

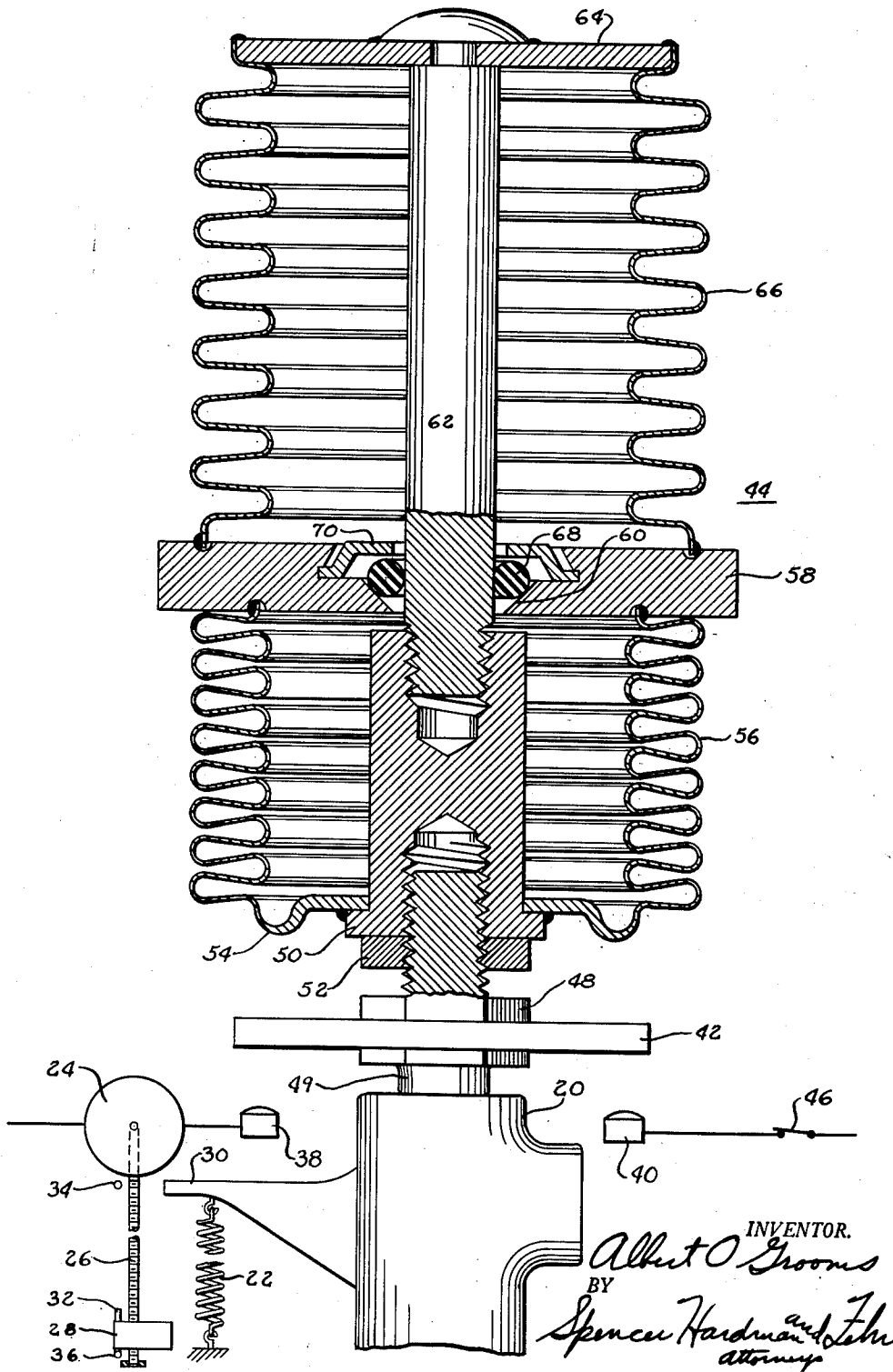
Aug. 12, 1952

A. O. GROOMS

2,606,631

FLUID CONTROLLED RETARDING APPARATUS

Filed May 15, 1946



UNITED STATES PATENT OFFICE

2,606,631

FLUID CONTROLLED RETARDING
APPARATUS

Albert O. Grooms, Dayton, Ohio, assignor to General Motors Corporation, Dayton, Ohio, a corporation of Delaware

Application May 15, 1946, Serial No. 669,999

3 Claims. (Cl. 188-94)

1

This invention relates to time delay apparatus and systems, for example, such as may be used for electrical apparatus.

Where machine guns are mounted upon airplane wings it is impossible to remedy any failure of operation in flight by personal attention. In such guns a cartridge sometimes fails to fire. Since the operation of the gun is dependent upon a recoil incidental to firing, the failure of a single cartridge to fire stops the operation of the gun. Electric motor driving means have been provided for operating the extractor and bolt mechanism in the event one of the cartridges fails to fire.

It is an object of my invention to provide a simple means for automatically initiating operation of electrical apparatus upon the failure of the bolt mechanism or any analogous device to reciprocate.

It is another object of my invention to provide a fluid controlled time delay apparatus whose timing is unaffected by variations in altitude or atmospheric pressure.

It is another object of my invention to provide a fluid controlled time delay apparatus whose valve is closed at a predetermined part of the stroke.

To attain these objects I have provided a time delay system including two cup-shaped bellows members separated by a dividing wall and having their movable end portions connected by a rod passing through the opening in the dividing wall. A ring-shaped valve member is frictionally carried by this rod for sealing the opening in the dividing wall. Connected to the rod is a switch element for controlling an electric circuit which includes an electric motor for cocking a machine gun in the event of the failure of a cartridge to fire.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawing, the figure is a sectional view through a time delay apparatus embodying one form of my invention, together with a diagrammatic and fragmentary showing of an electrical circuit and apparatus for cocking a machine gun in event of its failure to fire properly.

Referring now to the drawing, there is illustrated, as an example of one application of my invention, the end portion 20 of the bolt mechanism of a machine gun. In normal operation of the machine gun this bolt mechanism reciprocates at a rapid rate varying with the design of the gun and the ease of operation. For example, a widely used type of machine gun fires about 750 rounds per minutes, thereby necessitating 750 reciprocations of the bolt mechanism 20. The reciprocation of the bolt mechanism 20 is caused by the recoil incidental to firing. This recoil sends the bolt mechanism 20 to the rear of the gun against the tension of a suitable spring 22. If it is desired to stop firing, the bolt mechanism 20 is latched in its rearward position with the spring 22 under full tension.

However, in the event of the failure of a single cartridge to fire, the recoil will be absent and there will be no force to send the bolt mechanism 20 rearwardly to tension the spring 22. In order to restore the gun to operation there is provided an electric motor 24 for rotating a long screw 26 carrying a self-releasing nut 28 which is adapted to engage the projection 30 extending from the bolt mechanism 20. The turning of the screw 26 by the electric motor causes the nut 28 to move along the screw 26 carrying the bolt mechanism 20 rearwardly and tensioning the spring 22 until the bolt mechanism is returned to its rearward position where it may be latched by the usual sear. The nut 28 is provided with releasing mechanism which releases it from the screw 26. For this purpose the nut 28 is provided with a releasing button 32 which, when it engages the pin 34 at the rearward end of the screw 26, causes the nut 28 to be released from the shaft 26 and be free to move back to the forward end. When the sear is actuated to release the bolt mechanism the nut 28 will be returned to the forward end of the gun where a second pin 36 will cause the nut 28 to return into engagement with the screw 26.

The motor 24 may be controlled manually to cock the gun whenever it fails to fire. However, because of the stress of combat it is desirable to control this motor automatically. For this purpose I have connected in series with the electric motor 24 the contacts 38 and 40 which are adapted to be bridged by a switch bar 42 carried by the time delay apparatus 44. Also connected in series with the electric motor is a manual or automatic switch 46 which is to be closed whenever the gun is in operation.

The switch bar 42 is mounted upon a projecting member 48 provided with a projection 49 which is contacted by the bolt mechanism 20 upon each reciprocation to move or hold the switch bar 42 away from the stationary contacts 38 and 40. This projecting member 48 is threaded

2

50

55

ed into the bellows post 50 and locked in place by a lock nut 52. The bellows post 50 extends through the movable head 54 into the bellows 56 and is sealed thereto. The rim of the bellows 56 is sealed to a dividing wall 58 provided with a central aperture including a beveled valve seat 60.

Connected to the post 50 is a rod 62 which extends through the central opening provided with the valve seat 60 and is connected at its opposite end to the movable end wall 64 of the compensating and sealing bellows 66 having its rim sealed to the dividing wall 58. Mounted on the rod 62 by friction is a resilient ring valve 68 which is round in cross-section so that it may contact the valve seat 60 and provide a seal between the valve seat 60 and the rod 62. This ring valve 68 is made of some suitable rubber-like material such as one of the synthetic or natural rubber materials suitably compounded for use as a valve of this type. The movement of the ring valve 68 away from the seat 60 is limited by the cage 70, which is fastened to the dividing wall 58.

When the bolt mechanism 20 engages the projection 49 the member 48 as well as the post 50, the rod 62 and the movable end walls 54 and 64 of the bellows 56 and 66 are carried rearwardly. The ring valve 68 is likewise carried rearwardly by the rod 62 with which it is in frictional engagement, but this rearward movement is limited by the cage 70. The cage 70 may be varied in its shape to allow any desired amount of rearward movement of the ring valve 68. Upon the forward movement of the bolt mechanism 20 the movable portions of the time delay mechanism initially will move with it, due to the spring force built up by the compression of the bellows 56 and the extension of the bellows 66. However, as soon as the rod 62 has moved a sufficient distance to carry the ring valve 68 into sealing contact with the seat 60 and the rod 62 the interior of the bellows 56 and 66 will be substantially sealed from each other preventing the flow of fluid therebetween. However, there is sufficient leakage through the valve member 68 to permit the time delay apparatus to move forwardly under the spring force built up by the compression of the bellows 56 and the stretching of the bellows 66 at a relatively slow rate which is considerably longer than the time it takes for the bolt mechanism to reciprocate through one cycle in the normal operation of the gun.

Should a cartridge fail to fire, the bolt mechanism 20 will not be thrust to its rearward position because of the absence of recoil. The projection 49 and the switch bar 42 as well as the remainder of the time delay apparatus 44 connected thereto will move forwardly until the switch bar 42 engages the stationary contacts 38 and 40, closing the circuit and energizing the electric motor 24. This will turn the screw 26 and cause the nut 28 to engage the projection 30 and carry the bolt mechanism 20 back to its rearward position where it may be held by the latching of the sear. The nut 28 will, at the same time, engage the pin 34 to cause it to be released from engagement with the screw 26 so that when the trigger is pulled to release the sear, the bolt mechanism 20 can again move forward freely to cause the firing of the gun and to return the nut 28 to its forward position where it will engage the pin 36 which will cause its re-engagement with the screw 26.

The return of the bolt mechanism to its rear-

ward position will move the projection 49 and the switch bar 42 upwardly to open the circuit of the electric motor 24 thereby deenergizing the electric motor when the gun has been properly cocked. The movement of the switch bar 42 to open position will be accompanied by the contraction of the bellows 56 which will force fluid, such as air, through the central opening in the dividing wall 58 past the ring valve 68 into the interior of the bellows 66. The rate of return of the time delay apparatus is governed by the distance the cage 70 allows the valve ring 68 to move away from the seat 60, since this controls the distance which the rod 62 must return before sealing of the opening is attained. Since the time delay of my delay mechanism 44 is longer than the time it takes for one cycle of reciprocation of the bolt mechanism 20, the switch bar 42 will be kept in the open position at all times excepting when the cartridge fails to fire. When firing is stopped in a normal manner the bolt mechanism 20 stops in the position shown in the figure, keeping the time delay mechanism 44 in the open position.

If air is used as a fluid and the atmospheric pressure is constant the bellows 66 and its end wall 64 may be omitted. However, when the machine gun is to be operated at varying altitudes, the time delay, with the bellows 66 omitted, would vary with the atmospheric pressure for two principal reasons. In the first place, the air within the bellows 56 would change in pressure in accordance with the change in atmospheric pressure. In the second place, the pressure effect of the atmosphere upon the outside of the end wall 54 would vary in accordance with atmospheric pressure.

These two factors are both compensated for by employing the second bellows which is substantially equal in all respects and characteristics to the bellows 56. The pressure effect of the atmosphere on the outside of the bellows is compensated for by connecting the end wall 64 directly to the end wall 54, so that the pressure effect is carried by this connection. The atmosphere within the two bellows 56 and 66 is sealed therein so that it will not change. To get the aforesaid compensation, the effective areas of the bellows should be made equal, but the effective areas may be made unequal to obtain an adjustment with varying external pressures. Since air may have a detrimental or aging effect upon the ring valve 68, the interior of the bellows may be charged with any desired fluid at whatever pressure is desired. The rate of retardation of the time delay may be increased by increasing the pressure. Thus the time delay apparatus is not affected by changes in atmospheric pressure.

While I have illustrated my time delay apparatus as applied to the automatic cocking of a machine gun, it may obviously be applied to any other device, particularly reciprocating devices, wherein some means is provided which may be used for holding open or holding closed a switch mechanism or any other sort of control device.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. A time relay control including an enclosed container means provided with a movable wall portion and a single opening, said container means containing a gas escaping and entering

5

through said opening, a control device responsive to the movement of said movable wall portion, a rod fastened to said movable wall portion extending through said opening, a ring member upon and in frictional engagement with said rod, and means supported by said container means for limiting the movement of the ring member away from said opening, said means being spaced away from said ring member over a predetermined portion of the path of movement of the ring member to permit a predetermined amount of unencumbered movement.

2. A time delay control including an enclosed container means having two movable wall portions of substantially equal area, a dividing wall means separating the interior of the container means into two compartments, said wall means having a single opening therein, a rod passing through said opening and being fastened to each of said movable wall portions, a resilient ring member carried by and in frictional engagement with said rod, said wall means having a valve seat for making sealing engagement with said ring member, said wall means being provided with a retaining means for the ring member, said retaining means having a stop portion spaced from the ring member when the ring member is in engagement with said valve seat for allowing a limited movement of the ring member with the rod away from said valve seat, said enclosed container means being filled at a predetermined pressure with a gas movable from one side of the dividing wall to the other side through said opening and a control device connected to and operated by the movement of said rod.

3. A time delay control including an enclosed container means having two movable wall portions of substantially equal area, a dividing wall means separating the interior of the container means into two compartments, said wall means having a single opening therein, a rod passing through said opening and being fastened to each of said movable wall portions, a resilient ring member carried by and in frictional engagement with said rod, said wall means having a valve

6

seat for making sealing engagement with said ring member, said wall means being provided with a retaining means for the ring member, said retaining means having a stop portion spaced from the ring member when the ring member is in engagement with said valve seat for allowing a limited movement of the ring member with the rod away from said valve seat, said enclosed container means being filled at a predetermined pressure with a gas movable from one side of the dividing wall to the other side through said opening, said valve seat being beveled inwardly to force the ring member firmly into contact with said rod, said retaining means being completely spaced from the periphery of said ring member in all of its movement to allow free movement of the ring member between said valve seat and said stop portion subject to its frictional engagement with said rod, and a control device connected to and operated by the movement of said rod.

ALBERT O. GROOMS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
322,763	Vincent	July 21, 1885
391,956	Fruger	Oct. 30, 1888
1,377,102	Whitesell	Sept. 13, 1932
1,941,989	Larsen	Jan. 2, 1934
2,116,860	Blaylock et al.	May 10, 1938
2,369,007	Beecher	Feb. 6, 1945
2,401,379	Smith	June 4, 1946
2,410,767	Wisman et al.	Nov. 5, 1946
2,413,113	Pontius et al.	Dec. 24, 1946
2,413,416	Ostlund et al.	Dec. 31, 1946
2,475,206	Smith	July 5, 1949

FOREIGN PATENTS

Number	Country	Date
53,836	Switzerland	Nov. 12, 1910