Jan. 12, 1960 B. STEVENS ET AL 2,920,530

AUTOMATIC GUN CHARGER

Filed Oct. 11, 1956 2 Sheets-Sheet 1

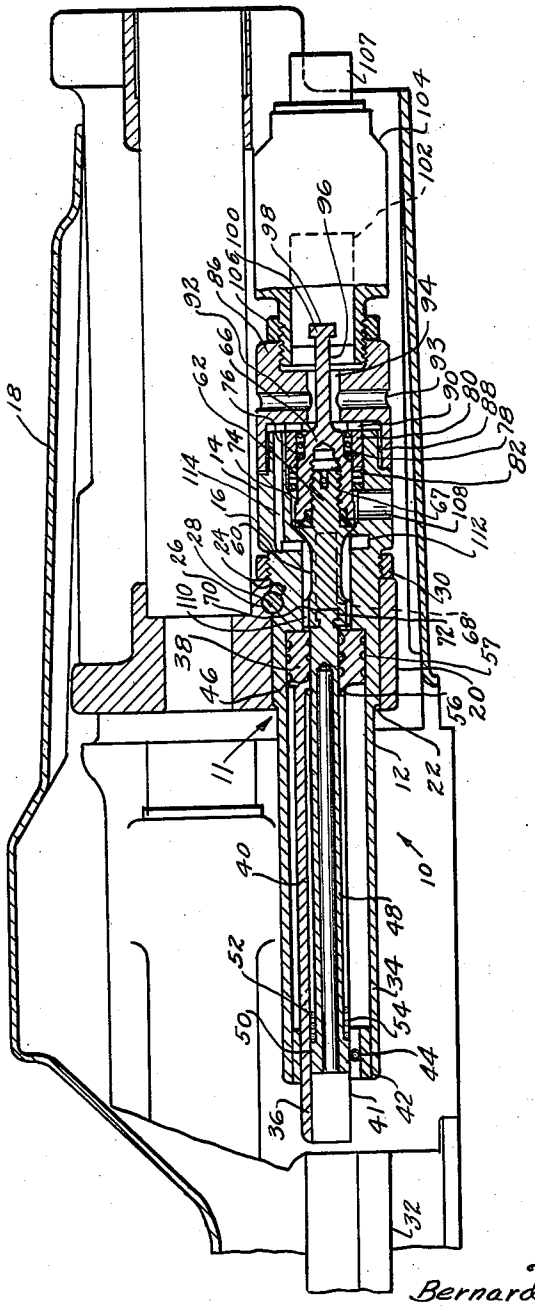

FIG. 1

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FIG. 2.

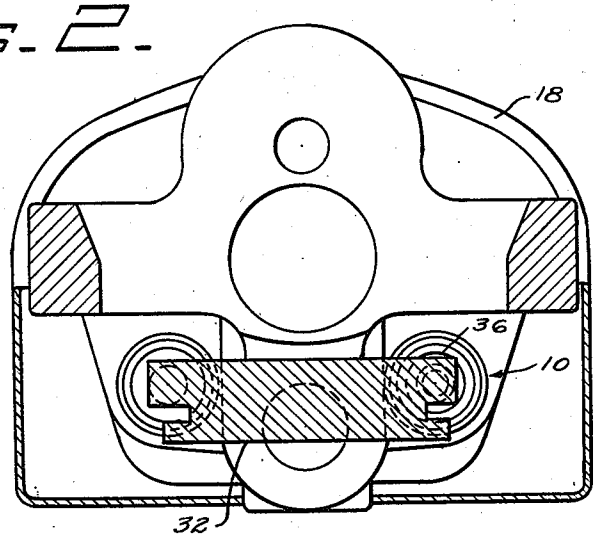


FIG. 3.

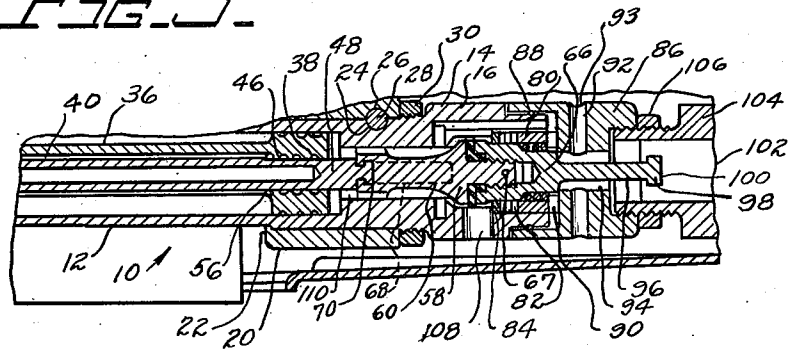


FIG. 5.

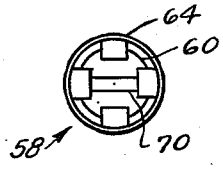
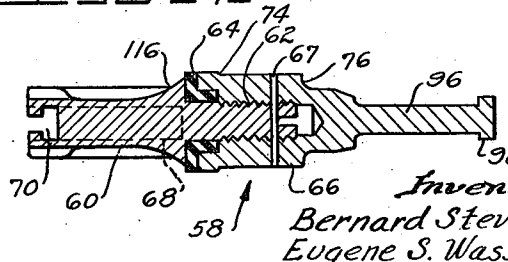


FIG. 4.



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AUTOMATIC GUN CHARGER

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6 Claims. (Cl. 89—1)

This invention relates to a gun charger, and more particularly, to an automatic charging device of the pneumatic type employed for charging an automatic gun during gun fire when a failure to fire occurs.

The main purpose of the present invention is to provide a new and improved gun charging device of the type employing a simple and effective electro-pneumatic system for charging an automatic gun during gun fire when the gun fails to fire usually rendering the gun inactive or even causing damage to the gun.

The gun charging device of the present invention is further characterized by its light weight and relatively small size, and by requiring only a small amount of fluid pressure for its operation, which fluid pressure may be supplied from the fluid pressure system of the aircraft.

It is further the purpose of the present invention to provide a gun charging device of this character which is of single action, i. e., the charger piston or plunger may be returned to its initial forward position by the action of the gun operating slide rather than by fluid pressure acting on the opposite side of the charger piston as in the gun chargers of the prior art.

The gun charging device constructed in accordance with the present invention is further provided with a system consisting of a fluid pressure motor or fluid pressure operated actuator and a valve assembly for controlling operation of the fluid pressure motor. The valve assembly is arranged to be moved to its open position by the action of a solenoid and to its closed position by the action of the charger piston or plunger in the fluid pressure motor at the end of its rearward stroke, after which the plunger is returned to its initial forward position in the fluid pressure motor by the action of the gun operating slide. The solenoid may be actuated by manually closing the solenoid circuit, or it may be actuated automatically by the action of an automatic control upon failure of the gun to fire when the firing circuit of the gun is closed.

These and other features of the present invention are described in detail below in connection with the accompanying drawings wherein like numerals designate like parts, and in which:

Figure 1 is a side elevation, partly in section, of a gun charging device embodying the present invention and mounted on the receiver of an automatic gun;

Figure 2 is an end view, partly in section, of the device of Figure 1;

Figure 3 is a fragmentary view of the device of Figure 1 showing the valve assembly in its forward position;

Figure 4 is a longitudinal section of the valve member employed in the device of Figure 1; and

Figure 5 is an end view of the valve member of Figure 4.

Referring now in detail to the drawings, the gun charging device illustrated in the drawings as an embodiment of the present invention is indicated generally by the reference numeral 10 and, as shown, comprises a fluid pressure motor or fluid pressure operated actuator 11 which consists of a cylinder assembly 12 and a valve assembly 14

housed in the forward section 16 of the cylinder assembly 12. The fluid pressure motor 11 is mounted on a gun receiver 18 by a mounting bracket 20, provided on either side of the receiver 18 for mounting the fluid pressure motor 11 either on the right or left side of the gun receiver 18, as shown in Figure 1.

The mounting bracket 20 is formed with an opening 22 through which is inserted the fluid pressure motor 11. A groove 24 across the top of the charger cylinder assembly 12 is arranged to be aligned with a mating internally threaded hole 26 in the receiver mounting bracket 20, and a pin 28 is screwed in tight. A locked nut 30 is tightened against bracket 20. The pin 28 properly positions the fluid pressure motor 11 in a longitudinal direction with respect to the gun receiver 18 and also properly orients the fluid pressure motor 11 to clear the gun slide rail, not shown. In this manner, the fluid pressure motor 11 of the charging device 10 may have a free travel of a fraction of an inch before contacting a gun operating slide as indicated at 32. This free travel permits the gun to counterrecoil a fraction of an inch before striking the fluid pressure motor as hereinafter described.

The cylinder assembly 12 of the fluid pressure motor 11 consists of a cylinder 34 and a hollow cylindrical piston or plunger 36 having a head 38 and a skirt 40 arranged for reciprocatory movement in the cylinder 34. The hollow cylindrical piston 36 is also formed with a cutaway portion 41 at the skirt 40 for avoiding interference with the gun slide rail, not shown, when extended rearwardly, and is further arranged to be slidably supported by a guide ring 42 and a transversely extending pin 44 in the rear end of the cylinder 34. The pin 44 prevents the piston 36 from rotating in the cylinder 34. The piston head 38 is further provided with a bore 46 through which extends a valve stem control rod 48, which also extends through the skirt 40, as shown in Figure 1. The control rod 48 is provided with a head 50 at the rearward end thereof slidably engaging the inner wall of the piston skirt 40. A coil spring 52 inserted over the control rod 48 and abutting the control rod head 50 is acting as a buffer when an outer shoulder 54 of the control rod 48, which shoulder 54 is formed by the control rod head 50, is engaged by an inner shoulder 56 of the piston 36 just before the end of the rearward stroke of the piston 36. The piston head 38 is also provided with suitable packing rings 57 for forming a fluid tight joint with the inner wall of the cylinder 34 and with the outer wall of the valve stem control rod 48.

Fluid pressure control for actuating the piston 36 is obtained by the valve assembly 14 housed in the forward section 16 of the cylinder assembly 12, as described above, and provided with a valve stem member 58 arranged in the valve housing section 16 for reciprocatory movement. The valve member 58 consists of a rear stem section 60 having a stud 62 supporting a valve seat washer 64 and threadedly engaged by a forward valve stem section 66. A pin 67 prevents relative rotation of the valve section 66 on the stud 62, as shown in Figure 4. The rear valve stem section 60 is further formed with fluid passages 68, as shown in Figure 4, and with a T-slot 70 at the rearward end thereof, in which T-slot 70 fits a T-shaped end 72 extending from the front end of the valve control rod 48. The front valve stem section 66 is also provided with an outer shoulder 74, located substantially at the middle section of the valve member 58, and with a forward shoulder 76 against which abuts a coil spring 78 fitted over the valve section 66 and extending between the shoulder 76 and a spacer collar 80. At its front end, the spring 78 abuts against the front end of the collar 80. The spacer collar 80 also retains in place a plurality of "O" seals 82 and a spacer ring 84. The spacer collar 80 is further held in place by a valve cap 86 threadedly

engaging the threaded forward end of the cylinder assembly **12**. Roll pins **88** prevent relative rotation of the valve cap **86** on the cylinder **34**. The spacer collar **80** is also formed with slots **90** at its front end, and the valve cap **86** is provided with fluid passageways **92** and a longitudinal bore **94** in fluid communication therewith.

Extending through the longitudinal bore **94** in the valve cap **86** is an extension **96** of the valve member **58**, which extension **96** has a T-shaped end **98** arranged to fit in a T-slot **100** in solenoid plunger **102** of a solenoid **104** threadedly secured in the forward end of the valve cap **86**. A stop nut **106** is provided for adjusting the solenoid **104** in the valve cap **86** as seen in Figure 1. The solenoid **104** is also provided with a socket **107** at the forward end thereof for connection with an electrical control system, not shown.

In operation, fluid under pressure enters the valve housing **16** through an inlet **108** therein from a source, not shown, and exerts a force upon the surface area of the shoulder **74** of the valve stem member **58**. In addition, a force is exerted on the valve member **58** by the valve spring **78** at the forward end thereof thereby holding the valve in its rearward position against its seat **64** and sealing the cylinder **34** against fluid pressure by preventing admission of fluid pressure through a port **110** in fluid communication with the cylinder **34**. When the solenoid **104** is energized, the valve member **58** and the valve stem rod **48** are pulled forward a fraction of an inch, opening the port **110** to the cylinder **34**. Simultaneously, fluid pressure enters an annular space **112** at the rear of the valve housing **16**, and through longitudinal passages **114**, only one of which is shown, enters the space between the front end of the valve member **58** and the valve cap **86** and exerts a force on the surface area of the shoulder **76**. Also, the fluid pressure exerts a force on the surface area of a curved rear valve shoulder **116**. Thus, fluid pressure is applied to both ends of the valve, but, because of the larger area of the curved shoulder **116** at the rear portion of the valve member **58**, a differential resulting force holds the valve member **58** against its forward seat at **118**, as shown in Figure 3, and thereby prevents escape of fluid pressure through the forward exhaust ports **93** formed by the passageways **92** in the valve cap **86**. Fluid pressure entered in the cylinder **34** through the port **110** then acts upon the piston or plunger **36** moving it rearwardly in contact with the gun operating slide **32**. When the piston **36** is within a fraction of an inch of the end of its stroke, it contacts the buffer spring **52** on the valve stem rod **48** and pulls the valve stem rod **48** and the valve member **58** by a force applied through the buffer spring **52**. This action moves the valve member **58** to its rearward position and the valve seat **64** prevents fluid pressure through the valve port **110** thereby sealing the cylinder **34** against fluid pressure. The spring **52** must also be further compressed an additional fraction of an inch after the valve member **58** is in the closed position before the piston **36** can contact the retaining bushing or guide ring **42** in the end of the cylinder **34**. At the same time, air pressure exhausts through the bore **94** and the fluid passageways **92** in the valve cap **86**, which are now open, and again the fluid pressure acts on the surface area of the valve member shoulder **74** and holds the valve member **58** against its rearward seat **64**. The piston **36** in the meantime is returned to its forward position, as shown in Figure 1, by the forward movement of the gun operating slide **32**. The fluid pressure in the cylinder during the forward movement of the piston is exhausted through the fluid passages **68**, annular space **112**, longitudinal passageways **114**, and through valve cap bore **94**, fluid passageways **92** and exhaust ports **93** to atmosphere.

The present invention has been described in detail above for purposes of illustration only and is not intended to be limited by this description or otherwise except as defined in the appended claims.

We claim:

1. A charging device for an automatic gun comprising a fluid pressure operated actuator arranged to engage and move a gun operating slide for charging the gun, said actuator provided with a valve assembly having a member for controlling fluid pressure to said actuator, said valve assembly having a first fluid inlet passageway to deliver fluid under pressure therein and said valve member having an intermediate shoulder in communication with said first inlet passageway and exposed to fluid pressure delivered into said first fluid inlet passageway normally holding said valve member in a closed position thereby preventing fluid pressure to said actuator, valve opening means for moving said valve member to an open position, said valve assembly having a second fluid inlet passageway and a plurality of interconnecting longitudinally disposed fluid passages delivering fluid under pressure therein and said valve member having a forward abutting shoulder of relatively large surface area and a rear curved shoulder of relatively small surface area spaced therefrom in respective opposed communication with fluid pressure delivered into said second fluid inlet passageway and said interconnecting fluid passages while in the open position to effect a resultant force which tends to retain said valve member in the open position thereby admitting fluid under pressure to said actuator to move said actuator to contact and move the gun slide to a retracted position.

2. A charging device for an automatic gun as defined in claim 1, and elongated valve closing means attached to said valve member at one end thereof and adapted to be engaged at a predetermined interval by said actuator at the other end thereof to actuate said valve-closing means for returning said valve member to the closed position at the end of the stroke of said actuator.

3. A charging device for an automatic gun comprising a fluid pressure motor adapted to be mounted on a gun and arranged to contact and move a gun operating slide to a retracted position for charging the gun, said motor having a valve housing defining a first inlet passageway, a port in communication with said fluid pressure motor, and an outlet, a valve member in said valve housing for controlling fluid motor pressure to said motor, said valve member having a first outer abutment in communication with said first inlet passageway and thereby exposed to fluid motor pressure for normally retaining said valve member in its seated position to close said port, biasing means tending to urge said valve member to its closed-port position, said valve housing having a second fluid inlet passageway and intercommunicating longitudinally disposed fluid passages in communication with said second fluid inlet passageway and said valve member having a second outer abutment spaced from said first-named abutment and a gradually diverging shoulder spaced from said second abutment in respective communication with said second fluid inlet passageway and said intercommunicating longitudinally disposed fluid passages to be exposed to fluid pressure acting in opposite directions on said valve member, actuating means for moving said valve member in opposition to the fluid pressure on said first mentioned abutment and said biasing means to expose said second abutment and said shoulder to the fluid pressure acting in respective opposite directions thereon resulting in a resultant force which tends to hold said valve member against said valve outlet thereby admitting fluid under pressure through said port to said motor for contacting and moving the gun slide to a retracted position.

4. A charging device for an automatic gun as defined in claim 3, and means in said fluid motor for moving said valve member in opposition to the resultant force on said second abutment and said gradually diverging

shoulder for closing said valve port and opening said valve outlet at the end of the fluid motor stroke.

5. A charging device for an automatic gun comprising a cylinder adapted to be mounted on a gun and provided with a plunger arranged to contact and move a gun operating slide to a retracted position for charging the gun, a valve housing defining a port in communication with said cylinder, a valve member in said housing for controlling fluid pressure to said cylinder through said port, said valve member having a first abrupt, peripheral projection exposed to fluid pressure for normally holding said member against said port to seal said cylinder against fluid pressure, said valve member having a second abrupt, peripheral projection and a gradually sloping projection spaced longitudinally on opposite sides of said first projection and adapted to be exposed to fluid under pressure, said valve housing being provided with fluid passageways between said projections on opposite sides of said first projection, and actuating means for moving said valve member in opposition to the fluid pressure exerted on said first projection of said valve member for exposing said projections on opposite sides of said first projection to fluid pressure the resultant force of which tends to hold said valve member in a forward open position thereby admitting fluid under pressure into said cylinder

for actuating said plunger to move the gun slide to a retracted position.

6. A charging device for an automatic gun as defined in claim 5 and in which said plunger is of hollow substantially cylindrical shape, and said valve member is provided with an extension extending through said hollow plunger, said valve member extension having an outer shoulder, and said plunger having an inner shoulder arranged to engage said valve member extension outer shoulder for moving said valve member in opposition to the resultant force of the fluid pressure exerted on said projections on opposite sides of said first projection against said port thereby sealing said cylinder against fluid pressure at the end of the stroke of said plunger, said plunger arranged to return to its initial position in said cylinder by the forward movement of the gun operating slide.

References Cited in the file of this patent

UNITED STATES PATENTS

2,384,834	Grant et al.	Sept. 18, 1945
2,409,623	Grant	Oct. 22, 1946
2,411,877	Heizer	Dec. 3, 1946
2,423,446	Grant	July 8, 1947
2,575,368	Thomsen	Nov. 20, 1951