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C. C. WHITTAKER ET AL

2,442,030

TORPEDO CONTROL SWITCH

Filed Nov. 24, 1943

2 Sheets-Sheet 1

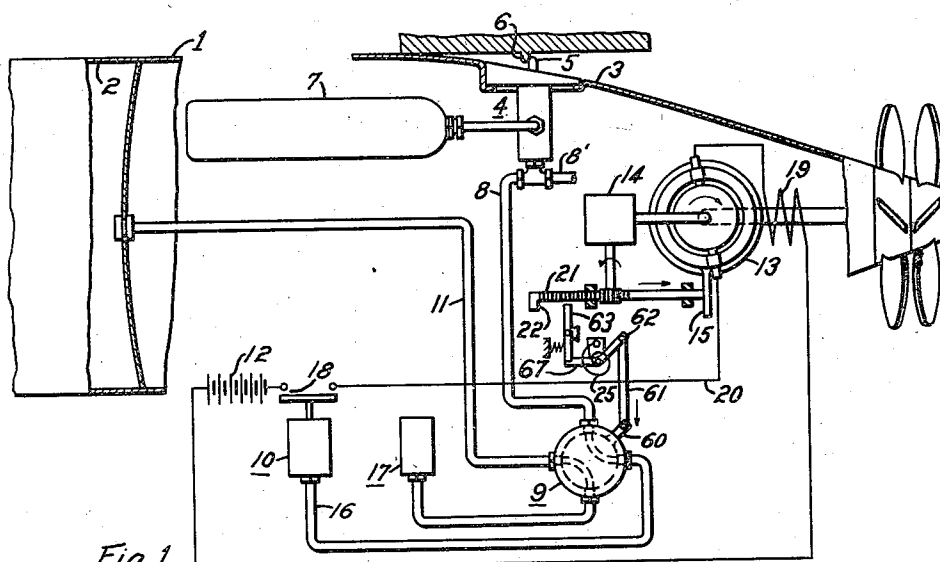


Fig. 1.

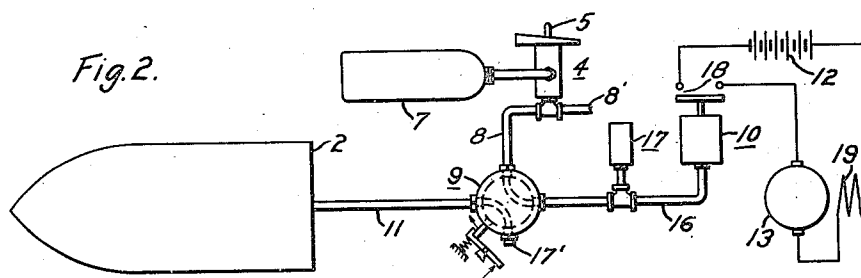


Fig. 2.

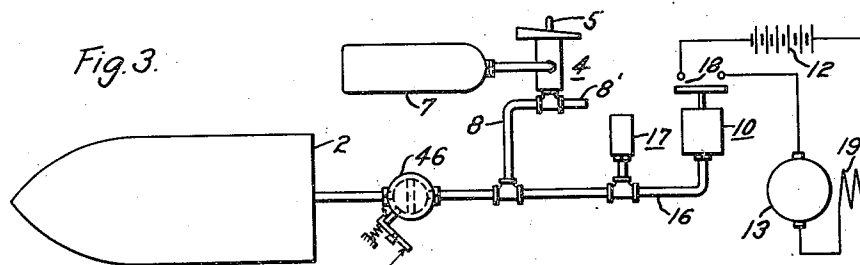


Fig. 3.

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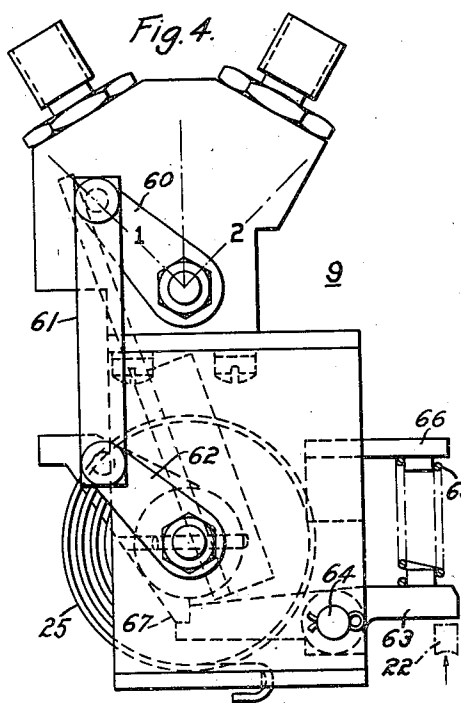
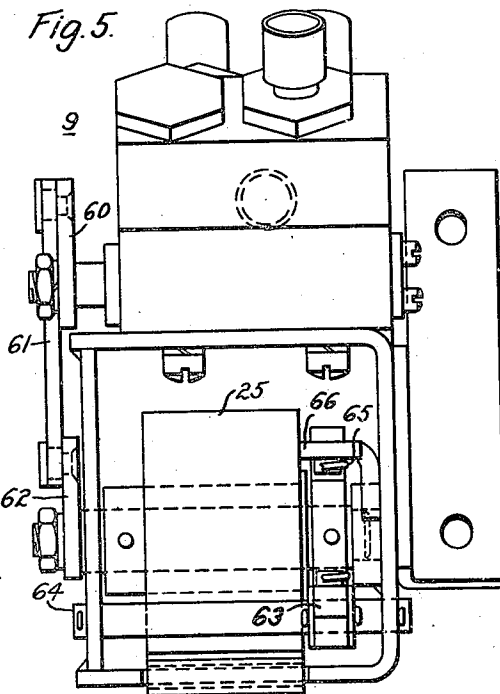
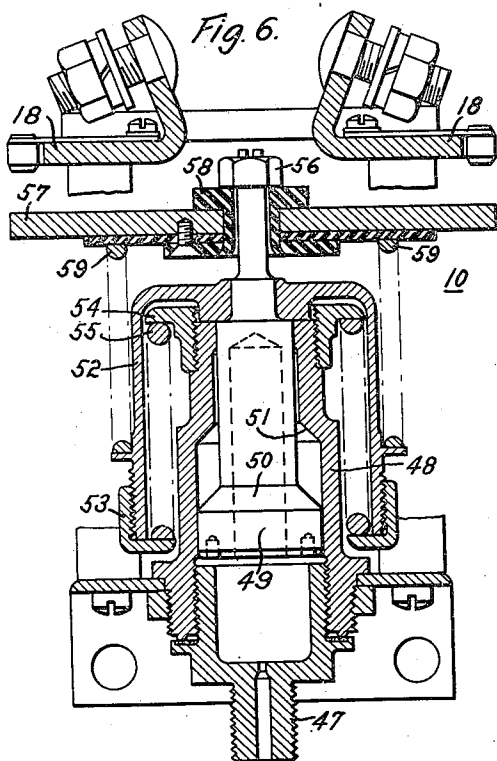
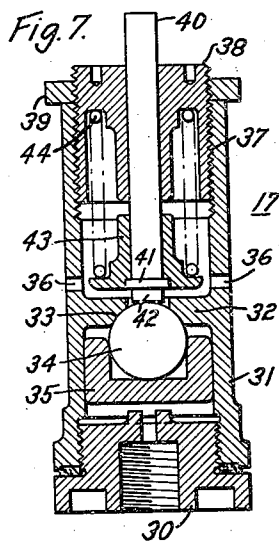
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2 Sheets-Sheet 2



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TORPEDO CONTROL SWITCH

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7 Claims. (Cl. 200—82)

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Our invention relates to a system of control, and more particularly to certain elements utilized in a system of control for a torpedo.

The present war has brought into use the electrically driven torpedo but in such torpedoes for certain operations gas flasks are still necessary for the operation of certain devices. While it is ordinarily not important to provide for certain specific operations, as the disconnection of an electric motor from the propulsion means, on the final run, it does become rather important how the system of control is utilized for a torpedo during exercise runs.

Further, since space is at a premium in a torpedo so that a maximum explosive charge may be carried, all of the devices must be relatively small, compact and yet sufficiently inexpensive not to raise the cost of a torpedo to excessive figures.

One object of our invention is the provision of a system of control for an electrically driven torpedo wherein the source of energy to the propulsion motor is disconnected a substantially definite time interval after a predetermined run of the torpedo has been completed.

A broad object of our invention is the provision of means for facilitating the recovery of a torpedo at the end of an exercise run.

A more specific object of our invention is the provision of pneumatic time limit means for rapidly effecting the opening of a pneumatically operated electric switch when the pressure for actuating the switch decreases to a given value.

It is an object of our invention to provide a pneumatically operable switch which is compact, rugged and inexpensive.

Another object of our invention is the provision of a low pressure relief valve in a pneumatic system which causes a rapid decrease of the pressure in the pneumatic system when the pressure in such system decreases below a given value.

The objects hereinbefore recited are merely illustrative, because many other objects and advantages will become apparent from a study of the following specification and the accompanying drawings, in which:

Figure 1 is a schematic showing of our system of control for facilitating the propulsion of a torpedo for a given length of time and the recovery of the torpedo at the end of a run;

Figs. 2 and 3 are showings even more schematic than those in Fig. 1, illustrating modifications of our system of control;

Fig. 4 is a side view of a four-way valve utilized in our system of control;

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Fig. 5 is an end view of the subject matter shown in Fig. 4;

Fig. 6 is a longitudinal sectional view of a pneumatically operable switch; and

Fig. 7 is a longitudinal sectional view of a low pressure relief valve.

Referring to Fig. 1, 1 designates the torpedo having the exercise head 2 attached thereto, 3 designates the after-body of the torpedo in the region of the starting valve 4. This starting valve 4 is provided with a trigger arm 5 coacting with the dog 6 on the torpedo tube and this valve is designed to be opened at the operation of arm 5 when the torpedo is fired. For the operation of the pneumatic devices a gas flask 7, which may contain air under high pressure as 3000 to 4000 pounds per square inch, is utilized. This flask is connected to the valve 4 actuated by the starting trigger 5 and, when opened, supplies air under pressure to the four-way valve 9 and thence to the pneumatic switch 10 during one stage of operation and for another stage of operation to the four-way valve 9, and thence through the tube 11 to the interior of the exercise head 2.

A battery 12 is utilized for supplying the energy to the propulsion motor 13. This propulsion motor 13 is of the series type having no commutating poles but is controlled for operation at constant speed by the governor mechanism 14 for shifting the brush ring 15 so that constant motor speed is maintained.

The four-way valve is also designed to be operated by the governor mechanism to shift the four-way valve from the connection shown to such a connection that the flask 7 is connected to the chamber of the exercise head and the conduit 16, for supplying the pneumatic switch with gas pressure, is connected to the pressure relief valve 17.

A better understanding of some of the details of our invention can probably be had from a study of a typical sequence of operation during an exercise run. This operation is as follows: The instant the torpedo is fired, the lever arm 5 is actuated by the dog 6 and the valve 4 is opened whereupon gas from the flask 7 under high pressure is admitted to the conduits 8 and 8'. The conduit 8' leads to various devices on the torpedo having no connection with the invention herein described. The conduit 8 leads to the four-way valve 9 and, as shown by the broken lines, provides gas pressure to the pneumatically operated switch 10 which is thereupon operated with a short time delay to close the contacts 18 to thus establish a circuit from the battery 12 through

the motor field winding 19, the motor armature, conductor 20, contacts 18 back to the battery 12. The motor thus, a very short time after the torpedo leaves the firing tube, assumes the propulsion of the torpedo driving it through suitable gyroscopic controls towards the target. If an exercise run is only contemplated, no war head is used, but the exercise head 2 is used.

The governor mechanism 14 through suitable gearing operates the stem 21 toward the right shifting the brushes to maintain the motor at a constant speed. After the run is substantially completed, the dog 22 on stem 21 actuates the latch lever 63 to release the lever arm 67 coupled to the relatively strong spring 25 which is under considerable stress. This spring causes the four-way valve to rapidly rotate in a clockwise direction connecting the conduit 8 to the conduit 11, thus driving the ballast water from the exercise head and making the torpedo buoyant so that recovery may be facilitated.

It is important that the switch contacts 18 and other devices may not be injured by a slow operation of the pneumatic switch 10. The conduit 16 therefore by the operation of the four-way valve 9 is connected to the low pressure relief valve 17. This low pressure relief valve 17 after a substantially predetermined interval of time, namely, at a predetermined pressure in conduit 16 suddenly dumps the pressure in this conduit 16, thus permitting a rapid opening of the contact members 18 of the pneumatic switch 10.

The low pressure relief valve (referring to Fig. 7) is provided with a base 30 for connection to the pneumatic system and for connection to the cylindrical portion 31 of the valve. This cylindrical portion is divided in two chambers by a partition 32 provided with the valve seat 33 for receiving a ball valve 34. This ball is held within a cup-shaped piston 35 disposed in the lower chamber of the cylindrical valve construction. The upper chamber is provided with discharge openings 36 and has internal threads 37 for receiving the valve adjusting nut 38. This nut once adjusted may be held in adjusted position by the lock nut 39. This nut further has an axial opening for receiving the stem 40 provided with the rim 41 at the base and the projection 42 therebelow, contacting with the upper surface of the ball valve 34. A spring supporting collar 43 rests on the rim 41 and against the lower or downwardly facing region of the adjusting nut 38. The downwardly facing region is provided with an annular chamber so that a spring 44 may be supported between the collar and the base of the chamber in nut 38. This spring is selected to have a predetermined strength and by means of suitable adjustment of the nut 33 may be caused to press downwardly on the ball valve 38 with a predetermined force.

This low pressure relief valve is designed to have a relatively slow leak past the ball valve 34, so that the pressure in the lower chamber once the pressure of the flask is removed is caused to disappear slowly, but when this pressure in the lower chamber has decreased to a sufficiently low value the pressure on the lower portion of the ball valve becomes less than the pressure of the projection 42 acted upon by the spring 44. Then the ball valve 34 is moved downwardly and the lower chamber of the relief valve is open directly to the discharge openings 36, thus dumping the pressure in the lower chamber.

This lower chamber, as shown in Fig. 1, is connected to the conduit 16 supplying pressure to

the pneumatically operable switch 10. It is thus apparent that although the pressure in conduit 16 at the instant the four-way valve 9 is operated may be 3000 pounds per square inch, it will slowly be dissipated by the pressure relief valve 17 and once the pressure has dropped to a given low value which may be 350 to 400 pounds per square inch, the pressure for maintaining the pneumatically operable switch closed is suddenly removed and the switch contacts 18 are rapidly opened.

With the high pressures encountered, the pressure relief valve can usually be depended upon without special design to effect the operation of the switch 10 within a relatively short time, as 15 to 20 seconds. If, however, it is feared that this valve may actually be perfectly gas tight and that the pneumatically operable switch be also perfectly gas tight, then a restricted exhaust port may be provided in the system supplying pressure to the switch. In Fig. 2, we have shown this restricted opening 17' at the four-way valve so that when the four-way valve is operated to the position to supply the gas to the exercise head, conduit 16 is connected to the port 17. At such time the conduit supplying pressure to the switch is connected to the restricted exhaust port in the four-way valve, and since, as shown, the low pressure relief valve is interconnected with this conduit, it will also function to cause rapid operation of this switch.

In Fig. 3, we have shown a scheme of control not requiring a four-way valve. In this case, the valve 46 is a simple valve for merely opening the connection of the flask to the exercise head. It will be noted that in this case the switch remains connected to the flask, but since substantially all of the gas under pressure from the flask is utilized to expel the ballast water from the exercise head, the pressure will naturally drop in the pneumatic system and after a given time the low pressure relief valve will function to rapidly effect the operation of the pneumatically operable switch.

The pneumatically operable switch comprises a connection 47 to be connected to the conduit 16, a cylinder 48 for housing the piston 49. This piston is designed as a valve at the region 50 and coacts with the valve seat 51 in the region of the mid portion of the cylinder 48. The reduced upper end of the piston is rigidly connected to the inverted cup-shaped member 52 having the reentrant shoulder connection 53. The upper outer portion of the cylinder is provided with a collar 54 and a spring 55 under compression is disposed between the collar 54 and the reentrant shoulder connection to thus normally hold the piston in the position shown.

The piston is provided with a rod having the stop nut 56. On this rod is disposed a contact member 57 suitably insulated from the rod by the insulating sleeve 58. The contact member 57 slides freely on the piston rod and is designed to resiliently engage the contact members 18.

To effect this resilient engagement of the contacts, a spring 59 under compression is disposed between the lower face of the contact members and a suitable circumferential outer ledge on the outer portion of the cup-shaped member 52.

The piston is designed to fit somewhat loosely in the cylinder so that when pressure is admitted to the conduit 16, there is some leakage of the gas past the piston and the switch is thus not operated with too much impact so as to injure any portion of the switch. However, once the piston is forced upwardly, the conical portion 50

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engages the valve seat 51, thus providing a substantially perfect seal against any leakage of the gas from the switch.

The four-way valve is provided with the necessary four connections to the flask, pneumatic switch, exercise head, and relief valve, respectively. This valve has its lever 60 connected to a link 61 which, in turn, is connected to another lever 62 which may be extended so as to form a handle for resetting this valve manually. The four-way valve is provided with a tripping latch 63 biased in a clockwise direction about the pivot pin 64 by the spring 65 disposed between the ledge 66 and the right-hand end of the latch member 63. The dog 22 on the governor mechanism at the end of the run is designed to move the latch member 63 counterclockwise whereupon the dog 67 on the hub of the lever 62 is released. The spring 25 thus causes the levers 60 and 62 to rapidly move in a counterclockwise direction through an angle of substantially 90° to thus change the connection from that shown in Fig. 1 to such a connection that conduits 3 and 11 are interconnected, and conduit 16 and the relief valve are interconnected.

While we have shown but few systems of control and but single embodiments of the details, we do not wish to be limited to the particulars shown or described but wish to be limited only by the scope of the claims hereinafter recited.

We claim as our invention:

1. A pneumatically operable switch for use in a system of control for a device, as a torpedo, said system including a source of gas pressure and valve means, in combination, a cylinder adapted to be connected at one end thereof through said valve means to the source of gas pressure, a piston disposed in said cylinder forming a compression chamber, said piston having a loose fit in the chamber to provide some lag in the movement of the piston when gas is admitted into the compression chamber by the operation of said valve means, said cylinder and piston on the side opposite the compression chamber forming a gas-tight valve so that no gas leaks out of the compression chamber once the piston has been operated, a piston rod projecting from the other end of the cylinder, an inverted cup-shaped member secured to the piston rod and disposed over the cylinder, spring means, normally under compression, engaging the outer portion of the other end of the cylinder and the inner edge of the cup-shaped member to thus bias the piston toward the said one end of the cylinder, a switch element slidably mounted on the piston rod, an abutment at the end of the piston rod to limit the slidable movement of the switch element in the direction to the outer end of the piston rod, spring means normally under compression engaging the outside of the cup-shaped member and the switch element to thus resiliently support the switch element.

2. A pneumatically operable switch for use in a system of control for a device, as a torpedo, said system including a source of gas pressure and valve means, in combination, a cylinder adapted to be connected at one end thereof through said valve means to the source of gas pressure, a piston disposed in said cylinder forming a compression chamber, said piston having a loose fit in the chamber to provide some lag in the movement of the piston when gas is admitted into the compression chamber by the operation of said valve means, said cylinder and piston on the side opposite the compression chamber

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forming a gas-tight valve so that no gas leaks out of the compression chamber once the piston has been operated, a piston rod projecting from the other end of the cylinder, an inverted cup-shaped member secured to the piston rod and disposed over the cylinder, said cup-shaped member having a reentrant ledge at the edge and said cylinder having a peripheral ledge facing the reentrant ledge, a spring under compression disposed between the said reentrant ledge and peripheral ledge, and a resiliently mounted switch element on the outer end of the piston rod.

3. A pneumatically operable switch for use in a system of control for a device, as a torpedo, said system including a source of gas pressure and valve means, in combination, a cylinder adapted to be connected at one end thereof through said valve means to the source of gas pressure, a piston disposed in said cylinder forming a compression chamber, said piston having a loose fit in the chamber to provide some lag in the movement of the piston when gas is admitted into the compression chamber by the operation of said valve means, said cylinder and piston on the side opposite the compression chamber forming a gas-tight valve so that no gas leaks out of the compression chamber once the piston has been operated, a piston rod projecting from the other end of the cylinder, an inverted cup-shaped member secured to the piston rod and disposed over the cylinder, said cup-shaped member having a reentrant ledge at the edge and said cylinder having a peripheral ledge facing the reentrant ledge, a spring under compression disposed about said cylinder and completely housed within said cup-shaped member between the said reentrant ledge and peripheral ledge, and a resiliently mounted switch element on the outer end of the piston rod.

4. A pneumatically operable switch for use in a system of control for a device, as a torpedo, said system including a source of gas pressure and valve means, in combination, a cylinder adapted to be connected at one end thereof through said valve means to the source of gas pressure, a piston disposed in said cylinder forming a compression chamber, said piston having a loose fit in the chamber to provide some lag in the movement of the piston when gas is admitted into the compression chamber by the operation of said valve means, said cylinder and piston on the side opposite the compression chamber forming a gas-tight valve so that no gas leaks out of the compression chamber once the piston has been operated, a piston rod projecting from the other end of the cylinder, an inverted cup-shaped member secured to the piston rod and disposed over the cylinder, said cup-shaped member having a reentrant ledge at the edge and said cylinder having a peripheral ledge facing the reentrant ledge, a spring under compression disposed between the said reentrant ledge and peripheral ledge, a switch contact disc slidably mounted on the piston rod, an abutment at the end of the rod to limit the movement of said disc toward the outer end of the rod, and spring means under compression engaging the cup-shaped member and the disc to bias the disc against said abutment.

5. A pneumatically operable switch for use in a system of control for a device, as a torpedo, said system including a source of gas pressure and valve means, in combination, a cylinder adapted to be connected at one end thereof through said valve means to the source of gas pressure, a piston disposed in said cylinder forming a compression chamber, said piston having a loose fit in the

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chamber to provide some lag in the movement of the piston when gas is admitted into the compression chamber by the operation of said valve means, said cylinder and piston on the side opposite the compression chamber forming a gas-tight valve so that no gas leaks out of the compression chamber once the piston has been operated, a piston rod projecting from the other end of the cylinder, an inverted cup-shaped member secured to the piston rod and disposed over the cylinder, said cup-shaped member having a reentrant ledge at the edge and said cylinder having a peripheral ledge facing the reentrant ledge, a spring under compression disposed between the said reentrant ledge and peripheral ledge, a switch contact disc slidably mounted on the piston rod, an abutment at the end of the rod to limit the movement of said disc toward the outer end of the rod, peripherally projecting means on the outer cylindrical surface of the cup-shaped member, and spring means under compression disposed between said disc and peripherally projecting means adapted to bias said disc against the abutment on the piston rod.

6. A pneumatically operable switch for use in a system of control for a device, as a torpedo, said system including a source of gas pressure and valve means, in combination, a cylinder adapted to be connected at one end thereof through said valve means to the source of gas pressure, a piston disposed in said cylinder forming a compression chamber, said piston having a loose fit in the chamber to provide some lag in the movement of the piston when gas is admitted into the compression chamber by the operation of said valve means, said cylinder and piston on the side opposite the compression chamber forming a gas-tight valve so that no gas leaks out of the compression chamber once the piston has been operated, a piston rod projecting from the other end of the cylinder, an inverted cup-shaped member secured to the piston rod and disposed over the cylinder, said cup-shaped member having a reentrant ledge at the edge and said cylinder having a peripheral ledge facing the reentrant ledge, a spring under compression disposed between the said reentrant ledge and peripheral ledge, a switch contact disc slidably mounted on the piston rod, an abutment at the end of the rod

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to limit the movement of said disc toward the outer end of the rod, a peripheral ledge on the cylindrical surface of the cup-shaped member, and a helical spring disposed about the piston rod and under compression engaging the peripheral ledge and the disc to bias the disc against the abutment on the piston rod.

7. A pneumatically operable switch for use in a system of control including a source of gas pressure, in combination, a cylinder adapted to be connected at one end thereof to the source of gas pressure, a piston disposed in said cylinder forming a compression chamber, said piston having a loose fit in the chamber to provide some lag in the movement of the piston when gas is admitted into the compression chamber, said cylinder and piston on the side opposite the compression chamber forming a gas-tight valve so that no gas leaks out of the compression chamber once the piston has been operated, a piston rod projecting from the other end of the cylinder, a member having a diameter somewhat greater than the cylinder secured to the piston rod and disposed above the cylinder, spring means secured to the member and the cylinder for biasing the piston toward the said one end of the cylinder, a switch element slidably mounted on the piston rod, an upper abutment on the piston rod for limiting the upward movement of the switch element, and spring means disposed between the said member and the switching element for biasing the switching element against the abutment at the upper end of the piston rod.

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