Aug. 15, 1967 G. P. PATRIQUIN 3,335,451

LINEAR ACTING DOOR CLOSER

Filed April 23, 1965 2 Sheets-Sheet 1

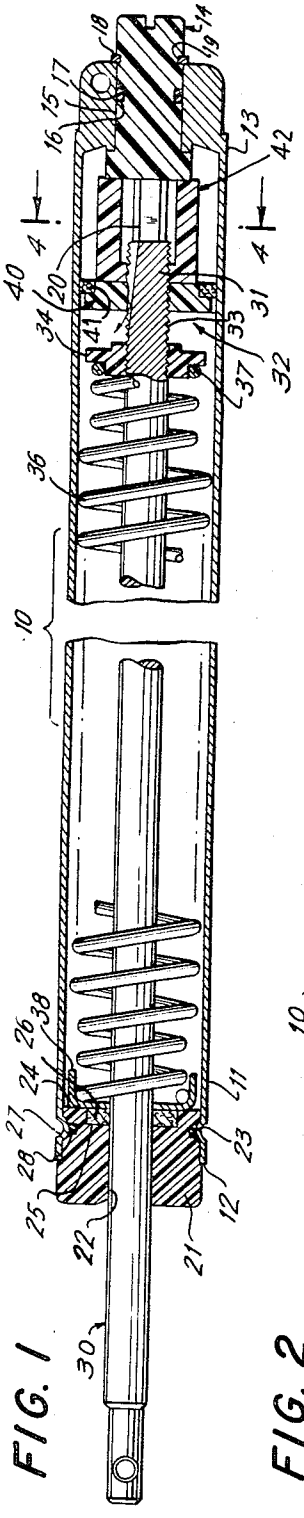


FIG. 1

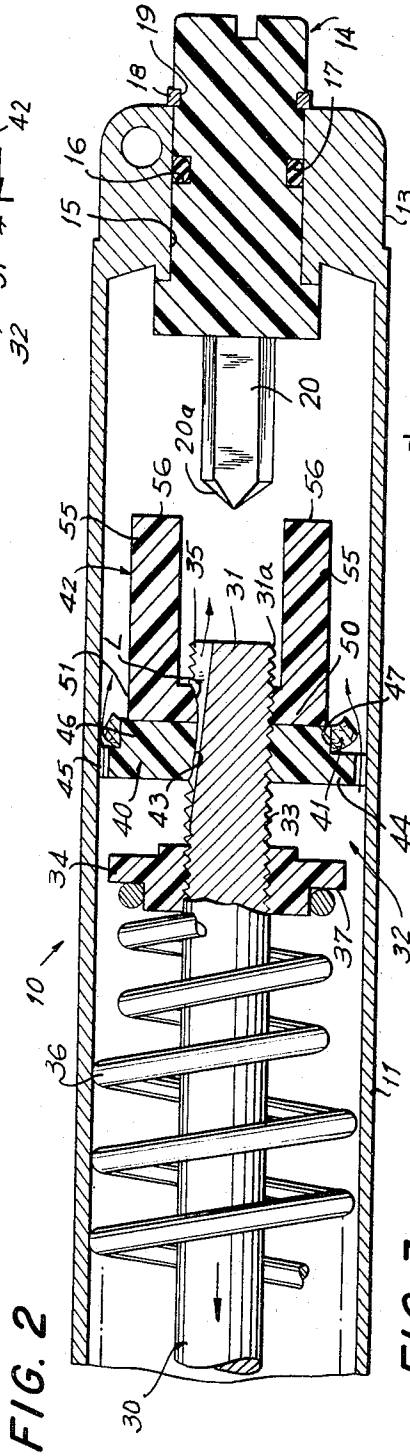


FIG. 2

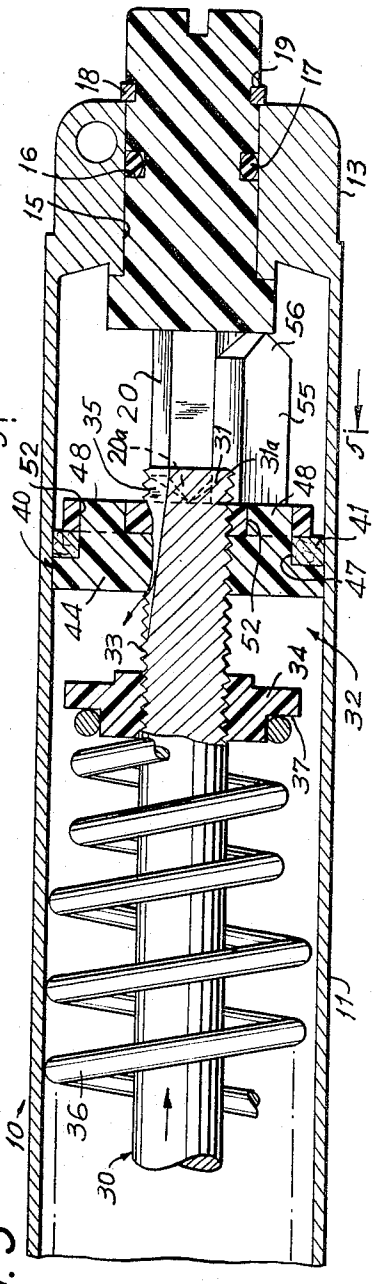


FIG. 3

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FIG. 4

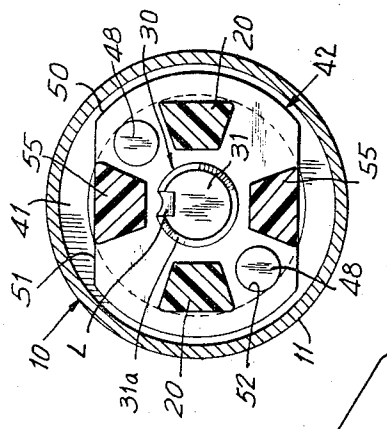


FIG. 6

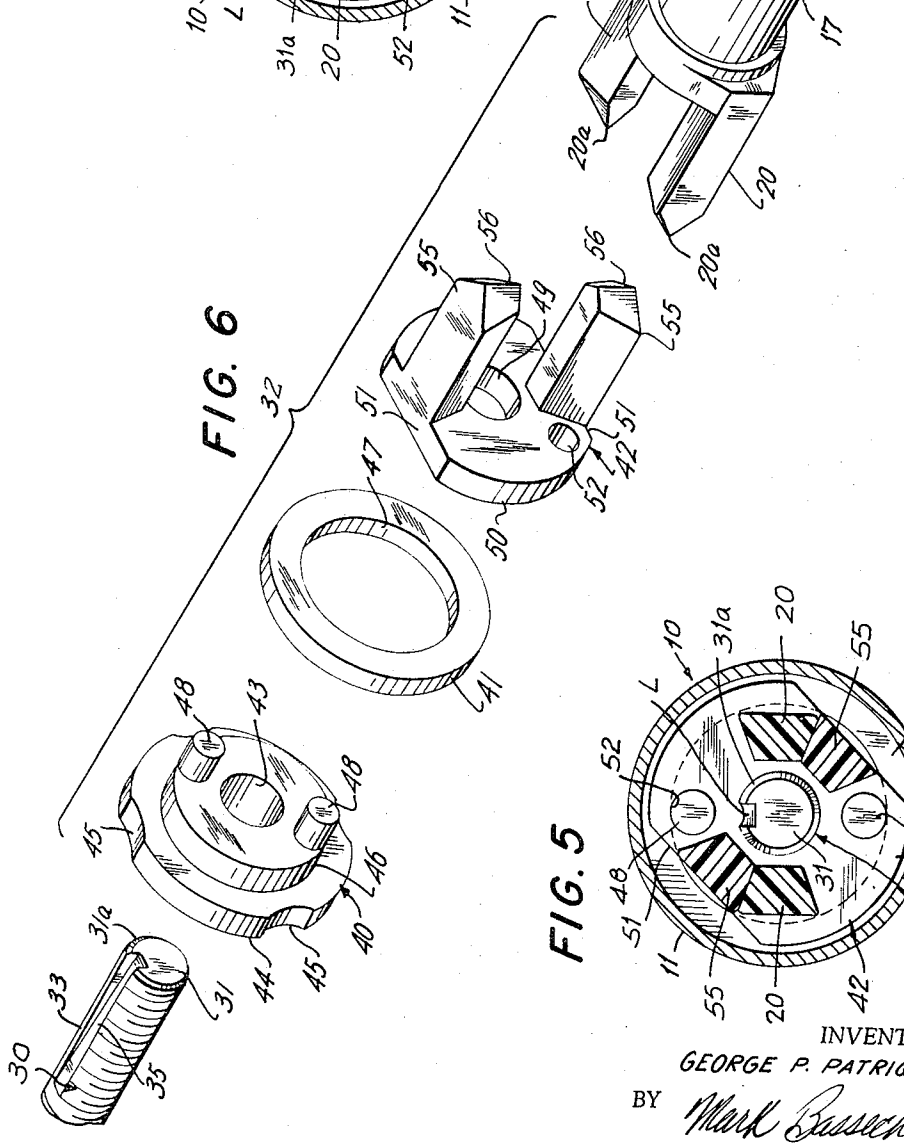


FIG. 5

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LINEAR ACTING DOOR CLOSER

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ABSTRACT OF THE DISCLOSURE

A door closer apparatus having closing speed adjustment means comprising a piston head rotatable on a threaded portion of a piston rod, the threaded portion including a variable cross section by-pass passage, adjustment being accomplished by rotating the head axially to advance the head with respect to the passage so that the head spans a variable increment of the passage, the head being formed of resilient plastics and being deformed when threaded on the rod to deflect a locking lobe into the groove, which lobe prevents inadvertent relative rotation of the head and rod.

This invention relates to a door closer device, and more particularly to a linear acting door closer of the type which is interposed between a door and door frame.

Door closers of this type typically include a piston riding within a cylinder and a spring interposed between the piston and one end of the cylinder. As the door is opened, the spring is compressed and the piston moved toward the one end. When the door is released, the spring serves to return the door to its initial closed position, there being provided damping means within the cylinder to assure slow and controlled closing of the door.

The present invention relates to an improved closing device of the type described. More particularly, the present invention relates to an inexpensive and efficient door closer of the linear acting type which may operate on either the hydraulic or pneumatic damping principle.

Still further, the present invention relates to a closer of the type described having novel and dependable means for adjusting the rate of flow of the damping fluid, and thus adjusting the closing speed of the door without the necessity for demounting the closer assembly.

This invention relates further to a device of the class described wherein the damping fluid metering setting may be readily adjusted, and when once adjusted, is substantially free from any tendency to shift from the desired adjusted position.

The invention further relates to an improved piston assembly for a device of the type described which is highly efficient in its operation and which nonetheless may be more cheaply manufactured and readily assembled than devices heretofore known.

Accordingly, it is an object of the invention to provide an improved door closer device.

It is a further object of the invention to provide an improved piston and piston head assembly for a door closer of the type described.

Still a further object of the invention is to provide a piston head assembly of the type described which consists of a few readily assembled components, advantageously manufactured of a resilient, deformable plastic composition having a high degree of plastic memory characteristic, the use of such plastic material providing functional advantages.

To attain these objects and such further objects as may appear herein or be hereinafter pointed out, I make reference to the accompanying drawing, forming a part hereof, in which:

FIGURE 1 is a longitudinal sectional view of a door closer device in accordance with the invention;

FIGURE 2 is a magnified fragmentary section of the device of FIGURE 1, showing the flow patterns of fluid in the back stroke movement of the piston;

FIGURE 3 is a view similar to FIGURE 2, showing the flow patterns in the closing movements of the piston;

FIGURE 4 is a magnified vertical section taken on the line 4—4 of FIGURE 1;

FIGURE 5 is a vertical section taken on the line 5—5 of FIGURE 3;

FIGURE 6 is an exploded isometric view of the components of the piston head assembly and the adjusting means therefor.

In accordance with the invention, there is shown in FIGURE 1 a door closer assembly **10** which comprises a cylinder member **11** having an open end **12** and a closed end **13**. An adjustment member **14** is rotatably mounted in the closed end **13** of the cylinder within an axial bore **15** formed in said closed end. The adjustment member **14** is provided with an annular groove **16**, within which is seated an O-ring **17**, forming a tight sealing fit in the bore **15**, the member being retained in position within the bore **15** by a snap ring **18** seated in an outer annular groove **19**. The adjustment member **14** includes rearwardly projecting adjustment studs **20**, **20**.

In the open end **12** of the cylinder there is mounted a bushing **21**, optionally but preferably of a low friction plastic, such as nylon, the bushing being provided with an inner bore **22** and an outer annular groove **23**. The inner face **24** of the bushing is provided with an annular recess **25**, within which is seated at a sealing washer **26**.

The bushing **21** is retained in the open end **12** of the cylinder by stamping, spinning or otherwise deforming a portion **27** of the cylinder wall into the groove **23**, a neoprene or like sealing washer **28** having previously been disposed in the groove.

A piston rod **30** is slidably passed through an aperture in the bushing **21** and carries adjacent its inner end **31**, a piston head assembly **32**. A length of the piston rod adjacent the inner end **31** is threaded as at **33**. A spring support seat member **34** is threaded over a portion **33** of the piston rod, to be disposed at a point in spaced relation to the inner end **31** of said rod. The support member **34**, which is centrally apertured, is preferably formed of a nylon plastic material, and the inner aperture thereof preferably does not have a thread formed thereon.

The inner end **31** of the piston rod adjacent the periphery thereof is provided with a beveled portion **31***a*. Additionally, the piston rod, at an area coincident with the threaded portion **33** thereof, is formed with a by-pass groove **35** which deepens progressively as it approaches end **31** of the piston rod.

I have discovered that the combination of the grooved, threaded piston rod, particularly where a beveled portion such as **31***a* is formed at the lead end, acts in the manner of a tap to deform the smooth bore portion of the spring support seat member **34** so that by merely pressing the bore against the inner end **31**, and relatively rotating these parts, an inner bore of the nylon member is deformed to permit a threaded engagement of the parts while at the same time generating a high degree of resistance to relative rotation of the parts. In other words, once the nylon member **34** has been advanced along the threaded portion **33** to a desired position, a considerable frictional resistance to backing off from the desired position is encountered.

A closer spring **36** is biased with its forward end lying against centering shoulder **37** formed on the member **34**, the rear end of said spring bearing against a centrally apertured cup member **38**. The spring **36**, which is at all times compressed, forces the rear edge of the cup mem-

ber against the gasket **26** which, as previously noted, preferably normally extends slightly outward of the recess **25** formed in the bushing **21**. It will be evident that the rearward pressure exerted by the cup member **38** under the influence of the closing spring against the forward face of the compressible sealing washer **26** will serve to urge the walls defining the inner diameter of said washer tightly against the outer periphery of the piston rod, which arrangement has been found particularly useful to eliminate possible leakage from the cylinder.

The piston head assembly **32** comprises a gasket support member **40**, a washer or gasket **41**, preferably of neoprene or a like material, and a front support member **42**. The gasket support member **40** is provided with a central, unthreaded aperture **43** of a diameter approximately equal to or slightly less than the diametric distance between the lands of the threaded portion **33** of the piston rod.

The gasket support **40** includes an outer shoulder portion **44**, the diameter of which approximates the diameter of the inner bore of the cylinder. A plurality of scalloped by-pass notches **45** are formed in the portion **44**, for purposes which will be evident from the ensuing description.

The support member **40** includes a forwardly extending annular shoulder **46** which intimately fits within the inner diameter **47** of the washer or gasket **41**. Additionally, support member **40** includes a pair of forwardly extending locking pins **48, 48**. The front support member **42** is provided with a central aperture **49**, of a size matching the apertures **43** in the gasket support member.

The front support member **42** includes a rear portion **50** formed with a pair of clearance areas **51, 51**. The front support member **42** is additionally provided with a pair of spaced apertures **52, 52** which mate, respectively, with the locking pins **48, 48** of the rear support **40**.

The piston head assembly components **40, 41, 42** are assembled on the piston rod **30** by first seating the washer gasket **41** on the shoulder **46** of the rear support member, and thereafter positioning the front support **42** on the rear support by passing the locking pins **48, 48** into the complemental apertures **52, 52** of the front support member.

With the parts thus disposed, it will be evident that no relative rotation of the front and rear support members will be permitted. Further, it will be seen that the by-pass scallops **45** of the rear support are at least partly aligned with a part of the clearance portions **51** of the front support **42**.

With the three piston head components supported in assembled condition, the composite may then be threaded onto the portion **33** of the piston rod **30**. As in the case of the spring support **34**, the apertures **43, 49** in the rear and front supports, respectively, are preferably not initially threaded and, being undersized, are deformed by the threaded area of the piston rod so as to be highly resistant to relative rotation about the rod.

Since, as will be hereinafter more fully explained, the relatively rotated position of the piston head assembly **32** on the rod **30** serves to adjust the degree of damping of the piston on its return stroke, it is extremely important that hap-hazard or accidental relative rotation of the head assembly and rod be avoided.

I have discovered that a combination of factors assures that such relative rotation will be prevented:

First, as previously explained, the tight threaded connection wherein the threads of the piston rod deform the inner bores of the nylon piston head components;

Second, the use of a plastic, such as a nylon, a long chain polyamide having a high degree of plastic memory;

Third, the provision of a spring support collar **(34)** which is independent of any connection with the piston head assembly;

Fourth, the provision of a groove **35** in the piston rod which registers with the inner bores formed in the piston head components, serving to provide a relief for the deformed or stressed plastic components.

Thus, as best seen in FIGURES 4 and 5, I have found that the tight threaded connection causes a flow of the plastic of the front and rear supports into the groove of channel **35**, to provide a hump or lobe **L** (the size of which slightly exaggerated for illustrative purposes), which greatly augments the resistance of the support components toward rotation relative to the piston rod.

I have further observed that the size or magnitude of the lobe **L** is relatively small as the support components are threaded onto the piston rod, but that once the unit is permitted to stand for a period of time, there is a slight increase or growth in size of the lobe portion, so that the resistance to turning after the piston head is assembled on the rod is greater than the turning resistance presented in initially rotating the head assembly to the desired position.

The forward support member **42** is provided with a pair of outwardly or forwardly extending adjustment prongs **55, 55**, the forward edges **56, 56** of which are beveled or chamfered. In like manner, the rearwardly extending adjustment studs **20, 20** of the adjustment member **14** are chamfered at their inner ends **20***a*, **20***a*.

In the normal or closed position of the door, it will be seen that under the action of the closer spring **36**, the piston head assembly will be urged toward the closed end **13** of the cylinder (to the right as shown in FIGURE 1) and tips or end portions **56** of the adjustment prongs **55** will bear against the adjustment member **14** at a position offset from the adjustment studs **20, 20**. The beveled portions of the studs and prongs assure that in the closing movement of the door, there will be substantially no tendency for the end portions of the studs and prongs to become engaged and thus block complete closing of the door.

As best seen in FIGURES 1, 2 and 3, the composite piston head assembly **32** spans or straddles an increment of the graduated depth by-pass groove **35**. It will be readily recognized that due to the forwardly deepening attitude of the groove, as the head assembly is shifted toward the end **31** of the piston rod, the effective area of the by-pass passage will be increased.

Conversely, if the head is moved further from the end **31**, a shallower portion of the groove will be spanned, and the effective capacity of flow through the grooce **35** will be decreased.

The relative position of the piston head **32** on the threaded portion **33** may be varied in the closed position of the door by simply rotating the adjustment member **14**. It will be evident that such rotary movement will be imparted through the driving engagement the studs **20** and the prongs **55**. In this connection, relative rotation of the piston rod **30** with respect to the cylinder is, in the mounted position of the assembly, prevented by a connector bracket (not shown) which, in such installations, is non-rotatably secured to the door frame and the piston rod proper.

From the foregoing description, it will be evident that on the rearward stroke of the piston, i.e. when the door is opened, fluid by-pass is permitted around the piston head assembly through the groove **35**. Additionally, in the course of such rearward movement, the washer **41** is, by reason of the pressure exerted against the rear face thereof, caused to flex forwardly into the clearance portions **51** of the front support member **42**, as shown in FIGURE 2. Thus, the deformation of the washer under pressure permits fluids to flow forwardly through the scallop portions **45**, over the radially deformed washer, and through the clearance portions **51**, to a position forward of the piston head.

By thus providing multiple paths for the flow of fluid around the piston head during the rearward movement of the piston, no substantial damping action is provided during the opening of the door.

When the opened door is released, it will be evident that the energy stored in compressed spring **36** will tend to return the piston toward the closed end **13** of the cylinder. In the course of such closing movement, the pressure acting against the front face of the washer **41** will serve to seat the same firmly against the portion **44** of the rear washer support, thereby forming a tight seal between the outer periphery of the washer and the inner bore of the cylinder.

It will be noted that by reason of the small size of the scallops **45**, the washer cannot be deformed during the closing stroke to an extent which would permit a by-pass between the periphery of the washer and the bore of the cylinder. Thus, on the closing stroke, the fluid is permitted to pass only through the by-pass groove **35** in the piston rod—see FIGURE 3.

While the herein described door closer assembly is useful both for pneumatic and hydraulic applications, it is primarily intended for use as an hydraulic device.

The device, and particularly the piston head assembly, consists of a minimum of parts which may be readily and inexpensively manufactured and assembled, and yet provides all of the adjustment functions normally found in more expensive and elaborate closer devices. Unlike other door closers wherein the closing speed setting is likely, after protracted use, to vary significantly, requiring repeated readjustment, the herein disclosed device, without the use of complex locking mechanisms, provides a very high resistance to movement from the set or desired position.

In the herein described device, the groove in the piston rod provides three distinct functions, namely, as an adjustable by-pass, as a tap or deforming means to facilitate threading the piston head over the rod, and to provide a relief or recess to receive a lobe of the deformable head parts to act as a more positive lock.

Having thus described the invention and illustrated its use, what is claimed as new and is desired to be secured by Letters Patent is:

1. A hydraulic door closer device comprising a cylinder having an open and a closed end, a piston rod having an outer end extending through the open end of said cylinder and mounted for sliding movement toward and away from the closed end, closer spring means in said cylinder urging said piston rod toward said closed end, a threaded portion on the inner end of said piston rod, the inner end of said rod terminating in an inwardly tapered portion, a longitudinally extended groove formed in the threaded portion of said rod, the cross-sectional area of said groove growing progressively greater at longitudinally spaced increments of said groove, a piston head assembly mounted on the threaded portion of said rod, said assembly including a gasket support portion of resilient, deformable plastic having a high degree of plastic memory and having a centrally apertured hub, the longitudinal extent of said hub being less than the length of said groove, the inner surface of the bore defining said aperture being deformed by said threaded portion to conform to the configuration of said threaded portion, the diameter of at least part of said threaded portion being greater than the diameter of said aperture, thereby to cause increments of said hub defining said aperture to flow into said groove, and adjustment means rotatably mounted in the closed end of said cylinder engaged in torque transmitting relation to said gasket support member when said support member is disposed adjacent said closed end, rotation of said adjustment means causing a concomitant rotation of said gasket support portion, thereby to shift said support portion axially along said threaded portion of said rod, whereby said support portion is variably positioned along the length of said groove, said groove and said increments of said hub defining a passage through said head assembly of variable cross sectional area in accordance with the adjusted position of said support portion along said rod.

2. A door closer assembly for mounting between a door and door frame comprising a cylinder, a piston rod extending through one end of said cylinder spring means biasing said rod toward the other end of said cylinder, and being movable toward and away from the other end of said cylinder, a threaded portion on the end of said rod adjacent said other end, a groove of gradually increasing cross-sectional area formed in said threaded portion of said rod, a piston head assembly mounted on said threaded portion and having a central aperture spanning an increment of said groove, said head being formed of a resilient, deformable plastic having a high plastic memory, the normal diameter of said aperture being no greater than the diameter across the lands of said threaded portion, whereby said head is in stressed condition when mounted on said rod and whereby parts of said stressed head flow into said groove to form a locking lobe, providing additional resistance to relative rotation of said rod and head and means for rotating said head relative to said rod, thus to axially shift said head with respect to said threaded portion and thereby vary said increment of said groove which is spanned by said aperture, thus varying the cross-sectional area defined between said groove and said locking lobe.

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