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HYDRAULIC DOOR CLOSER

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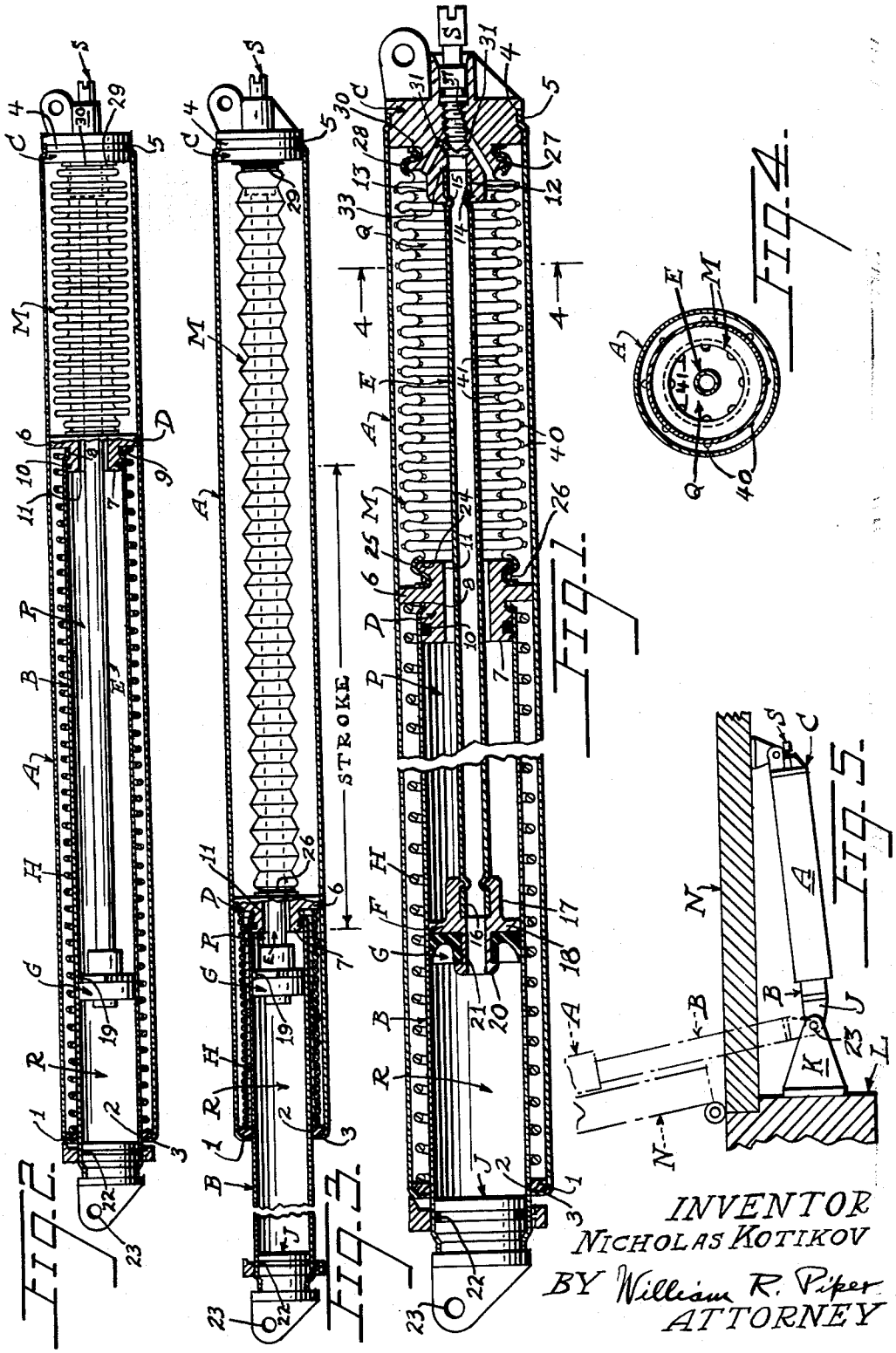


FIG. 2.

FIG. 3.

FIG. 1.

FIG. 4.

FIG. 5.

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HYDRAULIC DOOR CLOSER

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The present invention relates to a hydraulic door closer and it consists in the combinations, constructions and arrangement of parts hereinafter described and claimed.

A door closing device that makes use of compressing air within it for slowing down the closing movement of the door has the disadvantage that air is compressible and therefore the door will first be rapidly swung toward closed position by the device and then at the very end of the closing movement, the air in the device will be compressed sufficiently to slow up the final closing of the door. Often the door bounces back before closing. Hydraulic fluid has the advantage over air in that it is not compressible like air and therefore a door closer using hydraulic fluid will slow down the closing movement of the door from the very beginning. The drawback of using hydraulic door closers of the conventional type is that the hydraulic fluid will leak out during the operation of the device and the door closer finally runs dry.

The conventional hydraulic fluid door closer makes use of a piston rod that slides through a packing gland at the end of the cylinder. Every time the rod is partially pulled out of the cylinder during the opening movement of the door, a very fine film of fluid remains on the rod and the packing gland prevents this fluid film from being returned to the interior of the cylinder. In time the fluid in the device finally runs dry. Even when the piston rod is highly polished, a thin film of fluid will still be applied to the rod and the fluid will leak out of the device.

The principal object of my invention is to provide a hydraulic door closer in which the hydraulic fluid is contained in compartments that will vary in capacity during the opening and closing movement of the parts due to the opening and closing of the door to which the device is attached, but the compartments will contain all of the fluid at all times and permit none of it to escape. The device therefore cannot run dry through use.

A further object of my invention is to provide a hydraulic door closer that is simple in construction and is durable and efficient for the purpose intended.

Other objects and advantages will appear as the specification continues. The novel features of the invention will be set forth in the appended claims.

Drawing

For a better understanding of my invention, reference should be made to the accompanying drawing, forming part of this specification, in which:

FIGURE 1 is a longitudinal section through the hydraulic door closer.

FIGURE 2 is a longitudinal section on a smaller scale showing the device in closed position, certain parts of the device being shown in elevation.

FIGURE 3 is a longitudinal section on the same scale as FIGURE 2 and shows the device in open position, certain parts of the device being shown in elevation.

FIGURE 4 is a transverse section taken along the line 4—4 of FIGURE 1 and shows the device on the same scale as FIGURE 1.

FIGURE 5 is a view showing the hydraulic door closer attached to a door and door frame and shows the device and door in closed position in full lines and in open position in dot-dash lines.

While I have shown only the preferred form of my invention, it should be understood that various changes, or modifications, may be made within the scope of the annexed claims without departing from the spirit thereof.

Detailed description

In carrying out my invention I provide a hydraulic door closer which comprises an outer cylinder A. Within the outer cylinder I slidably mount an inner cylinder B. The outer cylinder A has a front bearing **1** and this bearing has an opening **2** for slidably receiving the inner cylinder B. The outer cylinder A has an inwardly curved flange **3** that receives the front bearing **1**.

The opposite end of the outer cylinder A is closed by a header C. This header has an annular recess **4** in its outer surface for receiving the inwardly crimped end **5** of the outer cylinder A. In this way the header C is secured to the outer cylinder.

Again referring to the inner cylinder, it will be seen that the right hand end is provided with a bearing sleeve D. This bearing sleeve has an annular flange **6** whose outer periphery rides on the inner surface of the outer cylinder A. The bearing sleeve D also has a cylindrical portion **7** that extends into the interior of the inner cylinder B. The cylindrical portion **7** has an outer annular groove **8** for receiving the inwardly crimped right hand end **9** of the inner cylinder B. An O ring **10** is received in an annular groove in the cylindrical portion **7** and bears against the inner surface of the inner cylinder B for forming a fluid-tight joint.

It will be seen from FIGURE 1, that I mount a hollow central piston rod E within the outer cylinder A and this rod extends through a central bore **11** in the bearing sleeve D and projects into the interior of the inner cylinder B. The right hand end of the hollow piston rod E is received in a central bore **12** provided in the header C. The cylindrical portion **13** of the header C that has the bore **12** therein, has its outer end crimped inwardly as shown at **14** for forming an inwardly extending annular rib **15** in the hollow piston rod E for staking of the rod in the header C.

The left hand end of the hollow piston rod E is received in a bore **16** provided in a cylindrical portion **17** of a piston F. The piston has an outwardly extending flange **18** whose outer periphery is formed into a polygon. The polygonal periphery provides spaces **19** for the passage of fluid from one side of the piston to the other side, see FIGURES 2 and 3.

The piston F has a cylindrical portion **20** for receiving a piston cup G preferably made of rubber or Neoprene. The cylindrical portion **20** is provided with an annular groove **21** for receiving the inner cylindrical portion of the piston cup G. The center cylindrical portion of the piston cup will have its outer edge bearing against the shoulder forming one side of the annular groove **21** and this shoulder will hold the cup in place on the piston F. The piston cup G has a long and thin outer lip that rides over the inner surface of the inner cylinder B. This thin annular lip collapses during the opening movement of the door as hereinafter explained and permits the fluid to flow from the right hand side of the piston to the left hand side.

I provide a coil spring H and mount this between the outer and inner cylinders A and B. The left hand end of the coil spring H bears against the front bearing **1** while the right hand end bears against the flange **6** of the bearing sleeve D. The coil spring H yieldingly moves the inner cylinder B into the outer cylinder A. FIGURE 1, shows the device in a closed door position and the inner cylinder is shown entirely received within the outer cylinder except for the left hand end of the inner cylinder that projects beyond the front bearing **1**.

The left hand end of the inner cylinder B is secured to a front plug J. The plug J has an annular groove and an O ring **22** is placed in the groove so as to seal the left hand end of the inner cylinder and prevent fluid leaking from the inner cylinder B and past the plug J. The plug J is provided with an opening **23** by means of which the

plug is connected to a bracket K, see FIGURE 5, which in turn is secured to a door frame L.

One of the principal features of my invention is to provide means for housing the fluid within the hydraulic door closer and sealing this fluid from escaping to the atmosphere. In other words, the fluid within the device is prevented from leaking out during the operation of the door closer and therefore the door closer will not run dry through use. To accomplish this, I provide a closed passage for the hydraulic fluid which will still permit the door closer to operate.

In FIGURE 1, I show the bearing sleeve D provided with an annular flange **24**. A flexible bellows M has a convolution **25** in its left hand end formed for receiving the annular flange **24** on the bearing sleeve D. A wrapping **26** is received in the annular groove provided at the left hand end of the bellows M and this wrapping secures the left hand end of the bellows to the bearing sleeve D and makes a fluid-tight connection. The central bore **11** in the bearing sleeve D has a diameter larger than the outer diameter of the hollow piston rod E and this will permit fluid to pass from one side of the bearing sleeve D to the other side.

The right hand end of the flexible bellows M is secured to the head C to form the liquid-tight seal therewith in the same manner as the left hand end is secured to the bearing sleeve D. The header C has an annular flange **27** for entering a right hand convolution **28** provided in the bellows M and adjacent to the right hand end of the bellows. A wrapping **29** is received in an annular groove **30** in the bellows M and secures the right hand end of the bellows to the header C for making a liquid-tight joint.

A compartment Q is provided by the bellows M, the bearing sleeve D and the header C. The compartment Q is in communication with the compartment P by means of the enlarged central bore **11** in the bearing sleeve D. The compartment Q also is in communication with passages **31** provided in the header C. FIGURE 1 shows the passages **31** communicating with the central bore **12** and this bore in turn communicates with the interior of the hollow piston rod E that leads to the compartment R. The bore **12** has an annular shoulder **33** against which the end of the piston rod E bears. An adjusting screw S has its inner end adapted to regulate the amount of fluid flowing from the passage **12** into the passages **31**. The adjusting screw is received in a threaded bore **37** provide in the header C. This flow takes place during the closing of the door as will be hereinafter explained. The adjusting screw S can be manually adjusted to control the speed at which the door will close. An O ring seals the adjusting screw S so that no fluid can leak thereby.

The compartments P, Q and R will contain the hydraulic fluid whether the door is opened or closed. As the door opens, the inner cylinder B will have its left hand end extended from the outer cylinder A, see FIGURE 3, but there will be no film of fluid on the outer surface of the exposed portion of the inner cylinder because at no time does the hydraulic fluid contact the outer surface of the inner cylinder.

When the door closure is in closed position as shown in FIGURE 2, the bellows M will be compressed and the coil spring H will be expanded. When the door N is opened, the inner cylinder B will be extended from the outer cylinder A as shown in FIGURE 5, and the flange **6** on the bearing sleeve D will move the right hand end of the coil spring H so as to compress the spring. This movement of the bearing sleeve D will expand the bellows M, but there will be no leakage of the fluid into the interior of the outer cylinder A. During the movement of the bearing sleeve D to the left in FIGURE 3, the fluid housed within the compartment P and formed by the inner cylinder B, the outer surface of the hollow piston rod E, the piston F and the bearing sleeve D will be forced past the piston cup G and the thin outer wall of the cup will collapse and permit the fluid to enter the compartment R as the compartment P is reduced in capacity. The compartment R is formed by the inner cylinder B, the front plug J and the piston F with its piston cup G. The compartment R will be increased in capacity as the compartment P is reduced in capacity.

However, when the door is released for closing it and the coil spring H tends to move the outer cylinder A so as to telescope it over the inner cylinder B, the hollow piston rod E will be moved as a unit with the outer cylinder because the two are interconnected by the header C. This will tend to cause the piston F to move to the left within the inner cylinder B, see FIGURE 3, and to decrease the capacity of the fluid compartment R. Some of the fluid in this compartment will therefore be forced through the interior of the hollow piston rod E and will flow into the passage **12** and will endeavor to enter the passages **31**. The extent that the inner end of the adjusting screw opens communication between the passage **12** and the passages **31** controls the amount of fluid entering the passages **31** and how quickly the door will be closed by the spring H. In this way a controlled opening for the flow of fluid from the fluid compartment R, through the interior of the hollow piston rod E and thence through the bore **12** and the passages **31** and to the compartment Q is provided.

It will be seen from the foregoing description that the fluid is always contained within the three fluid compartments P, Q, and R regardless of whether the door is closed or open. Also it will be seen that no fluid can contact with the outer surface of the inner cylinder B and be exposed to the atmosphere when the door is opened and a portion of the inner cylinder projects beyond the left hand end of the outer cylinder.

The flexible bellows M is shown in transverse section in FIGURE 4. The outer loops of the convolutions of the bellows are provided with outwardly extending protuberances **40**. These protuberances may be rounded or tapered and are spaced circumferentially around the outer loops. The inner loops of the convolutions are provided with inwardly extending protuberances **41** which are spaced circumferentially apart and are shaped like the protuberances **40**. The outer protuberances **40** will ride on the inner surface of the outer cylinder A before the outer loops of the bellows M contacts with this surface at any point during the expanding and contracting of the bellows. This will take place on the outer loops of the bellows. The inner protuberances **41** will ride on the outer surface of the hollow piston rod E before the inner loops of the bellows M contacts with this surface at any point during the expanding and contracting of the bellows. This will prevent wear taking place on the inner loops of the bellows.

In FIGURE 1, the two ends of the bellows M are shown in section. The portion of the bellows between these ends is also in section but the drawing indicates this portion by a singe line formed into a series of inner and outer loops rather than a double pair of lines in parallel arrangement and following the same contour. The complete showing of a sectioned bellows M in FIGURE 1 from end to end of the bellows would make the drawing more difficult to understand since the scale is so small. The scale of FIGURES 2 and 3 is too small to indicate the outer protuberances **40** and they are not illustrated in these two figures.

No ball check valve in the passage **12** in the header C is necessary if the piston cup G has a tapered outer lip that is thin enough to collapse and permit the fluid to flow directly from the compartment P into the compartment R during the opening of the door and the movement of the piston F to the right in the inner cylinder B. If the piston cup G should have a thick annular lip that cannot collapse to permit fluid to pass thereby during

the opening movement of the door, then a ball check valve, not shown, in the passage **12** would be needed.

I claim:

1. A hydraulic door closer comprising:

(a) an outer elongated cylinder open at one end;

(b) an inner cylinder slidably mounted in said open end and having its inner end extending into said outer cylinder; said inner cylinder being movable to have a portion project from the outer cylinder;

(c) a bearing sleeve slidably mounted in said outer cylinder and having the inner end of said inner cylinder hermetically sealed thereto;

(d) a header closing the opposite end of said outer cylinder and having a central bore;

(e) a hollow piston rod having one end secured to said header, the interior of said piston rod communicating with the central bore in said header;

(f) said bearing sleeve having a central opening for receiving said hollow piston rod and being of a larger diameter than the outer diameter of said piston rod;

(g) a piston mounted on the end of said hollow piston rod that is disposed opposite to the end connected to said header, said piston having a central opening communicating with the interior of said hollow piston rod;

(h) a coil spring disposed between said outer and inner cylinders and bearing against said bearing sleeve for yieldingly urging said sleeve toward said header for moving said inner cylinder within said outer cylinder;

(i) a flexible bellows enclosing said hollow piston rod and having one end hermetically sealed to said bearing sleeve so as to enclose the central opening in said sleeve and having its other end hermetically sealed to said header;

(j) said header having a valve-controlled fluid passage opening into a first fluid receiving compartment bounded by said bellows, bearing sleeve, the exterior surface of said hollow piston, and said header, said fluid passage also communicating with the central bore in said header;

(k) a second fluid-receiving compartment bounded by the inner surface of said inner cylinder and the outer surface of said hollow piston rod and by said piston and by said bearing sleeve, the second compartment being in communication with said first-named compartment by the central bore in said bearing sleeve;

(l) a third fluid-receiving compartment bounded by the inner surface of said inner cylinder and by said piston and by a plug hermetically sealing the outer end of said inner cylinder; said third compartment being in communication with the interior of said hollow piston rod; and

(m) said three compartments being filled with fluid and being hermetically sealed for preventing the escape of fluid and for preventing any fluid from contacting with the outer surface of said inner cylinder; whereby no film of fluid will collect on the portion of the outer surface of said inner cylinder that is extendible from said outer cylinder.

2. The combination as set forth in claim **1**: and in which

(a) said bellows has outwardly extending looped portions provided with outwardly extending projections that will prevent said outwardly looped portions from contacting with the inner surface of said outer cylinder; and

(b) said bellows has inwardly extending looped portions provided with inwardly extending projections that will prevent said inwardly looped portions from contacting with the outer surface of said hollow piston rod.

3. In a hydraulic door closer;

(a) an outer cylinder having an open end;

(b) an inner cylinder slidable in said open end and extending into said outer cylinder; said inner cylinder being movable to have a portion project from the outer cylinder;

(c) a bearing sleeve slidable in said outer cylinder and having the inner end of said inner cylinder hermetically sealed thereto;

(d) a header closing the outer cylinder at the end opposite said open end;

(e) a hollow piston rod having one end secured to said header and extending through a central bore in said bearing sleeve;

(f) a bellows enclosing the portion of said hollow piston rod disposed between said bearing sleeve and said header and having one end hermetically sealed to said bearing sleeve so as to enclose the central bore therein and having its other end hermetically sealed to said header;

(g) said header having valve-controlled passages placing the interior of said hollow piston rod in communication with the interior of said bellows;

(h) a piston mounted on the free end of said hollow piston rod and being slidably mounted in said inner cylinder, said piston having a central bore communicating with the interior of said hollow piston rod;

(i) a plug hermetically sealing the outer end of said inner cylinder; and

(j) a fluid filling the inner cylinder on both sides of said piston and filling the interior of said bellows and the interior of said hollow piston rod; said bellows preventing the fluid from escaping to the outer surface of said inner cylinder.

4. The combination as set forth in claim **3**: and in which

(a) a piston cup is mounted on said piston and has a flexible rim that permits fluid to flow past the cup when said bearing sleeve is moved toward said piston, said piston having passages in its periphery permitting fluid to flow thereby;

(b) said piston cup preventing any flow of fluid past the piston in the opposite direction when said bearing sleeve is moved away from said piston during the inward movement of said inner cylinder into said outer cylinder.

5. The combination as set forth in claim **4**: and in which

(a) said bellows will elongate during the movement of said bearing sleeve toward said piston and will still have its ends hermteically sealed to said bearing sleeve and said header so as to prevent any leakage of fluid into the interior of said outer cylinder.

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