May 31, 1955 H. F. HOLM ET AL 2,709,450

PNEUMATIC TIMING DEVICE

Filed April 20, 1953

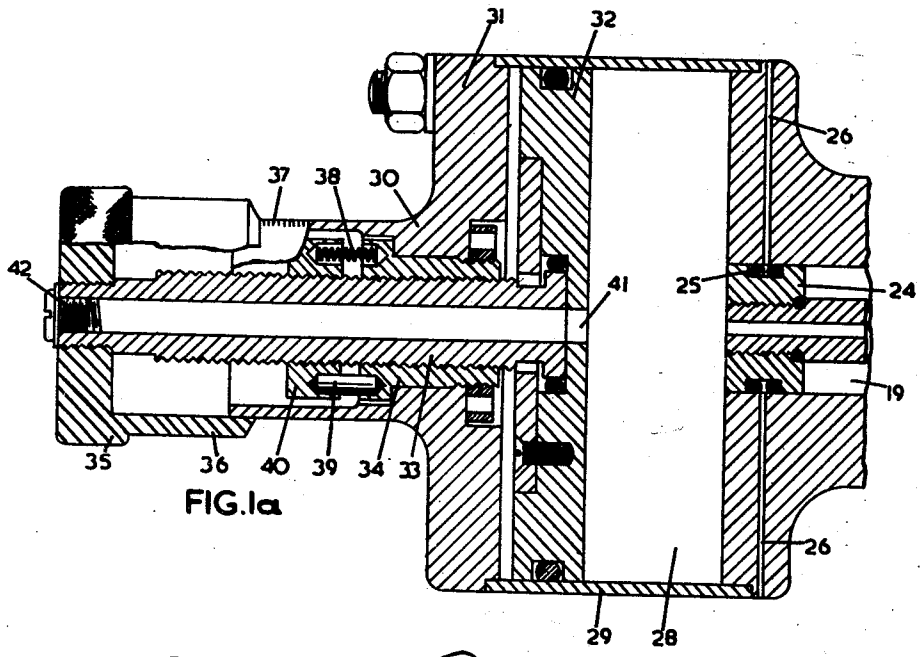


FIG.1a

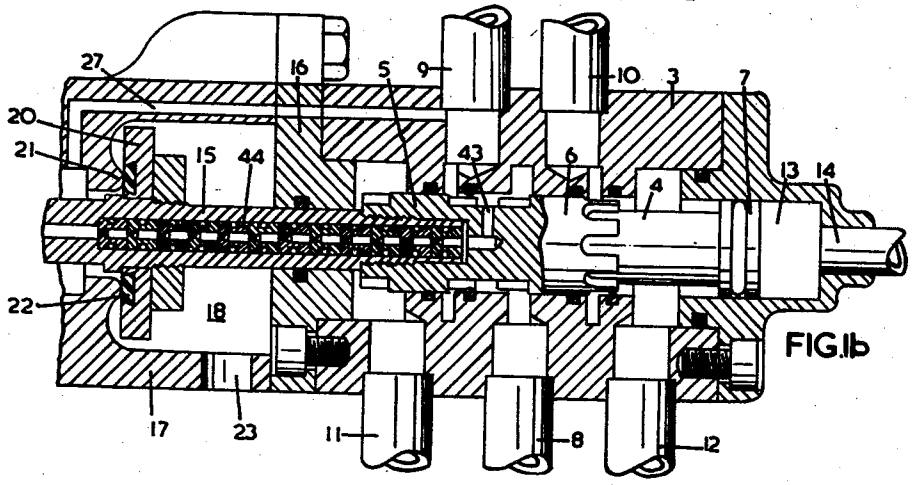


FIG.1b

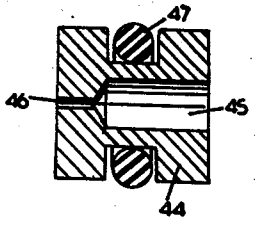


FIG 2

INVENTORS

H. F. HOLM &

N. F. HOPPE

BY Mawhinney & Mawhinney

ATTYS.

United States Patent Office 2,709,450 Patented May 31, 1955

2,709,450

PNEUMATIC TIMING DEVICE

Hans Feser Holm and Nils Ferdinand Hoppe, Stockholm, Sweden, assignors to Smallpiece Limited, Richmond, England

Application April 20, 1953, Serial No. 349,798

5 Claims. (Cl. 137—622.5)

This invention relates to a pneumatic timing device which essentially consists of a control valve of which the valve member is moved between two end positions (in which two outlet conduits are respectively supplied with fluid pressure) by alternately applying fluid pressure to chambers at the ends of the valve member.

Such a pneumatic timing device or control valve may be used for supplying the fluid pressure through its outlet conduits alternately to opposite sides of a double-acting piston movable in a cylinder.

The main object of the invention is to ensure that, after a working stroke of the valve member to one end position, it shall automatically be returned to its other end position after a predetermined time lag.

According to the invention, one of the said end chambers is placed in communication with the fluid pressure through a narrow restricted duct, when the valve member has been moved to the said one end position (i. e., towards the end chamber in question) by the application of the fluid pressure to the other of the said end chambers, whereby a pressure is gradually built up in the said one chamber until it reaches a value which is sufficient to effect the return of the valve member to its original end position after overcoming an initial resistance against the return movement of the valve member.

The narrow restricted duct may contain a number of removable liners each with a bleed hole therein. The volume of the said one chamber may be adjustable by means of a movable piston in the chamber, so that the return movement of the valve member can be delayed by increasing the volume of the chamber, and vice versa.

In the accompanying rather diagrammatic drawings:

Figure 1A and Figure 1B jointly represent a control valve with an adjustable end chamber according to the invention, Figure 1A constituting the left-hand end and Figure 1B the right-hand end; and

Figure 2 is an enlarged sectional view of a liner for the narrow restricting duct.

The right-hand portion of the control valve (i. e., Figure 1B) comprises a housing 3 in which the valve member reciprocates. The valve member includes a piston rod 4 with a number of pistons 5, 6 and 7 thereon. 8 represents a pressure supply conduit, and 9 and 10 are pressure outlet conduits, whilst the conduits 11, 12 on opposite sides of the conduit 8 lead to exhaust.

As will be well understood, the outlet conduits 9 and 10 may lead to the opposite ends of a double-acting pressure-responsive device such as is shown in both of my Patents Nos. 2,688,314 and 2,689,548.

The valve member is shown in its extreme left-hand position, in which there is a cylindrical chamber 13 at the right-hand end of the piston 7, this chamber being supplied with fluid pressure by a conduit 14. Such pressure may be supplied through a three-way impulse valve which is normally open to exhaust but which on operation against a return spring delivers the fluid pressure to the chamber 13 to move the valve member to the position shown. Such an impulse valve is not shown in the present instance, being of a well-known kind. It is, however, illustrated in the drawings of both the aforesaid patents.

It is known to form the left-hand end of the valve casing and valve member in a similar manner to the right-hand end; but, in the present instance, the end chamber at the left-hand end of the valve member is a large one, as hereinafter described. Thus, the piston rod 4 terminates just beyond the piston 5, the left-hand end of the piston rod having an axially-extending threaded bore into which a tubular extension 15 is secured by screwing. The said extension is sealingly slidable in a hole in a wall 16 which is secured in any convenient manner to the left-hand end of the valve housing 3, the extension extending into a housing 17. The housing 17 has adjacent the wall 16 a space 18 of relatively large cross-section, and, further along, a bore 19 of less cross-section. A ring 20 of a size to operate in the space 18 is secured to the extension 15, the ring being provided in one face with a rubber or like sealing ring 22 which is shown as making a sealing engagement with an annular re-entrant edge 21 of the housing 17. The chamber 18 has an exhaust opening 23.

At the extremity of the extension 15 (see Figure 1A) is secured a piston 24 which is slidable in the cylindrical space 19, the piston carrying packing rings 25 in a peripheral groove. When the piston 24 is in the position shown in the drawings, the piston and packing rings seal the adjacent ends of radial exhaust ducts 26 passing through the housing 17. (In the other extreme position of the valve member and piston 24, the radial ducts 26 are clear of the piston and communicate with the cylindrical space 19 on the left-hand side of the piston.)

The cylindrical space 19 on the right-hand side of the piston 24, as shown, communicates with the pressure outlet conduit 9 by way of a duct 27, the outlet 9 being in communication with the supply conduit 8, whilst the outlet 10 is in communication with the exhaust 12.

Adjacent the face of the piston 24 is a large chamber 28. This chamber is bounded by the end wall of the housing 17, by a hollow cylinder casing 29, and by an end wall at the other end of the casing 29 which is provided by a cap 30 having a securing flange 31. An adjustable piston 32 is mounted in the chamber 28, whereby to vary the volume of the end of the chamber adjacent the piston 24. In the arrangement shown, the piston 32 is rotatively connected to one end of an externally-threaded tube 33 which has a screw-threaded engagement with a ring 34 fast with the cap 30. The other end of the tube 33 carries a knob 35 fast with a sleeve 36 which embraces the outer end of the cap 30. The position of the piston 32 within the chamber 28 can be read on a scale 37 on the outside of the cap.

Compression springs 38 and dowel pins 39 are carried in openings on opposite sides of the ring 34 and of another ring 40 which also has a threaded engagement with the tube 33, whereby any wear in the threads is taken up.

The inner end of the tube 33 communicates with the chamber 28 through a hole 41 in the piston 32, and its other end is closed by a plug 42. The bore of the tube 33 thus forms, in effect, part of the volume between the piston 32 and the wall 17. If a larger volume is required at any time, the plug 42 can be removed and that end of the tube can be coupled to an appropriate container.

In the present instance, the aforesaid extension 15 is a hollow one, its interior communicating by a duct 43 in the piston rod 4 with the supply pressure conduit 8, the duct being between the pistons 5 and 6. The tube 15 has a relatively large bore containing a number of restricting liners 44 placed end-to-end to limit the supply of air to the chamber 28. One of these liners is

shown to a larger scale in Figure 2 as consisting of a cylinder with a central bore 45 which leads to a bleed hole 46—having a diameter, for example, of about 0.15 mm. The cylinder has a peripheral groove carrying a packing ring 47.

In order to obtain a sufficiently slow supply of air pressure to the chamber 28 with a single liner, it would be necessary for that liner to have a bleed hole of a diameter about ten times less than that of the bleed holes 46 of the liners 44, and with such a minute bleed hole there would always be a risk of a blockage occurring. Furthermore, by using a relatively large number of liners 44 as shown, their cleaning is facilitated, and, in addition, it is possible to vary the air supply by varying the number of liners used.

The arrangement described operates in the following manner:

As mentioned above, the tube 15 with the liners 44 is connected to the supply pressure conduit 8 whereby air pressure continuously leaks to the chamber 28. So long as the valve member of the control valve and the piston 24 are in the right-hand position (opposite to that shown), the outlet conduit 10 is in communication with the pressure supply conduit 8 and the ducts 26 are open, and a rise in pressure does not occur in the chamber 28. The amount of such leakage air is, from an economic point of view, insignificant.

If the valve member is now moved to the left, to the position shown in the drawings, the ducts 26 are closed so that the pressure in the chamber 28 is slowly increased. At the same time the pressure conduit 8 is also connected with the outlet conduit 9, and thus the air pressure is also supplied to the space 19 behind the piston 24 through the relatively large duct 27, so that the pressure in this space almost immediately reaches the full value, that is to say, the same as the pressure in the conduit 8. Since the rear of the piston 24 has a larger surface than the exposed surface of the ring 20 which is acted on by pressure in the space 19, the packing ring 22 will be firmly pressed against the edge 21. This pressure between the edge and packing ring must therefore first be overcome before the piston rod 4 can again be moved to the right, and this takes place when the pressure in the chamber 28 reaches the required high value—which, according to the position of the piston 32 and the number of liners 44, may take between a few seconds and a few minutes. When the pressure on the front of the piston 24 is so great that the piston is moved backwards, the packing ring 22 is moved away from the edge 21 whereupon the pressure in the space 19 is discharged via the space 18 and outlet 23. As the resistance against the return movement of the valve member disappears completely, the valve member is immediately returned to the right end position, which is of fundamental importance for obtaining a rapid changeover. The pressure in the chamber 28 is discharged through the now open ducts 26 and the valve is then ready for carrying out a fresh operation, when pressure is again supplied through the conduit 14.

The invention is of course not limited to the example shown in the drawing. Thus, the resistance against the return stroke, acting on the rear of the piston 24, need not be brought about by air pressure, but could be provided by means of a spring arrangement, or by means of a ratchet member which holds the piston with a certain force in the regulated end position until a slight movement of the piston occurs. The bleed holes 46 for the supply of pressure medium to the chamber 28 need not necessarily be in liners mounted in the extension 15 of the valve member, but can instead be taken in other ways from the conduit 9, in which case it is supplied only after the movement of the valve member towards the chamber 28.

What we claim as our invention and desire to secure by Letters Patent of the United States is:

1. A control valve having a valve member, a valve casing in which the valve member is slidable between two end positions, outlet conduits of the valve casing which are respectively connected by the valve member with a source of fluid pressure in the respective end positions of the valve member, a piston at one end of the valve member, said piston working in a bore of said casing which communicates at its outer end with a relatively large chamber, said piston having an annular inner end, valve means coacting between said valve member and said casing inwardly of said piston, means for moving the valve member to one end position in which said piston is adjacent said large chamber and said valve means is closed, means admitting fluid pressure to act on said inner annular end of said piston to hold said valve means closed and to hold said piston in its position adjacent said chamber, and means for supplying the fluid pressure to said chamber through a restricted passage whereby the pressure in said chamber will build up with a time lag until the pressure therein acting on the outer end of said piston will overcome the pressure acting on its inner annular end and effect the return movement of the valve member.

2. A control valve having a valve casing, a valve member slidable therein between two end positions, a pressure supply conduit and two outlet conduits connected to the valve casing, the valve member arranged so that the pressure supply conduit will be connected to a different one of the two outlet conduits in each of the end positions of the valve member, a first piston at one end of said valve member and working in a first bore of said casing, means admitting fluid pressure to act on said first piston for moving the valve member to opposite end position, a second piston fast at the other end of said valve member and working in a second bore of said casing, said second bore communicating at its outer end with a relatively large chamber and said second piston having an annular inner end, valve means coacting between said valve member and said casing inwardly of said second piston, means admitting fluid pressure to act on said inner annular end of said second piston to hold said valve means closed and to hold said second piston adjacent said chamber, and means including a restricted passage extending between said supply conduit and said chamber whereby pressure in said chamber will build up with a time lag until the pressure therein acting on an outer end of said second piston will exceed the fluid pressure acting on its inner annular end thereby to effect the return movement of the valve member.

3. A control valve, according to claim 2, in which said chamber is a cylindrical one bounded at its end remote from the second piston by an adjustable piston whereby the operative size of the chamber, and thereby the time-lag, may be varied.

4. A control valve, according to claim 2, in which the second piston operates in a cylindrical bore which in said opposite end position of the valve member has one end closed by the inner annular end of said second piston, the opposite end of said cylindrical bore being sealed from exhaust by the valve means, said second piston in its said opposite end position closing exhaust passages for said chamber.

5. A control valve, according to claim 2, in which the restricted passage is provided in an extension of the valve member leading to the second piston, the restricted passage incorporating a plurality of liners arranged end to end and each having a bleed hole in it.

References Cited in the file of this patent

UNITED STATES PATENTS

193,800	Boyle	Aug. 7, 1877
1,896,950	Groeniger	Feb. 7, 1933
2,637,303	Cintron	May 5, 1953
2,646,074	Hopkins	July 21, 1953
2,661,766	Adams	Dec. 8, 1953

FOREIGN PATENTS

119,666	Australia	1943