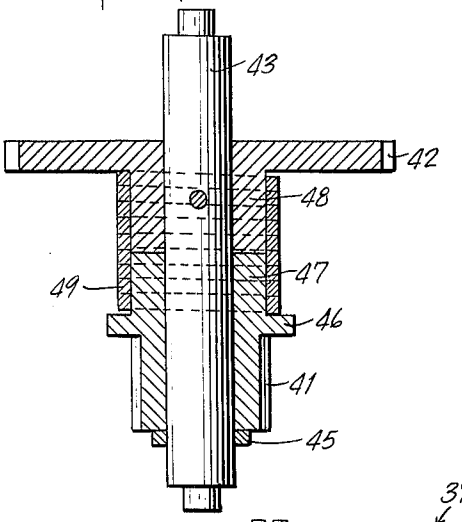


Fig. 5.

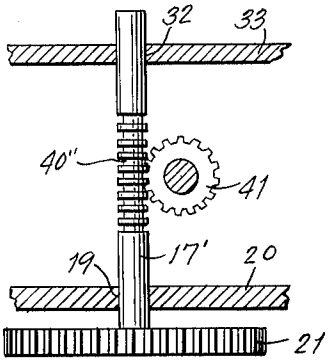
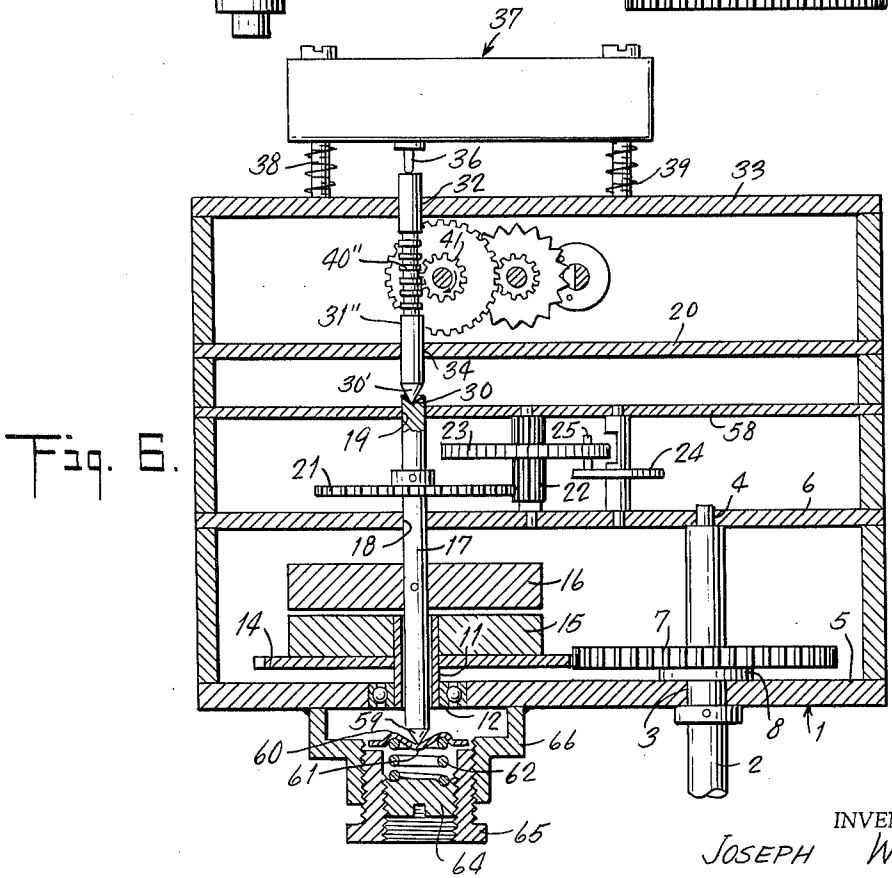


Fig. 6.



INVENTOR.
JOSEPH WEISS

BY
Kraziuski & Nolan

ATTORNEYS

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3,235,047

DRIVING MECHANISM

Joseph Weiss, 134 W. 93rd St., New York 25, N.Y.

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9 Claims. (Cl. 192—84)

The present invention relates to driving mechanisms and, more particularly, to driving mechanisms for governors.

A primary object of the invention is to provide a slip type magnetic drive mechanism having axial movement which is utilized in actuating an element.

A further object of the invention is to provide means whereby axial movement of the magnetic drive mechanism is controlled.

A still further object of the invention is to provide means whereby rotational movement of the magnetic drive mechanism is controlled.

Another object of the invention is to provide a magnetic drive mechanism in which the transmitted torque is held to a minimum during overload.

A primary feature of the invention resides in a mechanism including a rotatable magnet which rotates, by virtue of its magnetomotive force, a second magnet synchronously with the first magnet as long as such rotation is within the torque transmission limit of the two magnets but, when the torque transmission limit of the magnets is exceeded, slip between the magnets occurs with resultant axial movement of the second magnet to actuate a device.

Other features will be apparent from the following detailed description of the drawings wherein:

FIG. 1 is a central, sectional view of a driving mechanism in accordance with one embodiment of the present invention;

FIG. 2 is a fragmentary sectional view taken along the line 2—2 of FIG. 1 in the direction of the arrows;

FIG. 3 is a partial view of a pawl-ratchet arrangement as an alternative of the pinion-rack arrangement shown in FIG. 1;

FIG. 4 is an enlarged sectional view showing in greater detail the spring mechanism for directional rotation of the pinion shown in FIG. 2;

FIG. 5 is another modification of the pinion-rack and shaft of FIG. 1; and

FIG. 6 is a central sectional view of a drive mechanism in accordance with another embodiment of the present invention.

Referring now to the drawings, particularly to FIGS. 1 and 2, there is shown one embodiment of a governor and its drive mechanism and switch actuating mechanism of my invention, comprising a casing or housing 1, provided with a shaft 2 which is driven from a suitable source (not shown) and which rotatably rides in bearings 3 and 4, of members 5 and 6 respectively of the housing. Firmly affixed onto the upper end of shaft 2 is a gear 7 which has a hub or bearing 8. Also affixed adjacent the lower end of shaft 2 is a collar 9, secured by a set screw 10, to prevent undue axial movement of shaft 2. A hollow shaft 11 is shown firmly press fitted into a bearing 12 which is carried by member 6. Rigidly fixed to hollow shaft 11 at its upper end is a gear 14 which meshes with and is adapted to be driven by gear 7. Rigidly fixed onto shaft 11 at its lower end is a magnet 15. Below magnet 15 is shown a magnet 16 which is capable of receiving rotary motion from magnet 15 and is also capable of axial movement with respect to magnet 15. Each of magnets 15 and 16 have at least one pair of north and south poles. Magnet 16 is rigidly fixed onto a shaft 17 which is capable of rotary and axial movement and which rides freely in guide bearings 18 and 19 of housing members 5 and 20, respectively. Shaft 17 passes through hollow shaft 11 which is provided with ample clearance between them. Rigidly affixed to shaft 17 between housing members 6 and 20 is a gear 21 which is in engagement with a conventional driven means, such as an escapement mechanism.

This escapement mechanism includes a pinion 22 which meshes with gear 21, a star wheel 23 and a flutter wheel 24 carrying spaced pins 25 which are engaged by the star wheel 23. The escapement mechanism rotates freely in support bearings in housing members 20 and 6, respectively, as is readily evident. The escapement mechanism retards rotation of gear 21 and, in turn, magnet 16 in the conventional manner.

At the lower end of shaft 17 is provided a screw 26 which is for the purpose of adjusting the axial travel of magnet 16 and because of shock imparted to the screw 26 by rapid axial movement of the shaft 17, it is preferred that the screw or tip 27 thereof be of resilient material. Screw 26 is threaded in a bridge 29 which is rigidly affixed to housing member 5.

Above the upper end of shaft 17 is shown a gear rack 31 which is concentric with shaft 17 and which is adapted for axial movement only in guide bearings 32 of housing member 33 at its upper end and at its lower end in guide bearing 34 provided in a bridge 35 mounted upon housing member 20. The upper end of rack 31 is in engagement with an actuating pin 36 of an electrical switch 37, such as a micro switch. Switch 37 is mounted on housing member 33 which is threaded to receive screws 38. Springs 39 are provided with screws 38 to urge switch 37 away from housing member 33 and thus from rack 31. These screws 38 are for the purpose of regulating the amount of engagement the switch's actuating pin 36 has with respect to rack 31, which engagement also determines how much of the switch's spring force and travel will be exerted on the rack 31 and thus on magnet 16 through shaft 17. Such engagement can also be utilized to control the proximity of magnet 16 with that of magnet 15 when the governor is at rest.

Rack 31 has gear teeth 40 in mesh with a pinion 41 which is part of a single directional rotation transmitting mechanism, as shown in detail in FIGS. 2 and 4, wherein pinion 41 is connected with a gear 42, as will be described hereinafter.

Referring to FIGS. 2 and 4, pinion 41 is rotatable on pinion staff shaft 43 which in turn rotates freely in bearings 44. Axial movement of pinion 41 is prevented by a collar 45, fixed on shaft 43. Pinion 41 has a flange 46 or shoulder and a hub 47 in close proximity to a similar hub 48 of gear 42, which hub 48 is rigidly fixed to shaft 43. A flat, coil spring 49 fits over hubs 47 and 48 and rotation of pinion 41 in one direction is transmitted to gear 42 by gripping action of the spring 49, while rotation of the pinion 41 in the opposite direction releases the gripping action of the coil spring 49, thus permitting free rotation of pinion 41.

In FIG. 1 the free rotation of pinion 41 is counterclockwise. This is a well known type of mechanism to those skilled in the art. An escapement mechanism, similar to that previously described, is in engagement with gear 42 which meshes with pinion 50. A star wheel 51 is carried by pinion 50 and it is in engagement with pins 52 of a flutter wheel 53. The escapement mechanism and single directional rotation transmitting mechanism is supported by bearings 44, 54, 55 in a casing 56 attached to housing member 20 by means of screws 57 threaded into housing member 20.

In operation, rotation of shaft 2 is transmitted by gears 7 and 14 to magnet 15, which rotation is then transmitted from magnet 15 to magnet 16 by means of their mag-

netomotive forces. Rotation of magnets **15** and **16** is synchronous as long as the escapement mechanism being driven by magnet **16** through gear **21** does not exceed the predetermined torque load that magnets **15** and **16** are capable of transmitting. This is controlled by the magnetomotive forces of the magnets, their proximity with respect to each other, frictional engagement when in contact with each other, and the forces urging rotary displacement and axial separation thereof. In this operation the final control of the governor is a movable element of a device which, for example, in this illustration is an escapement mechanism that builds up an increasing torque load resistance as the speed of rotation increases. Of course, any other mechanism besides the escapement mechanism, requiring a predetermined amount of torque for its operation, may be used. Thus by predetermining the aforesaid forces, the speed of rotation at which a sufficient torque load will be developed to force magnets **15** and **16** out of synchronism, can be determined.

Assume that switch **37**, when the governor is at rest, to be in its operative position. Switch **37** then exerts a force upon magnet **16**, through actuating pin **36**, rack **31** and shaft **17**. This force alone is insufficient to cause axial separation of magnet **16** away from magnet **15** as long as the unlike (north and south) poles of the two magnets are in alignment with each other, their magnetomotive forces of attraction for each other being greater than the force urging axial separation. Now, when the speed of rotation is increased in excess of that for which the governor had been set, the poles of magnets **15** and **16** are then forced out of alignment and their forces of attraction for each other are accordingly decreased depending upon what angular degree the poles are disaligned. When the force of magnetic attraction decreases below that of the switch **37** the magnets are further separated and switch **37** is rendered inoperative.

For example, assume the governor to be set to operate at 15 r.p.m. and assume further that rotation of magnet **15** is rapidly accelerated to a much higher speed, say 200 r.p.m. Then the magnet **15** will move out of step with respect to magnet **16**, that is, magnet **16** will no longer be attracted to magnet **15**, so that there will be little or no transmission of torque and/or rotation of magnet **16** with respect to magnet **15**, which is rotating at 200 r.p.m. Thus there is no wear imposed on the escapement mechanism comprising elements **22**, **23**, **24** and **25**.

Now when the speed of magnet **15** is decreased to less than 15 r.p.m., the magnet **16** is attracted to magnet **15** and urges shaft **17** and rack **31** upwards to actuate pin **36** of switch **37**. Axial movement upwards of magnet **16**, shaft **17**, rack **31** is time controlled by the escapement mechanism comprising elements **50**, **51**, **52** and **53** through teeth **40**, pinion **41**, and gear **42**.

Assume, instead, that the speed of rotation of magnet **15** is gradually increased or held consistently at a speed of 17 r.p.m. where separation and attraction of the magnets occur intermittently. The number of times during which the two magnets will be out of step will be too few and insufficient to keep them continually separated, so that we have the condition termed hunting, when at one instant the poles of the magnets are disaligned and at another instant the poles are aligned. To overcome this hunting condition gear rack **31** is arranged to freely move downwardly with shaft **17** and magnet **16**, when separation occurs, but is delayed in returning, when magnet **16** approaches its normal position with respect to magnet **15**. This is accomplished by the escapement mechanism comprising elements **50**, **51**, **52** and **53**, which retards the return of rack **31** within a predetermined time period. Of course, other suitable retarding means could be used, such as a dash-pot.

FIG. 3 shows a modified rack **31'**, whereby the teeth **40'** are ratchet toothed to engage a pawl **41'** whereby axial travel of rack **31'** is permitted in one direction but not in the opposite direction until such time as the pawl **41'** is actuated, to release rack **31'**, by manual or automatic means (not shown).

FIG. 5 shows still another modification of pinion rack **31** and of shaft **17**, whereby both of them are joined or are one continuous member and teeth **40''** encircles shaft **17'**. This construction permits rotary motion of teeth **40''** without affecting pinion gear **41** which is affected only when there is axial movement of teeth **40''**.

In FIG. 6 there is shown another embodiment of the governor drive mechanism with the switch actuating mechanism of FIG. 1. For simplicity, elements shown in FIG. 6 which are similar in structure and function as those in FIGS. 1 to 5 will be similarly numbered. In this figure, there is shown a housing **1** provided with a shaft **2** driven from a suitable source (not shown), which shaft rotatably rides in bearings **3** and **4** of members **5** and **6**, respectively, of the housing. Rigidly affixed to shaft **2** is a gear **7** which has a bearing flange or hub **8**. A hollow shaft **11** is rigidly carried by bearing **12** which is press fitted into an opening **13** of member **5** of the housing. A double row ball bearing or roller type of bearing can be utilized to insure against axial or eccentric movement of the shaft **11**. Rigidly fixed on shaft **11** is a gear **14** which meshes with and is adapted to be driven by gear **7**. Also rigidly affixed to shaft **11** is a magnet **15**. In close proximity to magnet **15** is magnet **16** which is capable of receiving rotary motion from magnet **15** by means of their magnetomotive forces and/or frictional contact. Magnet **16** is rigidly fixed on shaft **17** which is capable of both rotary and axial movement and rides freely in guide bearings **18** and **19** of members **6** and **58** of the housing **1**. Shaft **17** passes downwardly through hollow shaft **11**, the diameters of shafts **11** and **17** being such that ample clearance is provided between them. The lower end **59** of shaft **17** is tapered to reduce frictional resistance with a disc **60**, shaped at its center **61** to receive pointed end **59**. Below the disc **60** is an expansion type spring **62** which is retained by disc **60** at its upper end and at its lower end by a threaded plug or screw **64**, which in turn is threadedly engageable in a hollow plug or bolt **65**. Both plugs **64** and **65** are individually adjustable, plug **65** being threadedly engageable in bridge **66**, which is rigidly fixed to member **5** of the housing in any suitable manner, as by welds. By this construction zero clearance or any desired gap clearance between magnets **15** and **16** can be obtained. The compression of spring **62** against disc **60** and in turn shaft **17** and magnet **16** is adjustable to the desired amount by means of the screw **64**. Adjacent the upper portion of shaft **17** and rigidly fixed thereon is a gear **21** which drives an escapement mechanism **23**, **24**, **25** through the pinion gear **22**. The operation and function of this escapement mechanism is the same as that shown in FIG. 1.

The upper end of shaft **17** has a concentric, tapered recess **30** to receive a tapered point **30'** of gear pinion rack **31''**. The operation of pinion rack **31''** is to prevent intermittent actuation of the switch **37** caused by the hunting action of magnet **16** with magnet **15**, as described hereinbefore. In this embodiment pinion rack **31''** is capable of both rotary and axial movement in guide bearings **32** and **34** in members **33** and **20**, respectively, of the housing **1**. The gear teeth **40''** encircle the pinion rack **31''**, so that any rotation of pinion rack **31''** with shaft **17** would not affect or impair its operation or efficiency. The pinion rack **31''** can be a continuation of the shaft **17**, as hereinbefore described in FIG. 5. As in FIGS. 1 and 2, the circular gear teeth **40''** engage pinion **41** which is rotatable freely in a clockwise direction, as viewed in FIG. 6.

In operation, the rotation of shaft **2** is transmitted to magnet **15** through gears **7** and **14**, while rotation of magnet **15** is transmitted to magnet **16** by means of their magnetomotive and/or frictional forces. At this time shaft **17** is urged downwardly by magnet **16** and thus compresses spring **62**. Rotation of the two magnets is syn-

chronous as long as their capabilities for transmitting a predetermined torque load are not exceeded. Now, should the predetermined torque load, for which the governor drive mechanism had been set, be exceeded, magnets **15** and **16** will be forced out of synchronism and will be thereby separated. Shaft **17**, since it moves upwardly with magnet **16** will be further moved upwardly by expansion of spring **62** to cause still further separation of the magnets and actuation of switch **37**. Should the speed of rotation drop below that for which the governor had been set, the magnet **16** will again be synchronized with magnet **15** and drawn towards it. Shaft **17** moves with magnet **16** and consequently compresses spring **62**, thus allowing switch **37** to return to its normal, unactuated position.

As various changes may be made in the form, construction, and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matters are to be interpreted as illustrative and not in any limiting sense.

What is claimed is:

1. A drive mechanism comprising a driven shaft, a magnetic member rigidly secured to and rotatable with said driven shaft, an axially movable second shaft freely rotatable with respect to said driven shaft, and a second magnetic member rigidly secured to said second shaft, each of said magnetic members having a north pole and a south pole spaced from each other, whereby when the north-south poles of the respective magnetic members are opposite each other said members are attracted to each other and rotate in synchronism and when the north-south poles of the members are disaligned said members are repelled from each other to cause said second shaft to be axially moved and to permit rotational slip continuously therebetween with axial movement of said second member.

2. A drive mechanism in accordance with claim **1**, wherein said driven shaft is hollow.

3. A drive mechanism in accordance with claim **2**, and means connected with said second magnetic member for limiting rotation of the latter to a predetermined speed.

4. A drive mechanism comprising a movable, self returnable element, a driven hollow shaft, a magnetic member rigidly secured to and rotatable with said hollow shaft, an axially movable second shaft freely rotatable within said hollow shaft, a second magnetic member rigidly secured to said second shaft, each of said magnetic members having a north pole and a south pole spaced from each other, whereby when the north-south poles of the respective magnetic members are opposite each other said members are attracted to each other and rotate in synchronism and when the north-south poles of the members are disaligned said members are repelled from each other to cause said second shaft to be axially moved and to permit rotational slip continuously therebetween, whereby axial movement of said second magnetic member actuates said movable element in one direction, and means for retarding return of said movable element.

5. A drive mechanism comprising a driven rotary member, a second member adapted to be moved rotatably and axially, said members having interacting magnetomotive forces for controlling movement of said second member, whereby said second member is adapted to transmit a predetermined amount of torque received from said driven member, escapement means responsive to torque transmission from said second member for controlling movement of said second member so that when said predetermined torque is exceeded axial movement is imparted to said second member and slip occurs continuously between said members, whereby rotation of said second member is reduced to substantially zero while rotation of said driven member continues, and a self returnable element responsive to said axial movement of said second member.

6. A drive mechanism in accordance with claim **5**, wherein means are provided for controlling return of said element when said torque falls to its predetermined value, thereby preventing hunting action between said members.

7. A drive mechanism in accordance with claim **6**, wherein said return controlling means is unidirectional.

8. A drive mechanism in accordance with claim **5**, wherein resilient means are provided for controlling axial movement of said element.

9. A drive mechanism in accordance with claim **7**, wherein said resilient means is adjustable.

References Cited by the Examiner

UNITED STATES PATENTS

2,603,731	7/1952	Weiss et al.
2,929,477	3/1960	Rodriguez et al.

DON A. WAITE, *Primary Examiner.*

DAVID J. WILLIAMOWSKY, *Examiner.*