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(71) Applicant
Jebron Limited (United Kingdom),
2 Nowell Street, King's Hill, Wednesbury, West Midlands

(72) Inventors
Peter Brown
Stephen James Harrison

(74) Agent and/or Address for Service
Forrester Ketley & Co,
Rutland House, 148 Edmund Street, Birmingham B3 2LD

(54) Door closer

(57) A piston (18, Fig. 1) is moved leftwards to close a door, fluid leaking past the piston to slow the door. Finally a piston gap (32, Fig. 3) overlaps a tube flat (41) to stepwise increase fluid flow, and hence door speed, to overcome a latch. The tube may be rotated (handle 36) to vary or remove the overlap, to vary or remove the stepwise flow increase. Handle rotation also varies the coverage of a channel (38) to throttle flow through the tube (37) and piston to vary piston and door speed. Air trapped within a space within a piston rack (20) is compressed with fluid expansion. Stops (28,29) on the piston limit lifting of a piston end (25) during the pistons' rightward movement.

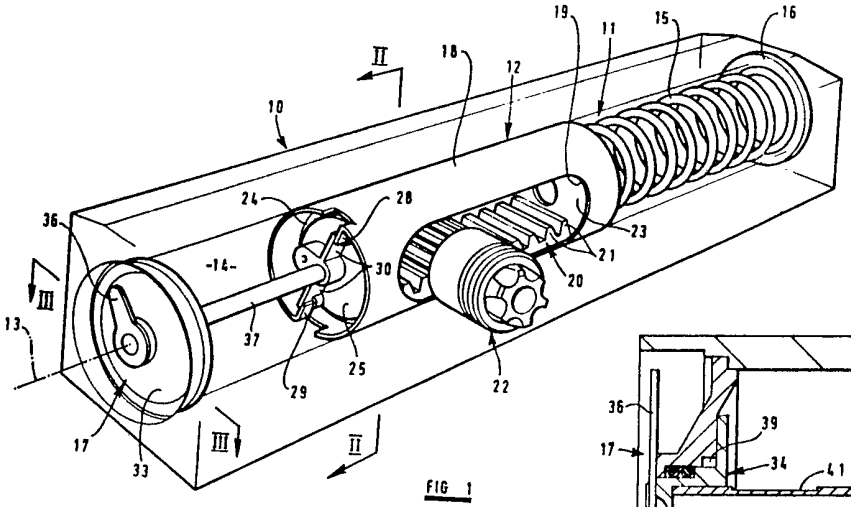

FIG 1

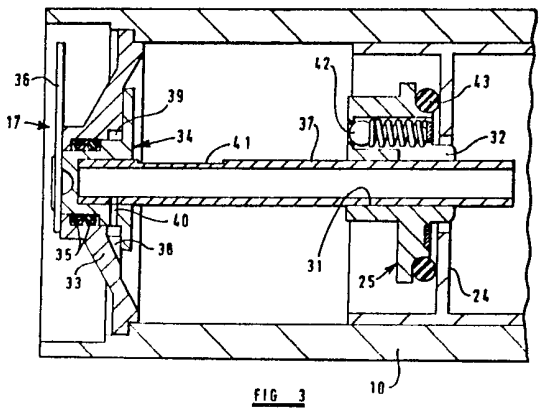

FIG 3

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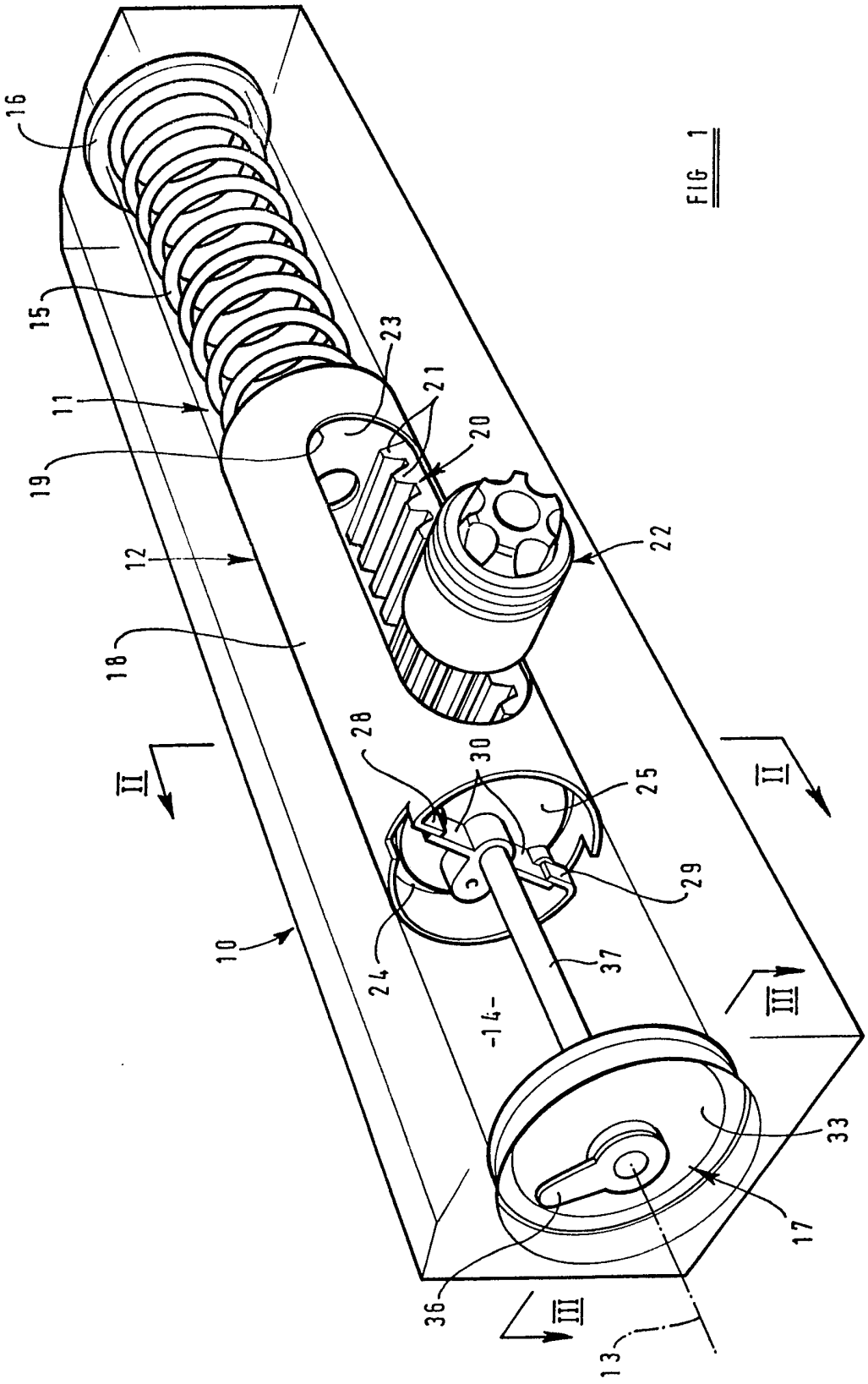

FIG 1

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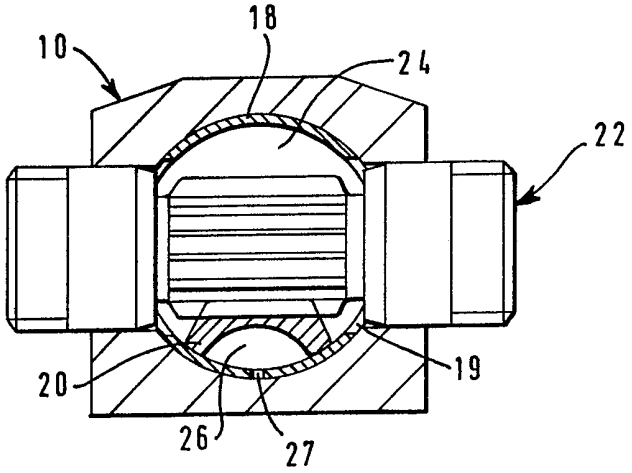
FIG 2



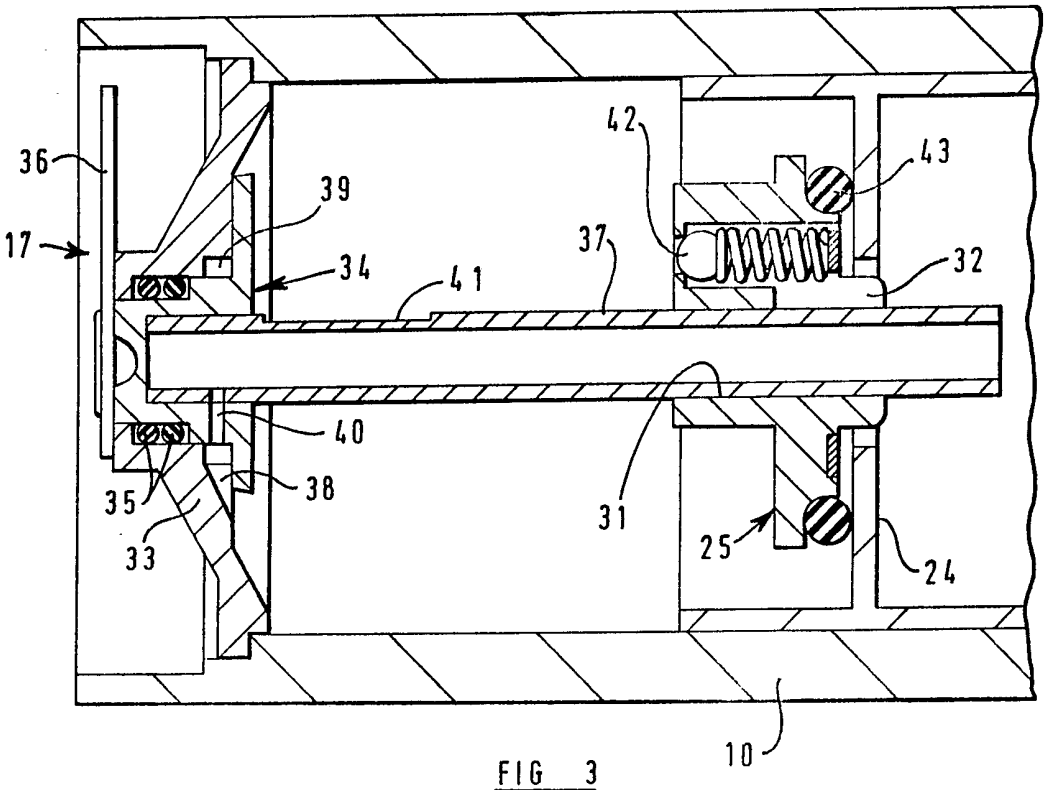


FIG 3

SPECIFICATION

Door control device

The present invention relates to a device of the kind commonly referred to as a door closer and comprising a hollow housing containing a piston, the movement of which is inhibited by fluid present inside the housing, the housing and piston usually being connected each with one of a door and a frame when the device is in use. Door closers generally contain a spring which biases the door to a closed position.

In a case where the door is provided with a latch, it is often desirable for the door closer to accelerate the door just before reaching the closed position, so as to increase the momentum of the door and enable the door to operate the latch. To fulfil this requirement, there have been proposed door closers wherein the resistance to movement of the piston decreases abruptly when the piston approaches an end of its stroke, so that the spring can accelerate the door.

There have also been proposed devices of the kind described which are adjustable, so that a selected degree of resistance to movement of the piston can be achieved.

According to a first aspect of the present invention, there is provided a door control device comprising a hollow housing defining an axis, a piston disposed within the housing and movable relative to the housing along the axis and adjustable flow control means for controlling flow of fluid from a first space which lies within the housing and is disposed between one end of the housing and the piston to a second space, whereby the speed of approach of the piston towards said end of the housing can be controlled by adjustment of the flow control means, and wherein the flow control means is settable in either selected one of a first condition, called herein the latching condition, such that said speed of approach is permitted to increase abruptly when the piston reaches a predetermined position relative to the housing, and a second condition, called herein the non-latching condition, such that no abrupt increase in the speed of approach of the piston is permitted as the piston approaches said end of the housing and wherein the flow control means is adjustable in each of said conditions to vary the resistance to said flow of fluid.

Adjustment of the flow control means may not make any significant difference to the rate of flow of fluid in each stroke of the piston when the flow control means is in the latching condition and the piston has moved beyond the position in which the abrupt increase of speed of the piston occurs.

The flow control means preferably includes a handle which can be turned from outside the housing to change the condition of the flow control means and also to adjust the resistance to flow of fluid.

According to a second aspect of the invention, there is provided a door control device comprising a hollow housing defining an axis, and a piston assembly disposed within the housing and slidable relative to the housing along the axis, the piston assembly comprising a tubular wall portion and a rack disposed inside the tubular wall portion, wherein there is defined between the tubular wall portion and the rack a space which communicates through an opening with a further space inside the housing.

The further space may be in the piston assembly or outside the piston assembly. Preferably, the opening is permanently open.

In a case where the housing is filled with a liquid which has a positive coefficient of thermal expansion, and the housing is then sealed to trap the liquid in a space defined by the housing and having a substantially constant volume, the space between the tubular wall portion and the rack can be used to trap air or another compressible fluid which will accommodate thermal expansion of the liquid.

According to a third aspect of the invention, there is provided a door control device comprising a hollow housing defining an axis and a piston assembly which is slidable in the housing along the axis, wherein the piston assembly comprises a tubular wall portion, a rack disposed inside the tubular wall portion, an end member for controlling flow of fluid between a position outside the piston assembly and a space within the piston assembly, the end member defining at least one opening for providing communication between said position and said space, and abutments on the wall portion for limiting movement of the end member along the axis relative to the tubular wall portion.

Said abutments may include at least one lug which is integral with the tubular wall portion and extends therefrom towards the axis.

One of said abutments is preferably a disc disposed inside the tubular wall portion and joined thereto at the periphery of the disc in a fluid-tight manner. The end member may be trapped between the disc and the lug or lugs. Preferably, the end member includes a formation with which the lug can engage to restrain turning of the end member about the axis.

An example of a door closing device which embodies each aspect of the present invention will now be described, with reference to the accompanying drawings, wherein:–

Figure 1 shows diagrammatically a perspective view of the device, certain parts being omitted or partly broken away for the purpose of illustration:

Figure 2 shows a cross-section on the line II–II of Fig. 1: and

Figure 3 shows a cross-section of certain

parts on the line III–III of Fig. 1.

The device shown in the drawing comprises a hollow housing 10 which defines a cylindrical cavity 11. Within the housing, there is a hollow piston assembly 12 which is a close sliding fit in the cavity 11. The piston assembly is urged along the axis 13 of the cavity 11 into an end portion 14 of the cavity by a coiled compression spring 15 engaged between the piston assembly and an end plate 16 of the housing which closes an end of the cavity 11 remote from the end portion 14. Movement of the piston assembly relative to the housing is impeded by a damping liquid, typically oil, present in the cavity 11 and inside the piston assembly. Control means is provided for controlling flow of oil between the end portion 14 of the cavity 11 and the space within the piston assembly 12. The flow control means is indicated generally by the reference numeral 17.

The piston assembly 12 comprises a tubular wall portion 18 which is formed from a length of tube. Windows 19 are formed at diametrically opposite positions in the wall portion 18, each window extending from a position near to one end of the piston assembly to a position near to the opposite end thereof. The piston assembly further comprises a rack 20 which is disposed inside the wall portion 18 and has teeth 21 which are spaced equally from the axis 13 and each extend transversely of that axis.

A pinion 22 is mounted in bearing openings formed in the housing 10 for rotation relative to the housing about a pinion axis which intersects and is perpendicular to the axis 13. The pinion has teeth which are enmeshed with the teeth 21 of the rack. When the device is prepared for use, the housing 10 is mounted on one of a door and door frame and the pinion 22 is connected by a linkage (not shown) with the other of the door and frame in a known manner, so that pivoting movement of the door relative to the frame causes rotation of the pinion relative to the housing and drives the rack 20 along the axis 13 in one direction or the other. The arrangement is usually such that spring 15 urges the door towards a closed position with respect to the frame.

The piston assembly further comprises apertured discs 23 and 24 positioned within the tubular wall portion 18 immediately adjacent to respective ends of the rack 20 and joined at their peripheries to the internal surface of the wall portion 18, at least in the case of the disc 24, in a fluid-tight manner. The disc 23 acts as an abutment for the spring 15, one end of which seats on the disc 23. The disc 24 acts as an abutment for engagement by an end member 25 of the piston assembly.

There is defined between the rack 20 and the tubular wall portion 18 a space 26 which communicates with the remainder of the cavity 11 through an opening 27 formed in the tubular wall portion intermediate the ends of the rack. Adjacent to ends of the rack, the space 26 may be closed in a fluid-tight manner by the discs 23 and 24. Alternatively, an aperture may be provided at one or each end of the rack to permit flow of fluid between the space 26 and the remainder of the cavity 11. Apertures may be formed in the rack itself or defined between the rack and one or each of the discs 23 and 24. Alternatively, additional openings could be formed in the tubular wall portion 18.

For limiting movement of the end member 25 along the axis 13 in a direction away from the disc 24, there are provided further abutments in the form of lugs 28 and 29 which extend from the tubular wall portion 18 towards the axis 13. These lugs are integral with the wall portion 18, are partly severed therefrom and are then bent inwardly of the wall portion. Bending of the lugs 28 and 29 may be carried out after the end member has been assembled with other parts of the piston assembly but bending of the lugs is preferably carried out prior to case hardening of the wall portion 18 and rack 20, the end member being inserted subsequently past the lugs 28 and 29 to lie between these lugs and the disc 24. In the assembled relation of the end member 25 and remainder of the piston assembly, the lugs 28 and 29 co-operate with webs 30 of the end member to restrain turning of the end member about the axis 13.

The end member 25 carries an elastomeric O-ring seal 43 for engagement with the disc 24 to seal the end member to the disc when the end member is urged against the disc by fluid pressure. The end member defines a generally cylindrical opening 31, the axis of which coincides with the axis 13. The cylindrical surface defining the opening 31 is interrupted, at one side of the axis 13, to provide a gap 32. The gap 32 extends from that end of the opening 31 which is adjacent to the disc 24 along at least one half of the length of the opening 31 but does not extend to that end of the opening which is remote from the disc 24.

The flow control means 17 includes an apertured end cap 33 which partly closes the cavity 11 at the end thereof remote from the plate 16. There is mounted in the aperture of the end cap 33 a throttle element 34 which is rotatable relative to the end cap about the axis 13 and closes the opening in the end cap. Seals 35 are provided at the interface between the end cap and throttle element. A handle 36 is mounted rigidly on a part of the throttle element which protrudes through the end cap to the outside of the housing. That part of the throttle element which lies inside the housing carries a tube 37 which extends along the axis 13 from the throttle element into the opening 31 defined by the end

member 25. The tube is rigidly secured in the throttle element and is a sliding fit in the end member 25. The tube maintains the opening 31 of the end member in coaxial relation with the cavity 11.

The flow control means 17 defines a passage through which oil can flow from the end portion 14 of the cavity 11 into the space within the piston assembly 12. A part of this passage lies in the end cap 33 and has the form of a channel 38 formed in a surface of the end cap which is presented along the axis 13 towards the throttle element 34. At its radially inner end, the channel 38 communicates with an annular duct 39 defined between the throttle element and end cap and a bore 40 extends through the throttle element 34 and wall of the tube 37 from the annular duct 39 to the interior of the tube.

The periphery of the throttle element 34 is non-circular. That part of the periphery which lies furthest from the axis 13 is slightly further from the axis than is the radially outer end of the channel 38. Thus, the thottle element 34 can be turned relative to the end cap 33 into a position in which the channel 38 is completely covered by the throttle element. If the throttle element is turned from this position, an outer end portion of the channel 38 is exposed to provide an opening through which oil can enter the passage defined by the flow control means 17. The depth of the channel 38 increases in a direction towards the axis 13 so that the size of this opening depends upon the rotational position of the throttle element 34 relative to the end cap 33. The opening has a maximum size when that part of the periphery of the throttle element which is closest to the axis 13 overlies the channel.

The external surface of the tube 37 is generally cylindrical. There is formed on the tube at a position near to the throttle element 34 a flat 41 which enters the opening 31 of the end member 25 when the piston assembly 12 approaches the end cap 33. If the flat 41 faces towards the gap 32, then, when the flat comes into overlapping relation with the gap, these provide a relatively low resistance path for flow of fluid from the end portion 14 of the cavity 11 to the interior of the piston assembly. If the flat 41 does not face the gap 32, this low-resistance flow path is closed. Travel of the piston assembly 12 relative to the housing 10 is terminated before the flat 41 protrudes from the end of the opening 31 which is nearer to the disc 24.

By means of the handle 36, the flow control means 17 can be set in a latching condition in which the flat 41 faces the gap 32. The profile of the throttle element 34, as viewed along the axis 13, is symmetrical about an axis perpendicular to the axis 13, so that the thottle element can be set to provide an opening of a selected size into the channel 38 either with the flow control means in the latching condition or with the flow control means in a non-latching condition.

To limit the stress which can be put on the fixings used for securing the housing 10 and linkage to the door and frame, there is provided in the end member 25 a spring-loaded non-return valve 42 which will permit oil to flow directly from the end portion 14 of the cavity 11 to the space within the piston assembly 12 when the pressure differential across the valve 42 reaches a threshold value.

During manufacture of the door closer, oil is introduced into the cavity 11 to occupy the major part of that cavity. However, a pocket of air is trapped in the space 26. The volume of air which is trapped in this way is determined by the orientation of the door closer during filling with oil and by the position of the or each opening which provides communication between the space 26 and the remainder of the cavity 11. Thus, a predetermined volume of air can reliably be trapped in the space 26 prior to closing of the housing 10. Subsequent thermal expansion of the oil during use of the door closer causes the trapped air to be compressed and does not give rise to a risk of bursting the housing 10.

When the door closer is used for controlling movement of a door relative to its frame, opening of the door causes the piston assembly 12 to move along the axis 13 towards the end plate 16 and compress the spring 15. During this movement of the piston assembly, oil flows, substantially unimpeded, into the piston assembly 12 through the aperture in the disc 23 and from the interior of the piston assembly between the end member 25 and the disc 24 to the end portion 14 of the cavity. The end member will be held by fluid pressure in engagement with the lugs 28 and 29.

If the door is subsequently released, the spring 25 will drive the piston assembly 12 along the axis 13 away from the end plate 16 and thus establish within the end portion 14 of the cavity 11 a pressure which exceeds the pressure inside the piston assembly. If the channel 38 is completely covered by the throttle element 34 then flow of fluid in a direction to reduce the pressure differential will occur only as leakage between the external surface of the tubular wall portion 18 and the internal surface of the housing 10. The piston will be permitted to move only slowly.

As the piston assembly approaches the end cap 33, a small degree of overlap between the flat 41 and the gap 32 may be established, thus permitting more rapid movement of the piston and enabling the door to accelerate so that the door acquires sufficient momentum to overcome a latch.

The handle 36 may be turned from the position in which the channel 38 is substantially closed by the throttle element 34 in a first direction which increases the degree of

overlap achieved between the flat 41 and the gap 32 or in the opposite direction to set the flow control means in the non-latching condition. In each case, the size of the opening through which oil can enter the channel 38 from the end portion 14 of the cavity is increased so that the resistance to flow of fluid is decreased. If the handle is turned in either of these opposite directions through an angle of 180°, the flow control means 17 is set in a condition where the resistance to flow of fluid has a minimum value. When the resistance to flow has a minimum value, the speed at which an associated door moves will generally be such that acceleration is unnecessary to bring about operation of a latch.

It will be seen that, by means of the handle 36 alone, a user can set the door closer in a latching condition or in a non-latching condition and set the flow control means to provide a required degree of resistance to movement of the piston assembly. Indications of the alternative settings may be marked on the external face of the end cap 33 and the handle 36 may point to a selected marking.

The housing 10 may be formed from a length of a hollow extrusion. The cylindrical wall portion 18 of the piston assembly is preferably formed from a length of steel tube, to which the rack 20 and the discs 23 and 24 are secured by fusion, preferably brazing. The rack may be a sintered component. The tube 37 may be a force-fit in the recess defined by the throttle element 34 and the throttle element may be held in assembled relation with the end cap 33 by the handle 36, a portion of the throttle element 34 which protrudes through the handle being upset to secure the handle in position. The end member 33, throttle element 34 and end member 25 are conveniently formed by die-casting.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. A door control device comprising a hollow housing defining an axis, a piston disposed within the housing and movable relative to the housing along the axis and adjustable flow control means for controlling flow of fluid from a first space within the housing and between one end thereof and the piston to a second space, whereby the speed of approach of the piston towards said end of the housing can be controlled by adjustment of the flow control means, and wherein the flow control means is settable in either selected one of a first condition, called herein the latching condition, such that said speed of approach is permitted to increase abruptly when the piston reaches a predetermined position relative to the housing, and a second condition, called herein the non-latching condition, such that no abrupt increase in said speed of approach occurs as the piston approaches said end of the housing and wherein the flow control means is adjustable in each of said conditions to vary the resistance to said flow of fluid.

2. A device according to Claim 1 wherein the flow control means includes a handle accessible from outside the housing and movable to change the condition of the flow control means and to adjust the flow control means to vary the resistance to flow of fluid.

3. A device according to Claim 2 wherein the handle is turnable relative to the housing about said axis.

4. A device according to any preceding claim wherein the flow control means includes a tube which is anchored against displacement relative to the housing along said axis and co-operates with the piston.

5. A device according to Claim 4 wherein the tube is received with a sliding fit in an opening defined by the piston, the cross-sectional profile of the tube changes abruptly at a position along the tube such that said position passes into said opening defined by the piston as the piston approaches said end of the housing.

6. A device according to Claim 5 wherein the profile of the opening in a plane perpendicular to said axis varies along the axis.

7. A device according to any of Claims 4, 5 and 6 wherein the tube is turnable about said axis.

8. A device according to any preceding claim wherein the flow control means defines an opening through which flow passes and includes an associated throttle element which is adjustable relative to the opening to adjust the degree of closure of the opening.

9. A device according to Claim 8 wherein the throttle element is arranged for turning relative to the housing about said axis.

10. A device according to Claim 9 as appendant to Claim 3 wherein the throttle element is fixed with respect to the handle.

11. A device according to Claim 10 wherein said opening defined by the flow control means is formed in an end cap of the housing and the throttle element is held by the handle in assembled relation with the end cap.

12. A device according to Claim 11 as appendant to Claim 4 wherein the tube is rigidly mounted in the throttle element.

13. A door control device comprising a hollow housing which defines an axis and a piston assembly disposed within the housing and slidable relative to the housing along the axis, the piston assembly comprising a tubular wall portion and a rack disposed inside the

wall portion, wherein there is defined between the tubular wall portion and the rack a space which communicates through an opening with a further space inside the housing.

14. A device according to Claim 13 wherein said opening is in the tubular wall portion.

15. A device according to Claim 13 or Claim 14 wherein said opening is intermediate ends of the rack.

16. A device according to any one of Claims 13 to 15 wherein there are two of said openings, these being spaced apart along the piston assembly.

17. A device according to any one of Claims 13 to 16 wherein there is adjacent an end portion of the rack a further opening through which said spaces communicate.

18. A device according to any one of Claims 13 to 17 wherein said opening is provided between the rack and the tubular wall portion.

19. A door control device comprising a hollow housing defining an axis and a piston assembly which is disposed inside the housing and is slidable relative to the housing along the axis, wherein the piston assembly comprises a tubular wall portion, a rack disposed inside the tubular wall portion, an end member for controlling flow of fluid between a position outside the piston assembly and a space within the piston assembly, the end member defining at least one opening for providing communication between said position and said space, and abutments on the wall portion for limiting movement of the end member along the axis relative to the wall portion.

20. A device according to Claim 19 wherein one of said abutments is a disc disposed inside the tubular wall portion and joined thereto at the periphery of the disc in a fluid-tight manner.

21. A device according to Claim 19 or Claim 20 wherein said abutments include at least one lug integral with the tubular wall portion and extending therefrom a part of the way towards the axis.

22. A door closer substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

23. Any novel feature or novel combination of features disclosed herein and/or shown in the accompanying drawings.

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