United States Patent [19]

Celli

[11] **3,859,952**

[45] **Jan. 14, 1975**

[54] **SHOCK ABSORBING TILT MECHANISM FOR STERN DRIVES FOR BOATS**

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[22] Filed: **Feb. 15, 1974**

[21] Appl. No.: **442,736**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 326,584, Jan. 26, 1973, abandoned.

[52] **U.S. Cl.** ..... **115/41 R,** 267/70

[51] **Int. Cl.** **B63h 5/12**

[58] **Field of Search** 115/41; 74/89.15; 188/129; 248/4; 267/60, 70, 168

[56] **References Cited**

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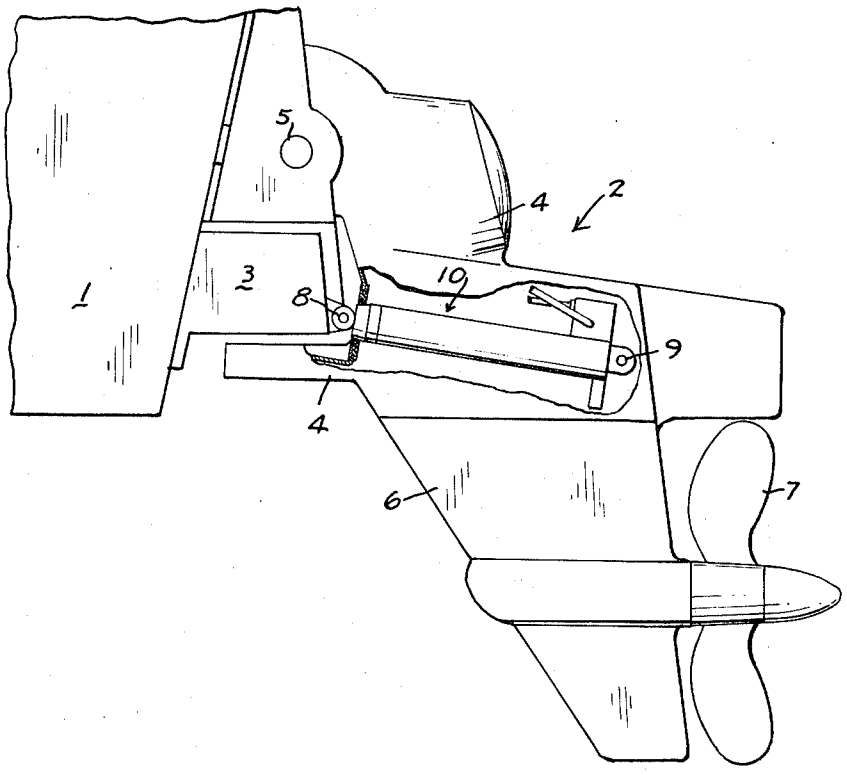
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[57] **ABSTRACT**

A tilt and shock absorbing mechanism for a boat stern drive unit which includes a pair of telescoping cylinders threaded one over the other and connected such that, when one is rotated relative to the other in opposite directions, the tiltable section of the drive unit is pivoted upwardly and downwardly. A compression spring assembly is enclosed with the cylinders to permit tilting of the movable section of the drive unit against a spring bias and a friction snubbing device is operated in response to compression of the spring assembly to damp and limit the tilting movement of the movable section of the drive unit under the control of the spring assembly.

13 Claims, 2 Drawing Figures



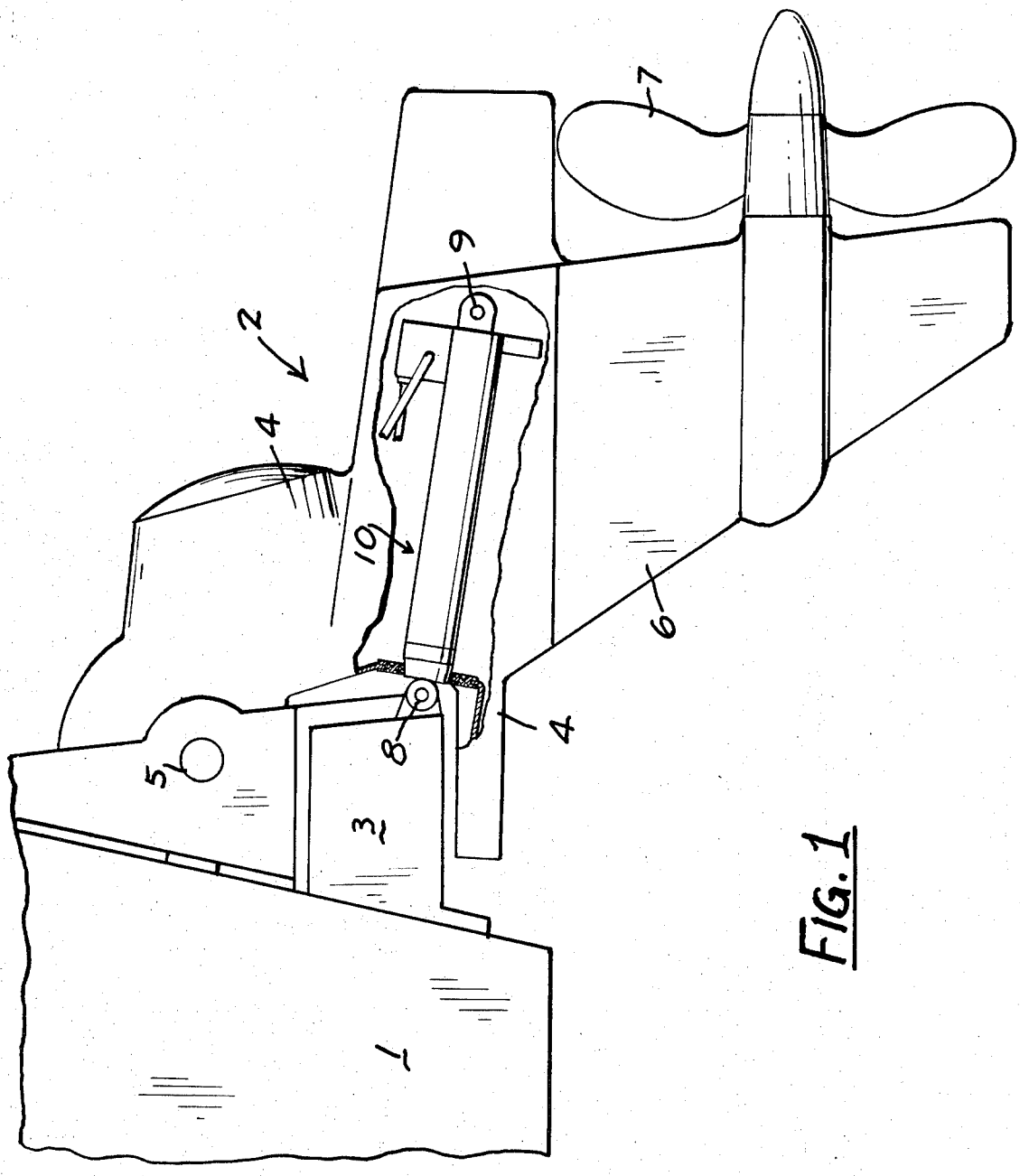


FIG. 1

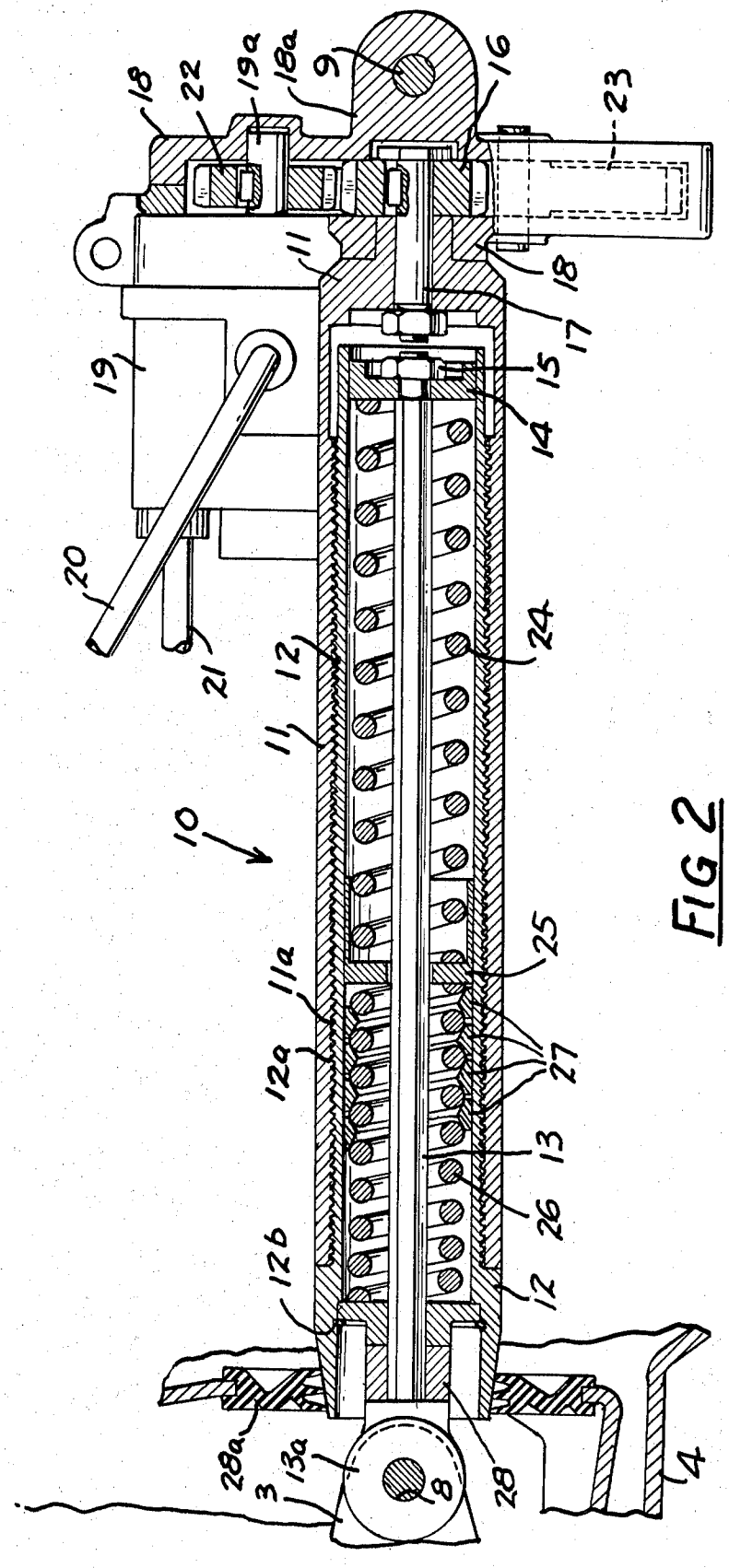

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19a
18a
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24
21
12
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10
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11a
12a
27
13
26
12b
12
28a
13a
3
8
28
4

FIG 2

SHOCK ABSORBING TILT MECHANISM FOR STERN DRIVES FOR BOATS

This application is a continuation-in-part of my copending application, Ser. No. 326,584, filed Jan. 26, 1973 now abandoned.

This invention relates to a mechanical system for motor boat stern drives of the type adapted to tilt so as to raise and lower a propeller drive unit. More specifically, the invention contemplates a mechanical means for allowing the submerged section of a stern drive to absorb shocks when it accidentally hits floating or submerged bodies, such as logs and the like.

In connection with motor boats it is common to have the engine installed inboard and the propeller drive located outboard or the whole unit (that is, the engine and the drive) both mounted outboard. In either case, the drive to the propeller includes a fixed section fastened to the stern of the boat and a tilting steerable section which is partially submerged and which comprises the propeller and a portion of its drive mechanism. In such arrangements the movable part of the drive unit must be such as to allow it to tilt whenever it is required to lift the propeller out of the water or when the submerged section of the drive unit accidentally hits a floating or under water object. In the latter case the tilting is required to avoid damage to the drive unit caused by the impact. For this reason a variety of arrangements have been used between the fixed and the tilting sections of such drive units. In general these devices allow tilting only in the case of violent shocks or impacts and they are normally designed to permit the drive unit to remain submerged in the event that the drive is reversed to propel the boat rearwardly.

The damping devices generally adopted heretofore usually consist of conventional automobile shock absorbers mounted between the fixed section and the tilting section of a stern drive unit. In order to lock the tilting section in a submerged position when the drive is reversed to propel the boat rearwardly a spring biased release hook or latch is provided. Normally this hook or latch holds the two sections together and snaps open to permit tilting when the propeller unit encounters a floating or submerged object. The hook or latch is also designed to be released when it is desired to lift the propeller section out of the water.

Devices of the type described have several disadvantages. They are generally expensive and are usually operated hydraulically. Furthermore, they are mounted on the outside of the case for the drive unit and are, therefore, exposed to water corrosion and breakage.

The object of this invention resides in the provision of a tilt and shock absorbing arrangement for motor boat stern drives which accomplishes the functions of tilting, shock absorbing and releasing in a simple manner and which is mounted within, rather than exteriorly of the drive casing so that it is not subjected to corrosion resulting from exposure to water and not apt to be broken or damaged by externally applied forces.

More specifically, the present invention contemplates a pair of telescopically arranged inner and outer cylinders which are threaded one upon the other and arranged to interconnect the fixed section with a tiltable section of the stern drive unit. Within the inner cylinder there is arranged a pair of opposed coil springs with the convolutions of one of the springs surrounded by an additional spring which is adapted to circumferentially expand and engage the bore of the inner cylinder when the coil spring is compressed, thus providing a braking or damping action to the compression of the coil springs. A motor is connected to the outer cylinder for rotating the same relative to the inner cylinder and thereby pivot the movable section of the drive unit upwardly and downwardly.

These and other features of the present invention will become evident from the following description and accompanying drawings, in which:

FIG. **1** is a fragmentary side elevational view, with a portion broken away, of a boat having an inboard motor and a stern drive incorporating the present invention; and

FIG. **2** is a vertical section on the longitudinal center line of the tilt and shock absorbing mechanism of the present invention.

Referring to FIG. **1**, there is illustrated the stern section of a boat **1** on which a stern drive unit **2** is mounted. Drive unit **2** includes a section **3** fixedly attached to the stern of the boat and a tilting section **4** pivotally supported on section **3** for tilting movement in a vertical plane by means of a horizontal pivot pin **5**. As illustrated in the drawings, the tilting section **4** comprises an outer casing or housing which contains a drive mechanism. On the lower portion **6** of unit **4** there is mounted a propeller **7**.

Within the outer casing of section **4** there is arranged a cylinder assembly **10** which comprises the tilting and shock absorbing mechanism of the present invention. Cylinder assembly **10** is pivotably mounted within the casing of section **4** on a pin **9**.

Referring to FIG. **2**, cylinder assembly **10** includes a pair of telescoped cylinders **11,12**, the outer cylinder **11** being internally threaded as at **11***a* and the inner cylinder **12** being externally threaded as at **12***a*. In FIG. **2** cylinders **11,12** are shown in the position fully threaded one within the other so that the tilting section **4** of the drive unit is in its normal upright drive position with the propeller **7** and the lower portion **6** submerged in water. Within cylinders **11,12** there is arranged a rod **13** which is of prismatic or other noncircular shape. One end of rod **13** is pivotally connected as by bushing **13***a* with pivot pin **8**. The opposite end of rod **13** has a piston **14** mounted thereon which slideably engages the bore of cylinder **12**. Piston **14** is fixedly secured to the end of rod **13** by a nut **15**. The end of cylinder **12** adjacent pivot **8** is closed by a fixed disc **12***b*. The aperture in disc **12***b* through which rod **13** extends has a periphery corresponding to the cross section of rod **13** so that disc **12***b* cannot rotate relative to the rod.

The end of outer cylinder **11** adjacent pivot pin **9** is rotatably supported within a bore in a casing **18**. Casing **18** is formed with a lug **18***a* by means of which the casing is pivotally supported on pin **9**. A motor **19** is mounted on casing **18**. The output shaft **19***a* of motor **19** has a gear **22** keyed thereto. Gear **22** drives a gear **16** which is keyed to a shaft **17** fixed to cylinder **11** by means of speed reduction gearing **23**.

In the illustrated embodiment motor **19** is hydraulically operated and is connected to a source of pressurized oil and a reservoir by means of conduits **20,21** and valving (not illustrated). When the rotor of motor **19** is rotated in one direction gear **22** drives gear **16** so as to rotate cylinder **11** in one direction and, by reason of the threaded connection between cylinders **11** and **12**, the two cylinders are extended relative to each other so

as to tilt the section 4 in an upwardly direction. When the rotor of motor 19 is rotated in the opposite direction cylinder 11 is threaded onto cylinder 12 so as to telescope the two cylinders together and thereby lower the tiltable section 4 to the submerged operative position.

Within cylinder 12 there are arranged two coil springs 24,26 -- the adjacent ends of which abut against a diaphragm member 25 slideably arranged within the bore of cylinder 12. Coil spring 24 is preferably weaker than coil spring 26 and has one end abutting against piston 14 and its opposite end against diaphragm 25. The heavier spring 26 has one end abutting against the end of disc 12*b* and its opposite end against sliding diaphragm 25. Spring 24 is preferably longer and weaker than spring 26 so that the initial compression occurs in spring 24 before spring 26 is compressed to any substantial extent.

An additional coil spring 27 encircles a portion of spring 26. Spring 27 is formed from a wire having a generally triangular cross section with its coils or convolutions wound around the convolutions of spring 26 in such a way that the inclined faces around the inner periphery of each convolution frictionally engage the radially outer surface portions of the adjacent convolutions of spring 26. The radially outer surface of each convolution of spring 27 is of a flat, generally cylindrical configuration contacting the bore of cylinder 12. The function of sliding diaphragm member 25 is to separate springs 24,26 at their abutting ends and to transmit in opposite axial directions movements of the springs resulting from compression and expansion. A stop 28 on rod 13 limits the extent to which the cylinder assembly is capable of shifting axially toward the fixed section 3 of the drive unit. Rod 13 and cylinder 12 extend through a flexible sealing grommet 28*a* in casing 4 which accommodates tilting of the cylinder and prevents water from entering the portion of casing 4 enclosing cylinder assembly 10.

With the system in the rest or normal position illustrated in FIG. 2, if it is desired to tilt section 4 upwardly out of the water, oil under pressure is directed to the proper conduit of motor 19 so as to rotate gear 22 in the proper direction and thereby thread cylinder 11 outwardly from cylinder 12. Initially the force resulting will cause disc 12*b* to bottom against stop 28. Thereafter, as cylinder 11 unwinds from cylinder 12, the cylinder assembly is extended and pin 9 will be displaced rearwardly and upwardly relative to pivot 8. As a consequence, section 4 of the stern drive unit will rotate upwardly about pivot 5 to the desired height. When the direction of rotation of motor 19 is reversed the tilting section 4 of the drive unit will be pivotally moved downwardly about pin 5. In either event, it will be observed that the interconnection between inner cylinder 12 and the non-circular cross section of rod 13 through the fixed disc 12b prevents the inner cylinder 12 from rotating when motor 19 is operating.

When the unit is in its normal submerged position and the lower portion 6 accidentally strikes a floating or under water object, unit 4 is permitted to rotate about pin 5 under the restraining influence of the springs in cylinder assembly 10. As the unit 4 starts to pivot upwardly rod 13 begins to withdraw from within cylinder 12. This causes springs 24 and 26 to be compressed between piston 14 and the bottom disc 12*b*. Since spring 26 is capable of resisting this compression to a greater extent than spring 24, spring 24 will initially compress more than spring 26 and, thus, permit the section 4 to tilt upwardly through a predetermined extent around pin 5. However, depending upon the extent of upward tilting of section 4 and the extent of compression of spring 24, eventually a point is reached where spring 26 compresses sufficiently so as to reduce the distance between adjacent convolutions thereof. As a result, spring 27 is expanded diametrically by the outward camming affect of the coils or convolutions of spring 26 on the sides of the triangularly shaped wire of spring 27. The diametrical expansion of spring 27 causes the spring to frictionally engage the bore of cylinder 12, thus producing a braking force on spring 26 which progressively increases as spring 26 progressively compresses until the braking force is such as to stop the upward tilting movement of section 4. The dimensions of the springs in relation to the forces, weights and speeds can be calculated so that the action of the coils of spring 24 increase gradually at a desired rate and, thus, arrest axial movement of the cylinders relative to the rod before both springs 24,26 are fully compressed. A desirable shock absorbing action is thus obtained. The dimensions of the springs can also be calculated to arrest the upward tilting movement of section 4 at a particular point so that this section of the drive unit will not tilt upwardly beyond a desired predetermined position. When the impact force on the lower portion 6 of the tiltable section 4 ceases the compression action on the springs is relieved and section 4 of the drive unit returns to its normal position.

When the stern drive is shifted to reverse so as to propel the boat rearwardly, the reverse rotation of the propeller tends to push the tilting section 4 of the drive unit away from the fixed section 3. When this occurs springs 24,26 are again compressed and the braking affect of spring 27 again comes into play to limit the extent to which the drive section 4 tends to tilt outwardly. This enables the boat to be propelled in a rearward direction.

I claim:

1. A mechanical lift and shock absorbing mechanism for a stern drive unit for a boat, said drive unit being of the type having one section fixed to the stern of the boat and another section pivotally supported thereon for upward and downward tilting movement comprising, a cylinder assembly interconnecting said fixed and tiltable sections of the drive unit, said cylinder assembly comprising a pair of cylinders coaxially telescoped one within the other, the outer cylinder being threaded over the inner cylinder, one of said cylinders being fixed against rotation relative to one section of the drive unit and the other cylinder being rotatably supported on the other section of the drive unit, means for rotating said last mentioned cylinder relative to the other to vary the effective length of said link so that, when the link is extended, the movable section is tilted upwardly and, when the link is contracted, the movable section is tilted downwardly, first coil spring means within said cylinders, means operatively connecting said first spring means with one of said sections for biasing the tiltable section to a lowered operative position, said first spring means being adapted to be compressed in response to tilting of the movable section upwardly against the bias of the spring means, second coil spring means surrounding said first spring means and engaging the outer periphery thereof so that the second

spring means are expanded diametrically in response to compression of the first spring means, said second spring means being dimensioned to frictionally engage the bore of the cylinder enclosing the same when expanded to progressively resist further compression of the first spring means.

2. The mechanism called for in claim **1** wherein said first spring means comprise a pair of coaxially opposed coil springs within the inner cylinder, said second spring means encircling only one of said coil springs so that the compression of the other coil spring is unhampered by the frictional engagement of the second spring means with the bore of the inner cylinder.

3. The mechanism called for in claim **2** wherein one of said first coil springs is designed to compress more readily under load than the other.

4. The mechanism called for in claim **2** wherein the coil spring enclosed by the second spring means compresses less readily under load than the other coil spring.

5. The mechanism called for in claim **2** wherein the coil spring not encircled by the second spring means is adapted to compress to a greater extent than the other coil spring before the second spring means expand into substantial frictional engagement with the bore of the inner cylinder.

6. The mechanism called for in claim **1** wherein said means operatively connecting the first spring means with one of said sections comprising a rod extending coaxially into said cylinders from one end thereof, said rod being pivotably mounted on one of said sections, said cylinders being axially slideable on said rod and said one cylinder being fixed against rotation on said rod, the distal end of the rod having an abutment thereon, said first spring means having one end abutting against said abutment and the other end abutting the end of the inner cylinder through which said rod extends.

7. The mechanism called for in claim **6** wherein the inner cylinder is fixed against rotation relative to said rod and relative to said fixed section of the drive unit.

8. The mechanism called for in claim **1** wherein the first coil spring means comprises a pair of opposed coil springs arranged in end abutting relation within said inner cylinder.

9. The mechanism called for in claim **8** including a diaphragm disposed between the adjacent opposed ends of said springs and slideable within the bore of the inner cylinder.

10. The mechanism called for in claim **1** wherein the second spring means comprises a coil spring having the inner periphery of each convolution engaging the radially outer portions of adjacent convolutions of the first spring means.

11. The mechanism called for in claim **10** wherein the inner periphery of the convolutions of said coil spring is of generally triangular cross section with the apex thereof facing radially inwardly and the opposed inclined sides thereof acting as cam faces engaging the radially outer portions of the adjacent convolutions of the second coil spring means.

12. The mechanism called for in claim **11** wherein the outer periphery of the convolutions of said coil spring defines a generally cylindrical surface adapted to frictionally engage the bore of the inner cylinder when the coil spring is expanded.

13. The mechanism called for in claim **1** wherein the outer cylinder is rotatably supported on the tiltable section and the means for rotating the same comprises a motor mounted on the tiltable section.

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