# United States Patent [19]

**Matuska**

[11] **3,860,993**

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[54] **DOOR CONTROL DEVICE**


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[73] Assignee: **Sealth Aero Marine,** Seattle, Wash.



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[52] **U.S. Cl.** ..... **16/52**

[51] **Int. Cl.** ..... **E05f 3/14**

[58] **Field of Search** ..... 16/49, 51, 52, 57, 58, 16/189; 192/45; 188/290



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*Attorney, Agent, or Firm*—Morris A. Case



[57] **ABSTRACT**

A viscous fluid is contained between a housing and a rotor to dampen rotation of the rotor. A tension spring extending inside the rotor is connected at one end to a means for controlling spring loading, and at the other end to a drive shaft for controlling movement of a door. A clutch is located on the drive shaft to allow the spring to move the door and the rotor in one direction of rotation and to release the rotor upon counter rotation.


**13 Claims, 10 Drawing Figures**

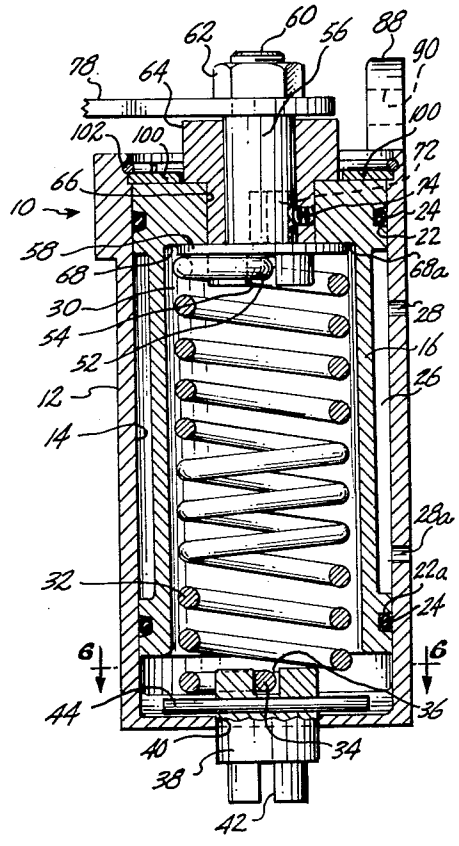
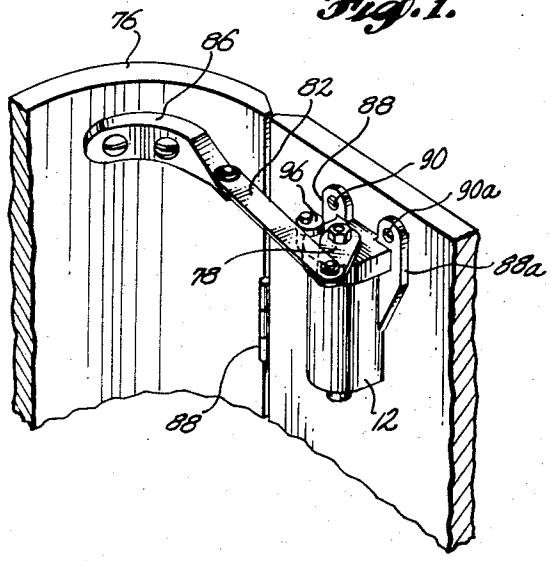


Fig. 1.



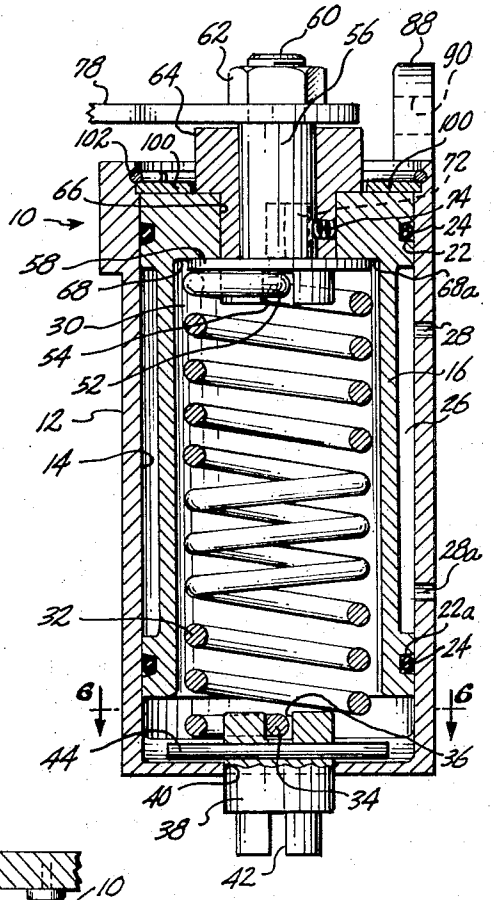
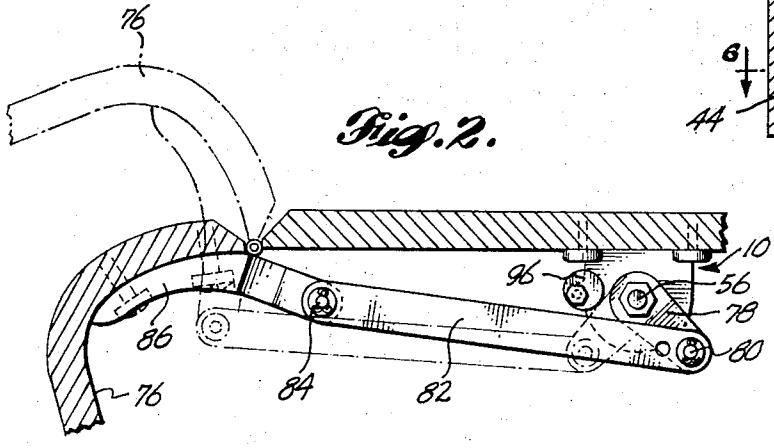




Fig. 4.

Fig. 2.



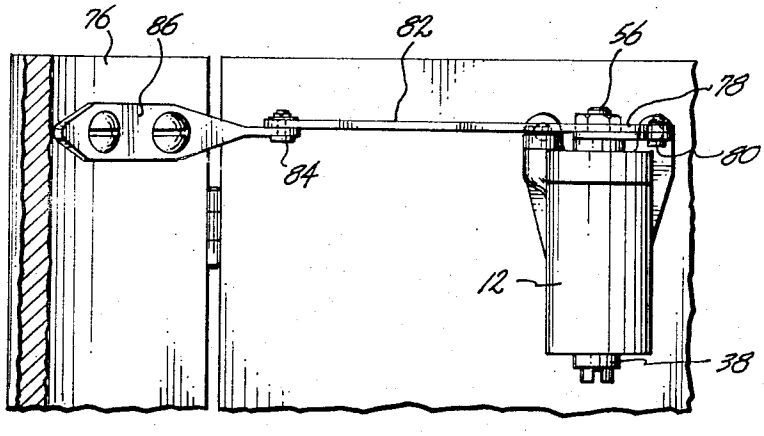




Fig. 3.

Fig. 5.

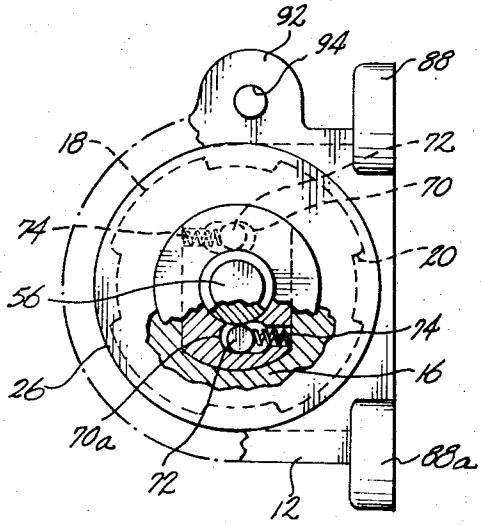
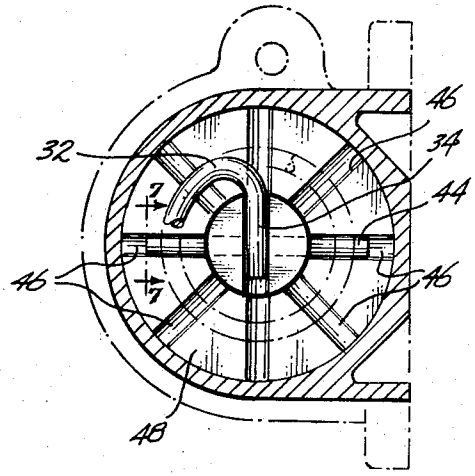



Fig. 6.



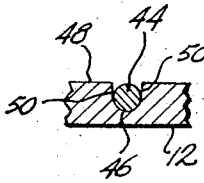




Fig. 7.

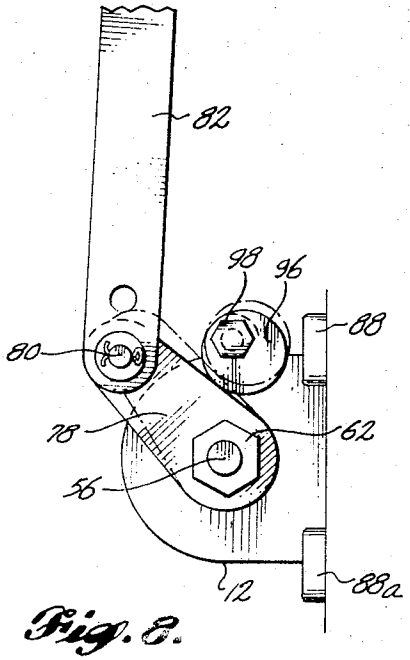



Fig. 8.

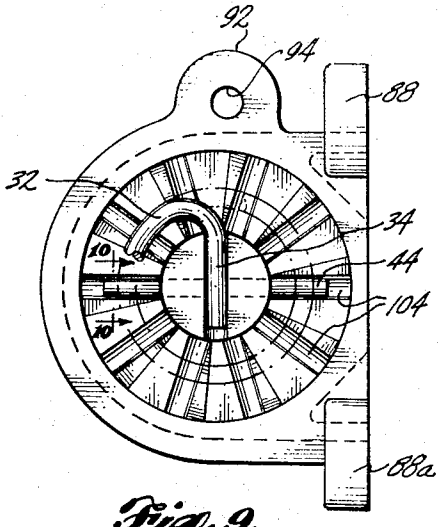



Fig. 9.

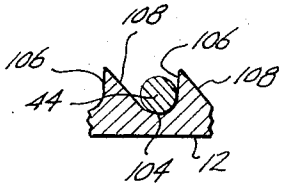



Fig. 10.

# DOOR CONTROL DEVICE

## BACKGROUND OF THE INVENTION

In a door opening or closing device it is normal to use a damping fluid to control the rate of movement of the door. The most common method of fluid use has been to meter the oil past an orifice, and to open a valve to allow free flow of fluid when the door movement is reversed. Due the high pressures involved these control devices are usually bulky.

In a recent patent a high viscosity fluid is place in the space between a housing and an internally mounted rotor. The rotor has an integral vane having an aperture or clearance at one end to provide a passage for the viscous fluid from one side of the vane or the other upon rotation or counter rotation of the rotor. This system imparts a damping effect when the fluid flows by the aperture in either direction of rotation of the rotor.

In another recent patent a high viscosity fluid is placed in the space between a housing and a rotor and the fluid dampens movement due to shearing of the fluid between cooperating ribs extending outward from the rotor and extending inwardly from the housing. This invention also dampens in both directions of rotation of the rotor.

The instant invention allows a rotor to rotate to dampen a spring actuated movement in one direction, but is released instead of counter-rotating.

## SUMMARY OF THE INVENTION

This invention is particularly well adapted to controlling stowage compartment doors on an airplane. It is desirable to use a light weight door control device that will open an unlatched door at a controlled rate of speed, will open a row of doors the exact same amount to give a neat uniform appearance and will allow ease in closing the door. An essentially cylindrical shaped housing encloses a torsion spring which extends longitudinally within the housing. The spring is fastened at one end to the housing and at its other end to a drive shaft that extends outside the housing. The connection to the housing is adjustably fastened to allow changing the pre-loading of the spring according to the weight of door to be opened. The means provided for adjustment allows for a considerable range in weight of door and for a fine adjustment for each weight. The door control device may be used to control either the opening or the closing of a door. When used to control the opening of a stowage compartment the end of the drive shaft is connected through linkage and fastens to the stowage compartment door. The act of closing and latching the door reloads the spring by the correct amount. Upon unlatching the loaded spring opens the door. The door travel is limited by an adjustable cam mounted to the housing and located to abut against a lever arm extending from the drive shaft as part of the linkage. A hollow rotor encircles the torsion spring and has an outside diameter slightly less than the inside diameter of the housing, with said diameter having at least one longitudinal recess. A highly viscous silicone fluid having a viscosity of from about 50,000 to 100,000 centistokes occupies the space between the rotor and the housing. Shearing action within the fluid dampens the rotation of the rotor. A clutch assembly encircles the drive shaft and is fastened to the rotor which moves in unison with the assembly. The clutch engages the drive shaft when it rotates in response to the spring to open the door and disengages when the drive shaft counterrotates when closing the door. This dampens and controls the rate of opening of the door, but has no damping effect when closing the door.

The rotor always rotates in the same direction. It acts as a damper to movement of the door when rotating, and permits free non-dampened movement when disengaged by the clutch.

## DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a fragmented perspective view of a mounted door control device linked to a door.

FIG. **2** is a fragmented top view of the device in FIG. **1**, showing the open door position in phantom.

FIG. **3** is a fragmented side elevation of the view shown in FIG. **1.**

FIG. **4** is a side elevation sectionalized to show the interior of the door control device.

FIG. **5** is an end elevation sectionalized in part to show a clutch arrangement.

FIG. **6** is a section taken along line **6—6** of FIG. **4** and looks into the end of the housing of the door control device.

FIG. **7** is a fragmented section of the end of the housing of FIG. **6.**

FIG. **8** is a fragmented end elevation of the door control device showing an adjustable cam for limiting travel.

FIG. **9** is a sectionalized view looking into the inside end of the housing as in FIG. **6** but showing another form of the invention.

FIG. **10** is a fragmented section of the end of the housing of FIG. **9.**

## DETAILED DESCRIPTION OF THE INVENTION

Door control device **10** has a housing **12** which has essentially a cylindrical inside diameter **14,** best shown in FIG. **4.** Inside the housing there is a rotor **16.** The rotor fits snugly inside the housing and has an outside diameter **18** which approximates the interior diameter of the housing. The rotor has one or more recesses **20** and in this embodiment there are four such recesses uniformly spaced around the periphery and extending longitudinally. The rotor has an encircling slot **22** near one of its ends and a second encircling slot **22*a*** near its other end. O-rings **24** fit into the slots to form a tightly sealed space **26.** A viscous fluid is placed in this space. It is preferably a silicone fluid having a viscosity of from about 50,000 to 100,000 centistokes with about 60,000 centistokes preferred. The fluid is introduced by turning the rotor until a recess is opposite filling holes **28** and **28*a*** entering the fluid and rotating until the next recess is opposite the holes, and repeating until the space **26** is full of fluid. The holes are then sealed closed.

The rotor **16** has a hollow interior **30** which encircles a torsion spring **32.** One end of the spring has a transverse tang **34** which seats in a slot **36** of a bolt **38.** The bolt extends through a hole **40** in the housing **12,** and in this embodiment has a slot **42** in its opposite end to accept a screwdriver for imparting an inward and a twisting movement to the bolt. The bolt end may be alternatively fashioned to accept an allen head wrench or be square or polygonal to allow movement with a wrench. The bolt also has at least one lateral projection. In this embodiment the projection is a pin **44**

which extends through the bolt and engages radially extending slots **46** on the inside end **48** of the housing. In one embodiment as shown in FIGS. **6** and **7** the side **50** and **50***a* of the radially extending slots are essentially vertical. The second end of the spring has a transverse tang **52** which extends through a slot **54** in a drive shaft **56.** The drive shaft has a ring **58** and is threaded **60** on its outside end to accept a nut **62.** A clutch housing **64** encircles the drive shaft and engages in a slot **66** in inwardly extending arms **68** and **68***a* of rotor **16** to allow the clutch housing and the rotor to move in unison. The clutch housing has a pair of oppositely located slots **70** and **70***a* having an opening to the drive shaft. A pin or dowel **72** in each slot is urged into the slot by a spring **74.** When the drive shaft is rotated the dowels wedge between the side of the slot and the drive shaft and the clutch housing rotates with the drive shaft. The springs keep the dowels in position. When the drive shaft is counter-rotated the dowels are moved from the wedged position and the shaft rotates free from the clutch housing. A dowel was used in the preferred embodiment; however, a pin, roller, ball or wedge may alos be used in place of the dowel.

The drive shaft **56** is connected to door **76** by linkage having a lever arm **78** which is fastened by nut **62.** The lever arm is rotatably pinned **80** to one end of link **82** and the opposite end is rotatably pinned **84** to part **86** which fastens to the door. The housing **12** has ears **88** and **88***a* with holes **90** and **90***a* to allow the housing to be connected to a structure as shown in FIG. **2.** The housing also has ear **92** with hole **94** to allow fastening an adjustable cam **96** to the housing to control lever arm **78** and limit the travel of the door. Bolt **98** is loosened, the cam rotated, as best shown in FIG. **8,** and the bolt tightened again to hold the cam in the desired position.

The rotor **16** is held in place with lock ring **100** and snap spring **102.**

In another embodiment, see FIGS. **9** and **10,** the radial slots **104** in the inside end of the housing have alternating sides **106** that are essentially vertical and the opposite sides **108** are tapered as on an incline plane. This allows the pin **44** to climb the incline to move from one slot to the next when the bolt **38** is rotated.

The rotor always rotates in one direction; however, an assembled door control device may be made up with either right hand or left hand parts to allow a choice of direction of rotation of the rotor.

The door control device may be used to open or to close a door. In operation loading of the torsion spring **32** is adjusted according to the weight of the door **76** to be moved. In the embodiment shown in FIGS. **6** and **7** a screwdriver is placed in slot **42** of the adjustment bolt **38.** The bolt is pressed inward against the spring until pin **44** clears a slot **46,** is rotated to obtain the required tension, and then released to allow the pin to catch in another of the series of slots. Whenever the door is unlatched the spring rotates drive shaft **56** with lever arm **78** to act through the linkage to move the door. Moving the door in the opposite direction reloads the spring. When the drive shaft rotates due to spring force the clutch assembly **64** is locked to the drive shaft and the clutch assembly and the rotor **16** rotates together. The fluid in space **26** dampens the rotation to give a controlled rate of movement. When the shaft counter-rotates the clutch is disengaged and the rotor remains stationary. Thus the rotor always rotates and dampens in only one direction. When the door is fully open, lever arm **78** is butting against cam **96.** The amount of the opening can be fixed by adjusting the cam. This is particularly helpful when a row of doors such as is found on stowage compartments are open. The opening on each door is adjusted separately to give the same uniform appearance.

In the embodiment as shown in FIGS. **9** and **10,** the spring tension is adjusted by use of a tool on the adjustment bolt **38** and rotating so that the pin **44** climbs up incline plane **108** and the pin falls in the next radially extending slot.

Having specifically described my invention, I do not desire to confine myself to the specific details of the constructional example herein shown and described as it is apparent that various modifications may be resorted to without departing from the broad principles of the invention as indicated by the scope of the following claims.

I claim:

**1.** A door control device comprising: a housing having a cylindrical shaped interior; a rotor mounted in the housing the outside diameter of which approximates the inside diameter of the housing, the rotor having a hollow interior and at least one longitudinal recess extending inward from the outside surface; a viscous fluid between the rotor and the housing; a torsion spring located inside the rotor; means for adjustably fastening a first end of the spring to the housing; means for fastening the second end of the spring to a rotatable drive shaft; means for linking the drive shaft to a door; and means for engaging the rotor to the drive shaft when the shaft rotates in one direction and for disengaging when the shaft counterrotates.

**2.** A door control device as in claim **1,** wherein the viscous liquid is a silicone fluid having a viscosity of about 50,000 to 100,000 centistokes.

**3.** A door control device as in claim **1,** wherein the means for adjustably fastening the first end of the spring to the housing comprises: a tang extending transversely at the end of the spring; a bolt extending through a hole in the end of the housing said bolt comprising: a transverse slot on the inner end to engage the tang of the spring, at least one laterally extending pin, and means for engaging the bolt to impart longitudinal and rotational movement to the bolt; a series of slots inside the housing to accept the pin from the bolt to vary the rotary loading of the spring.

**4.** A door control device as in claim **3,** wherein the slots in the housing have alternating vertical and tapered sides to allow adjustment of the spring by exerting a rotating force in one direction.

**5.** A door control device comprising: a housing having a cylindrical shaped interior; a rotor mounted in the housing the outside diameter of which approximates the inside diameter of the housing, the rotor having a hollow interior and at least one longitudinal recess extending inward from the outside surface; a viscous fluid betweeen the rotor and the housing; a torsion spring located inside the rotor; means for adjustably fastening a first end of the spring to the housing; means for fastening the second end of the spring to a rotatable drive shaft; a lever arm fastened to and pivoted by the drive shaft, and further the door control device includes an adjustable cam mounted to the housing to limit the travel of the lever arm; and means for engaging the rotor to the drive shaft when the shaft rotates in one di-

rection and for disengaging when the shaft counterrotates.

**6.** A door opening device for a stowage compartment in an airplane comprising: a housing having an essentially cylindrical inside diameter, means for mounting the housing to airplane structure, a torsion spring extending longitudinally inside the housing, means for adjustably mounting a first end of the spring to an end of the housing, means for fastening a second end of the spring to a drive shaft, means for linking the drive shaft to a stowage compartment door to open an unlatched door due to spring pressure and to reset the spring due to closing the door, a hollow cylindrical shaped rotor inside the housing encircling the tension spring and having an outside diameter approximating the inside diameter of the housing and also having at least one longitudinal recess extending from the outside diameter, means for engaging the rotor to the drive shaft when the drive shaft rotates to open the stowage door and to disengage the rotor from the drive shaft when the drive shaft counterrotates said means comprising a clutch assembly fastened to the rotor having a clutch to engage the drive shaft when it rotates in response to the spring and disengages when the drive shaft counterrotates, and a viscous fluid contained in a space between the housing and the rotor to dampen the door opening due to the shear of the fluid.

**7.** A door opening as in claim **6,** wherein the viscous fluid is a silicone having a viscosity of from about 50,000 to 100,000 centistokes.

**8.** A door opening device as in claim **6,** in which the means for adjustably mounting a first end of the spring to an end of the housing comprises: a series of radially extending slots in the inside end of the housing, a bolt extending through the end of the housing, means for fastening the inside end of the bolt to the tension spring, means for connecting to the outside end of the bolt to impart inward and rotational force to the bolt, and at least one laterally extending pin from the bolt to engage one of the slots in the housing.

**9.** A door opening device as in claim **8,** wherein the radially extending slots each further comprise: one side of the slot essentially perpendicular to the end of the housing and the other side of the slot tapered outwardly to allow movement of the lateral projection from one slot to the next by rotating the bolt; so that the projection climbs the tapered side.

**10.** A door opening device as in claim **6,** in which means for linking the drive shaft to a door includes a lever arm fastened to the drive shaft and means for linking the lever arm to the door, and in which the means for limiting travel comprises an adjustable cam located to contact the lever arm to limit its travel and means for fastening the cam to the housing.

**11.** A door control device comprising: a housing having an essentially cylindrical inside surface; means for mounting the housing to a structure; a torsion spring extending longitudinally inside the housing; means for adjustably mounting a first end of the spring to an end of the housing, said means comprising a series of radially extending slots in the inside end of the housing, a bolt extending through the end of the housing, means for fastening the inside end of the bolt to the tension spring, means for connecting to the outside end of the bolt to impart inward and rotational force to the bolt, and at least one lateral projection from the bolt to engage one of the slots in the housing; means for fastening a second end of the spring to a drive shaft; a clutch assembly mounted upon the drive shaft to effect engagement between the clutch and the drive shaft when the shaft rotates in response to the spring and disengagement when the drive shaft counterrotates; a rotor which encircles the spring having an outside diameter approximating the inside diameter of the housing, said rotor having at least one longitudinal recess adjacent the housing; means for joining the rotor to the clutch assembly to impart clutch housing movement to the rotor; a viscous fluid between the rotor and the housing to dampen the spring actuated rotation of the drive shaft; and means for linking the drive shaft to a door to control the movement of the door in one direction of travel.

**12.** A door control device as in claim **11,** wherein the viscous fluid is a silicone fluid having a viscosity of about 50,000 to 100,000 centistokes.

**13.** A door control device comprising: a housing having an essentially cylindrical inside surface; means for mounting the housing to a structure; a torsion spring extending longitudinally inside the housing; means for adjustably mounting a first end of the spring to an end of the housing, said means comprising a series of radially extending slots in the inside end of the housing, a bolt extending through the end of the housing, means for fastening the inside end of the bolt to the tension spring, means for connecting to the outside end of the bolt to impart inward and rotational force to the bolt, and at least one lateral projection from the bolt to engage one of the slots in the housing; means for fastening a second end of the spring to a drive shaft; a clutch assembly mounted upon the drive shaft to effect engagement between the clutch and the drive shaft when the shaft rotates in response to the spring and disengagement when the drive shaft counterrotates; a rotor which encircles the spring having an outside diameter approximating the inside diameter of the housing, said rotor having at least one longitudinal recess adjacent the housing; means for joining the rotor to the clutch assembly to impart clutch housing movement to the rotor; a viscous silicone fluid having a viscosity of about 50,000 to 100,000 centistokes between the rotor and the housing to dampen the spring actuated rotation of the drive shaft; and means for linking the drive shaft to a door to control the movement of the door in one direction of travel, said means comprises; a lever arm fastened to and pivoted by the drive shaft, and the door control device includes an adjustable cam mounted to the housing located to limit the travel of the lever arm.

* * * * *