April 20, 1948. J. M. BOSHKA ET AL 2,440,071

SEMIAUTOMATIC HYDRAULIC-ELECTRIC GUN CHARGER

Filed March 15, 1945 2 Sheets-Sheet 1

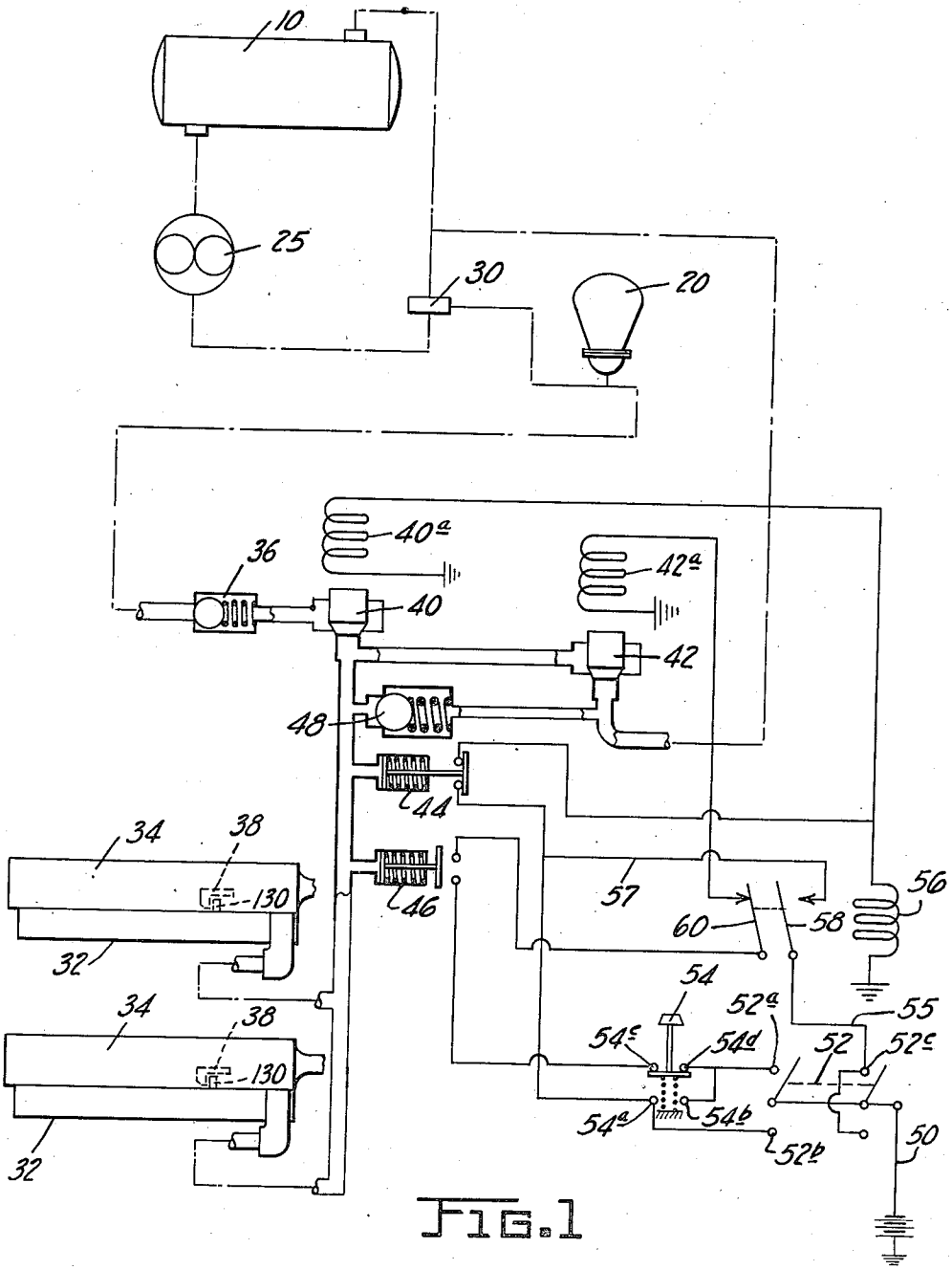


FIG. 1

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SEMIAUTOMATIC HYDRAULIC-ELECTRIC GUN CHARGER

Filed March 15, 1945 2 Sheets-Sheet 2

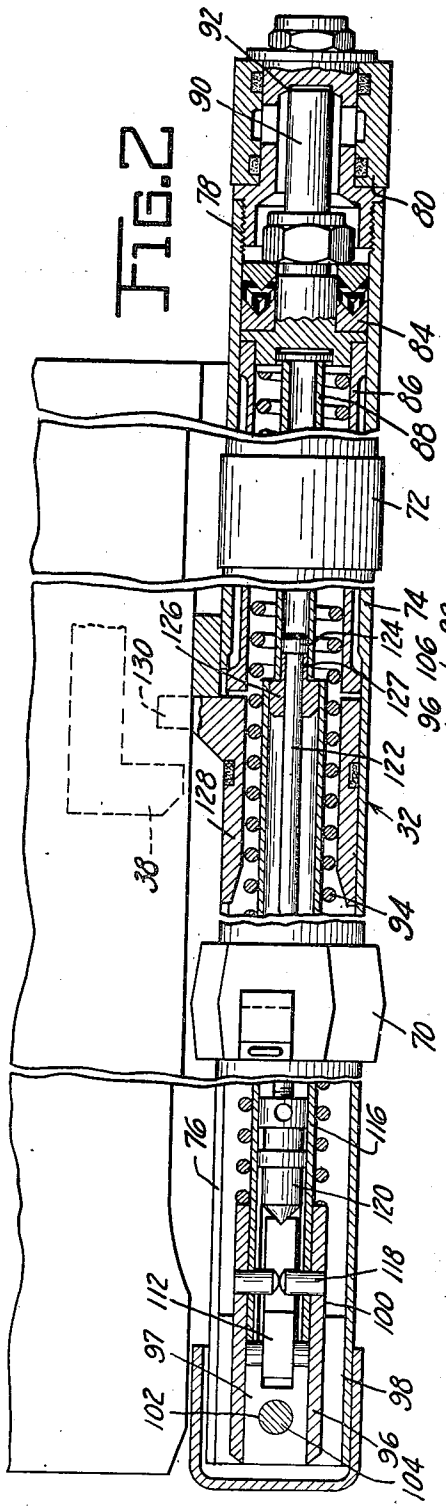


FIG. 2

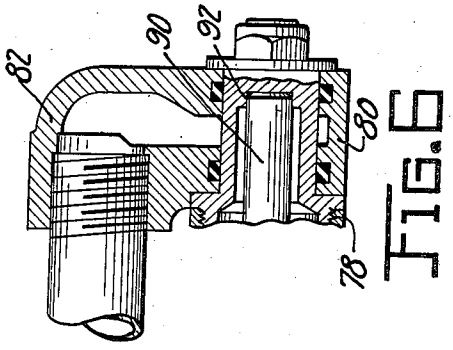


FIG. 6

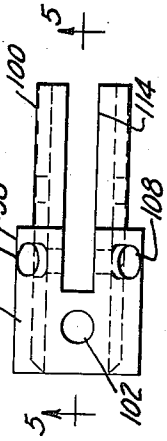


FIG. 4

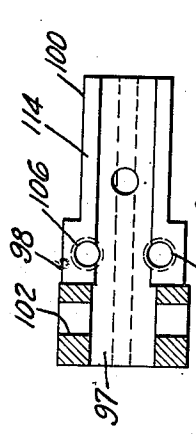


FIG. 5

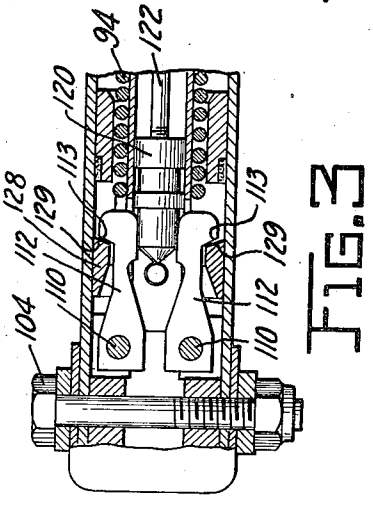


FIG. 3

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SEMIAUTOMATIC HYDRAULIC-ELECTRIC GUN CHARGER

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Application March 15, 1945, Serial No. 582,824

16 Claims. (Cl. 89—1)

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This invention relates to aircraft armament and is particularly concerned with the provision of apparatus for charging machine guns.

Most present-day types of military aircraft are equipped with one or more machine guns located in the wings or in the fuselage at points which are generally remote from the pilot or gunner. In most instances, the guns are provided with trigger means located near the control stick of the aircraft for actuating a firing solenoid attached to the guns.

To initiate firing of such a machine gun after a new belt of ammunition is supplied a reciprocable bolt stud is provided which must be pulled rearwardly and released for countermovement to feed the first cartridge from the ammunition belt into the gun. After the first cartridge has been fed into the gun and fired the gun will automatically eject the used cartridge and feed another one into the gun chamber. However, the insertion of defective ammunition into the gun chamber results in a misfire of the gun which interrupts normal gun operation. This defective cartridge may be removed by manually operating the bolt stud to extract the defective cartridge and then feeding a new one into the gun chamber. After this manual operation of the gun bolt stud the gun is now ready for firing. Since most guns are so remotely located in the aircraft, manual charging is not only very difficult but impractical. It is to cope with this cumbersome method of manual charging that the present invention incorporating semi-automatic means to simulate normal gun operation has been proposed.

It is, therefore, an object of this invention to provide a semi-automatic mechanism for charging a gun.

A further object of the invention resides in the provision of a semi-automatic gun charging mechanism which is constructed and arranged to complete a charging cycle once initiated.

Another object of the invention is to provide a gun charging mechanism having manual means for controlling a charging cycle.

An important object of this invention is to provide means responsive to predetermined pressures for operating the charging mechanism.

A further important object resides in the provision of a pressure-operated device which is constructed and arranged to connect the charging mechanism for exhausting the pressure acting therein when it exceeds a predetermined low value.

An additional object of the invention is to provide a pressure-operated charging motor in combination with an electrical system which responds to predetermined pressures acting in the motor for retracting the bolt stud of a gun and then releasing the stud for countermovement.

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A still further object of the invention is to provide a fluid pressure system for a charging mechanism having means for exhausting the fluid under pressure should it exceed a predetermined maximum value.

Other objects and advantages of the present invention should be readily apparent by referring to the following specification, considered in conjunction with the accompanying drawing which is illustrative of one embodiment thereof, but it will be understood that any modifications may be made in the specific structural details thereof within the scope of the appended claims without departing from or exceeding the spirit of the invention.

Figure 1 shows the invention in diagrammatic form with parts in section;

Figure 2 is a detailed plan view of the charging device of the invention, showing portions broken away and in section;

Figure 3 is an elevational view in detail of the latching mechanism of the charging device showing the auxiliary piston in latched position;

Figure 4 is a plan view of a part of the latching mechanism;

Figure 5 is a section taken on the line 5—5 of Figure 4; and

Figure 6 is a section through the inlet connection.

Referring to Figure 1 of the drawing, reference numeral 10 designates a reservoir which contains an adequate supply of fluid to be put under pressure in an accumulator 20 by a pump 25. Disposed between the pump and accumulator is a regulator or unloading valve 30, of any conventional design for disconnecting the accumulator from the pump to by-pass the fluid to the reservoir when the fluid in the accumulator has been put under a predetermined maximum pressure and for connecting the accumulator to the pump to charge said accumulator when the fluid under pressure in the accumulator has fallen to a predetermined minimum value. The accumulator 20 is connected to one or more charging devices 32 which are mounted on guns 34 to charge the same when desired. The charging device or hydraulic motor per se, which will be subsequently described in detail, is constructed and arranged to engage a bolt stud 38 for reciprocating it to charge the gun in the event of its malfunction.

A check valve 36 prevents the reverse flow of fluid from the charging device to the accumulator should the accumulator pressure fall below the pressure in the charging device.

Fluid under pressure is admitted to the charging motor 32 by a normally closed valve 40 and exhausted from the charging motor by a normally closed valve 42. The valves 40 and 42 are of the electrically operated type.

A pair of pressure-responsive devices or pressure switches 44 and 46 are constructed and arranged to respond to predetermined maximum and minimum pressures respectively acting in the charging motor. It is to be noted that this combination of pressure switches may be used with a single charging motor or with a plurality of charging motors comprising a single group, as shown in the drawing.

To prevent destruction of the mechanism due to thermal expansion of the fluid, under certain conditions of operation when the exhaust valve is rendered inoperative, a thermal relief valve 48 is disposed between the charging mechanism and the reservoir. Any tendency for abnormally high and hazardous pressures to act on the mechanism will operate the relief valve to cause the fluid to be bled directly to the reservoir whereby that pressure above the predetermined maximum pressure acting on the mechanism is relieved.

An electrical system is provided for controlling valves 40 and 42. The electrical system may be conveniently divided into a first and a second circuit. The first circuit is connected to a source 50 and to a winding 40*a* of the valve 40. The circuit includes a double pole double throw switch 52, a manually operated push button switch 54, normally open with respect to the first circuit, the normally closed high pressure switch 44, a relay 56, and a holding circuit having connections 55 and 57 connected in parallel with the switch 54. The holding circuit which is normally open includes a contactor 58 which is closed when the relay or control 56 is energized in response to closing switch 54 onto contacts 54*a* and 54*b*. When the switch 54 is released it assumes the normally open position, as shown in the drawing, with respect to the first circuit but contactor 58 which has been closed now completes the circuit to maintain the relay 56 energized and to supply current to the winding 40*a* to operate the valve 40 to admit fluid under pressure to the charging mechanism. The contactors 58 and 60 are in the form of a double pole knife switch and in conjunction with relay coil 56 provide a control device for the holding circuit and the second circuit.

The second circuit connects the source 50 to a winding 42*a* of the valve 42 and comprises the double pole double throw switch 52, the switch 54 normally closed with respect to the second circuit on contacts 54*c* and 54*d*, the normally opened low-pressure switch 46 and a contactor 60 which normally closes the second circuit but is opened when the relay 56 is energized.

The switch 52 is constructed and arranged to be closed on either contacts 52*a* and 52*c* or contact 52*b* to connect the charging mechanism to battery position or safety position respectively. That is, if it is desired to complete a charging cycle the switch is moved to battery position so that the bolt will be retracted and then released for countermovement. However, if it is desired to retract the bolt and hold it in retracted position to prevent unintentional firing of the gun the switch is moved to safety position.

The charging motor 32 is held in operative relationship to the gun by brackets 70 and 72 which are secured to the gun frame. The charging motor per se comprises a cylinder 74 having a slotted portion 76 which extends longitudinally thereof. One end of the cylinder is threaded internally at 78 to receive a fitting 80 equipped with an inlet connection 82 for connecting the motor to the hydraulic source. Disposed within the cylinder is a piston 84 comprising an outer tube 86, an inner tube 88 and an extended shank portion 90. The fitting 80 is drilled at 92 to slidably receive the shank portion 90. A close machine tolerance is held between the drilled portion 92 and the shank 90 so as to provide a dash-pot effect upon the piston to retard its motion at the end of the return stroke as shown in Figure 2. The piston is returned to this latter position by a spring 94.

Disposed in the other end of the cylinder 74 from the inlet 82 is a latching mechanism comprising a retainer plug 96 longitudinally bored at 97 and having a large diameter 98 and a small diameter 100. The large diameter is drilled at 102 for the reception of a bolt 104 to secure the plug to the cylinder 76. The enlarged diameter of the retainer plug 96 is further drilled transversely at 106 and 108 to receive pins 110 upon which latching levers or dogs 112 are pivotally mounted. The plug 96 is slotted at 114 to allow the dogs 112 to expand or pivot about the pins 110. A guide sleeve 116 has one end secured in the bore 97 by a pin 118. An actuating member 120 engages the latching levers 112 to pivot the same about pins 110. The member is slidable within the sleeve 116 and is provided with an extension rod 122 having an enlarged end 124. The pin 118 acts as a stop for the actuating member 120 and also keeps the levers 112 spaced apart when the member is in its normal position. The inner tube 88 has fixed thereto an expanded head member 126 drilled at 127 to slidably receive the rod 122. An auxiliary piston or bolt engaging member 128 is freely reciprocable within the cylinder 76 and is provided with a lug 130 for engaging the bolt stud or slide 38 of the gun when it is desired to move the bolt to the rear to simulate normal gun operation. The lug 130 protrudes through the longitudinally slotted portion 76 provided therefor. The dogs 112 are provided with inclined surfaces 113 for cooperating with inclined surfaces 129 of the auxiliary piston 128 when the piston has been moved to the position shown in Figure 3, for latching the bolt 38 to the rear.

The admission of fluid under pressure at the inlet 82 causes piston 84 and its associated parts 86 and 88 to move to the left. The tube 86 engages the auxiliary piston 128 and carries it to the left to the position shown in Figure 3. The head member 126 which is fixed to the tube 88 is likewise carried to the left to engage the actuating member 120 to cause the same to move between the dogs 112 to thereby expand said dogs so that the inclined surfaces 113 and 129 coact to latch the auxiliary piston and bolt stud to the rear. After latching of the bolt to the rear has been consummated fluid under pressure in the charging motor is exhausted and the piston 84 returns to the position shown in Figure 2, under the action of spring 94. Because of the lost motion connection between the head member 126 of piston 84 and the actuating member 120 the head member 126 does not engage the enlarged end 124 of the actuating member until the piston 84

has approached the end of its return stroke. Engagement of the end 124 by the head 126 moves the member 120 from between the latching levers 112. Now the levers are free to swing inwardly. The force of the spring returned gun bolt acting against the lug 130 tending to return the auxiliary piston to its forward position will be transmitted to the inclined surfaces 129 to thereby create a camming action between the two surfaces 113 and 129 to cause the latching levers to be rotated out of engagement with the auxiliary piston. This arrangement whereby the bolt stud is not released until the piston 84 has approached the end of its forward or return stroke permits the unimpeded return of the bolt stud. It is to be noted that the organization of the parts and the timing is such that when the bolt is moved rearwardly the auxiliary piston must move over the dogs before the actuating member is moved between the dogs so that when the dogs are expanded their inclined surfaces 113 will engage the inclined surfaces 129 of the auxiliary piston.

Operation of the charging mechanism is as follows: Assume the switch 52 is in battery position, that is, closed on contacts 52*a* and 52*c*, and it is desired to charge the guns 32. Here it will be well to bear in mind that when the double pole double throw switch 52 is closed on battery position, the first circuit is open through the manually controlled switch 54, which is normally open with respect to the first circuit and that the second circuit is open through the normally opened low pressure switch 46. The holding circuit, which is a part of the first circuit, is open through the contactor 58. Therefore the normally closed valves 40 and 42 are closed since the respective windings 40*a* and 42*a* are not energized so as to cause the valves to be operated.

To charge the guns, the manually controlled switch 54 is closed on contacts 54*a* and 54*b*. This energizes winding 40*a* and operates valve 40 to admit fluid pressure to the charging mechanism. Relay 56 which was also energized upon the closing of switch 54, as above described, closed contactor 58 which completed the holding circuit to thereby provide a secondary current path to the valve 40 and relay 56. This secondary path provides for the completion of a retracting operation of the bolt once the cycle is initiated notwithstanding manually-operated switch 54 has again been allowed to resume its normal open positiion with respect to the first circuit. In this latter position of the switch it is normally closed with respect to the second circuit. Fluid under pressure will now be admitted past valve 40 to the charging mechanism until the pressure in the mechanism has reached a predetermined maximum value, at which time the normally closed switch 44 will open the first circuit to deenergize the winding 40*a* to allow valve 40 to close to cut off fluid under pressure to the charging mechanism. Opening pressure switch 44 also deenergizes relay 56 which opens contactor 58 to break the holding circuit including connections 55 and 57, which as aforementioned, comprise a part of the first circuit.

It will be remembered that pressure switch 46 which is normally open tends to close the second circuit in response to predetermined low pressures in the charging mechanism. Consequently, after valve 40 is opened and the pressure rises above a fixed low value in the charging mechanism switch 46 closes. However, whether the second circuit will now be closed to pass current to the winding 42*a* to operate valve 42 depends upon the pressure in the charging mechanism. If the switch 44 has opened in response to high pressure in the charging mechanism to open the first circuit to deenergize relay 56 to thereby allow the normally closed contactor 60 to close, the second circuit will be closed. With the low pressure switch 46 closed and contactor 60 in its normally closed position, after relay 56 is deenergized, current passes through the winding 42*a* to energize it to operate valve 42 to exhaust fluid under pressure from the charging mechanism to complete the charging cycle. When the pressure in the charging mechanism has been exhausted to a predetermined low value switch 46 will open the second circuit which deenergizes winding 42*a* of valve 42 to allow it to resume a normally closed position.

It is well known that fluids of the type used in hydraulic systems change in volume due to temperature variations. When such a fluid is confined to a prescribed space, such as in the charging mechanism of the present invention, expansion of the liquid may cause unintended movement of some associated part of the mechanism, in this case the bolt stud. To preclude such undesirable action, pressure switch 46 is constructed and arranged to close the second circuit upon a rise in pressure in the charging mechanism above a predetermined value. This will energize winding 42*a* and cause valve 42 to be operated to exhaust the pressure from the charger. The foregoing action takes place so long as the single pole double throw switch is in battery position. However, with the switch in safety position the second circuit which controls exhaust valve 42 is no longer capable of energizing winding 42*a* so other means must be provided for exhausting the fluid pressure in the charger mechanism which may be caused by thermal expansion of the fluid.

To safety the guns, switch 52 is moved to safety position. This causes valve 40 to be operated to admit fluid under pressure to the mechanism to build up the pressure therein until it reaches a predetermined maximum value at which time switch 44 opens to deenergize the valve 40 to cut off the source of fluid under pressure.

After the operation just described fluid pressure at its maximum value is confined in the charging mechanism. In order to properly protect the mechanism from injury due to excess pressure rise, caused by thermal expansion of the fluid, when the guns are in the safety position, means such as the relief valve 48 is provided for discharging fluid pressures in excess of a predetermined value. This valve is so constituted that the excess fluid under increased pressure will be by-passed directly to reservoir when the pressure rises above a predetermined value.

We claim:

1. The combination with a machine gun having a bolt stud reciprocable during normal gun operation, of a hydraulic system comprising a charging device for retracting the bolt stud and then releasing the same for countermovement, a source of fluid under pressure connected to the charging device, means operable for controlling the flow of said fluid under pressure to the charging device, means operable for exhausting said fluid in said charging device, and means for controlling a charging cycle including a pair of devices responsive to predetermined high and low pressures respectively acting in said charging device, said high pressure device constructed and arranged to control said first-named means, said low pressure device constructed and arranged to control said second-named means,

whereby reciprocable movement of the bolt stud is obtained.

2. The combination with a machine gun having a bolt stud reciprocable during normal gun operation, of a pressure operated charging device for operating the bolt stud, means operable for admitting fluid under pressure to said charging device, means operable for exhausting said fluid under pressure from the charging device, means responsive to predetermined high and low pressures acting in said charging device for controlling said first and second-named means, said last-named means being constructed and arranged and so connected to said first and second-named means that said first-named means is controlled by said predetermined high pressure and said second-named means is controlled by said predetermined low pressure, whereby said charging device is operated to reciprocate the bolt stud, and means for controlling a charging cycle.

3. A mechanism to be associated with a machine gun for retracting the bolt stud thereof and then releasing it for countermovement comprising a charging motor having a portion engageable with the bolt stud, means operable for admitting fluid under pressure to said motor, means operable for exhausting said fluid under pressure, a first circuit including said first-named means, a switch in the circuit for closing the same to operate said first-named means to admit fluid under pressure to the motor, means in the first circuit responsive to a predetermined high pressure in the charging motor to open said first circuit to disconnect said first-named means from said circuit, a second circuit including said second-named means, and means in the second circuit including a mechanism in the first circuit and responsive to opening said first circuit to close the second circuit to operate said second-named means to permit said fluid under pressure to be exhausted from said motor.

4. A mechanism to be associated with a machine gun for retracting the bolt stud thereof and then releasing it for countermovement comprising a charging motor having a portion engageable with the bolt stud, means operable for admitting fluid under pressure to said motor, means operable for exhausting said fluid under pressure, a first circuit including said first-named means, a switch in the circuit for closing the same to operate said first-named means to admit fluid under pressure to the motor, means in the first circuit responsive to a predetermined high pressure in the charging motor to open said first circuit to disconnect said first-named means from said circuit, a second circuit including said second-named means, means in the second circuit including a mechanism in the first circuit and responsive to opening said first circuit to close the second circuit to operate said second-named means to permit said fluid under pressure to be exhausted from said motor, and means in the second circuit responsive to a predetermined low pressure in the charging motor to disconnect said second-named means from the second circuit.

5. A mechanism to be associated with a machine gun for retracting the bolt stud thereof and then releasing it for countermovement comprising a charging motor having a portion engageable with the bolt stud, means operable for admitting fluid under pressure to said motor, means operable for exhausting said fluid under pressure, a first circuit including said first-named means and a control device, a first switch in the circuit to close the same to operate said first-named means to admit fluid under pressure to the motor and to energize the control device, means in the first circuit responsive to a predetermined high pressure in the charging motor to render said first-named means inoperative and to open said first circuit to deenergize said control device, and a second circuit including said second-named means, said control device comprising a second switch constructed and arranged in the second circuit to be normally closed and openable in response to energization of said control device, whereby opening the first circuit permits said second switch to close to operate said second-named means to allow fluid under pressure to be exhausted from said motor.

6. A mechanism to be associated with a machine gun for retracting the bolt stud thereof and then releasing it for countermovement comprising a charging motor having a portion engageable with the bolt stud, means operable for admitting fluid under pressure to said motor, means operable for exhausting said fluid under pressure, a first circuit including said first-named means and a control device, a first switch in the circuit to close the same to operate said first-named means to admit fluid under pressure to the motor and to energize the control device, means in the first circuit responsive to a predetermined high pressure in the charging motor to open said first circuit to render said first-named means inoperative and to deenergize said control device, a second circuit including said second-named means, said control device comprising a second switch constructed and arranged in the second circuit to be normally closed and openable in response to energization of said control device, whereby opening the first circuit permits said second switch to close to operate said second-named means to allow fluid under pressure to be exhausted from said motor, and means in the second circuit responsive to a predetermined low pressure in the charging motor to open said second circuit to disconnect said second-named means therefrom.

7. A mechanism to be associated with a machine gun for retracting the bolt stud thereof and then releasing it for countermovement comprising a charging motor having a portion engageable with the bolt stud, means operable for admitting fluid under pressure to said motor, means operable for exhausting said fluid under pressure, a first circuit including said first-named means and a control device, a first switch in the circuit to close the same to operate said first-named means to admit fluid under pressure to the motor and to energize the control device, means in the first circuit responsive to a predetermined high pressure in the charging motor to open the first circuit to render said first-named means inoperative and to deenergize said control device, a second circuit including said second-named means, said control device comprising a second switch constructed and arranged in the second circuit to be normally closed and openable in response to energization of said control device, whereby opening the first circuit permits said second switch to close to operate said second-named means to allow fluid under pressure to be exhausted from said motor, and means in the second circuit responsive to a predetermined low pressure in the charging motor to open said second circuit to disconnect said second-named means therefrom, said first circuit including a

holding circuit constructed and arranged to close in response to energization of said control device to provide another path for current to said control device to keep the same energized after opening said first switch to enable the completion of a bolt retracting movement once initiated.

8. A mechanism to be associated with a machine gun for retracting the bolt stud thereof and then releasing it for countermovement comprising a charging motor having a portion engageable with the bolt stud, means operable for admitting fluid under pressure to said motor, means operable for exhausting said fluid under pressure, a first circuit including said first-named means and a control device, a first switch in the first circuit to close the circuit to operate said first-named means to admit fluid under pressure to the motor and to energize the control device, means in the first circuit responsive to a predetermined high pressure in the charging motor to open said first circuit to render said first-named means inoperative and to deenergize said control device, a second circuit including said second-named means, said control device comprising a double pole switch constructed and arranged so that one pole is in the second circuit normally closed but openable in response to energization of said control device, whereby opening the first circuit permits said double pole switch to close said one pole thereof to operate said second-named means to allow fluid under pressure to be exhausted from said motor, and means in the second circuit responsive to a predetermined low pressure in the charging motor to open said circuit to disconnect said second-named means therefrom, said first circuit including a holding circuit constructed and arranged to close in response to energization of said control device to provide another path for current to said control device to keep the same energized upon opening said first switch to thereby complete a bolt retracting movement once initiated, said other pole of said double pole switch constructed and arranged in the holding circuit to be normally open and closable in response to energization of said control device.

9. A mechanism to be associated with a machine gun for retracting the bolt stud thereof and then releasing it for countermovement comprising a charging motor having a portion engageable with the bolt stud, means operable for admitting fluid under pressure to said motor, means operable for exhausting said fluid under pressure, a first circuit including said first-named means, a switch in the circuit for closing the same to operate said first-named means to admit fluid under pressure to the motor, means in the first circuit responsive to a predetermined high pressure in the charging motor to open said first circuit to disconnect said first-named means from said circuit, a second circuit including said second-named means, means in the second circuit responsive to pressure above a predetermined low pressure in the charging motor to close said second circuit to operate said second-named means to exhaust fluid under pressure from said motor, and means in the first and second circuits responsive to closing the first circuit to open the second circuit to render said second-named means inoperable.

10. The combination with a machine gun having a bolt stud reciprocable during normal gun operation, of a pressure operated charging motor for operating the bolt stud, means for admitting fluid under pressure to said charging motor, means for exhausting said fluid under pressure from the charging motor, means comprising a pair of devices responsive to predetermined high and low pressures acting in said motor for controlling respectively said first and second-named means, said last-named means comprising an electrical system including said first and second-named means, said first-named means constructed and arranged in said system to be controlled by said high pressure device responsive to predetermined high pressure in the charging motor to shut off the flow of fluid under pressure to said motor, said second-named means constructed and arranged in said system to be controlled by said low pressure device responsive to predetermined low pressure in the charging motor and by electrical means in said electrical system, said electrical means constructed and arranged to be controlled by said high pressure device whereby fluid under pressure is exhausted from said charging motor, and manual means in said electrical system for controlling a charging cycle.

11. In combination with a machine gun having a bolt stud reciprocable during gun operation, a charging device associated with the gun for reciprocating the bolt stud to charge the gun, a first means operable for admitting fluid under pressure to said device, a second means operable for exhausting said fluid under pressure from said device, an electrical system, comprising a first circuit including said first means and a pressure switch normally closed but constructed and arranged to be opened when the pressure in said device reaches a predetermined maximum value to allow said first means to shut off said fluid under pressure, a second circuit constructed and arranged to be closed after said first circuit is opened and including said second means, and manually operated means for controlling a charging cycle and constructed and arranged to open the second circuit to disconnect said second means therefrom and close the first circuit, to operate said first means to admit fluid under pressure to said device.

12. In combination with a machine gun having a bolt stud reciprocable during gun operation, a charging device associated with the gun for reciprocating the bolt stud to charge the gun, a first means operable for admitting fluid under pressure to said device, a second means operable for exhausting said fluid under pressure from said device, an electrical system, comprising a first circuit including said first means and a pressure switch normally closed but constructed and arranged to open when the pressure in said device is above a predetermined maximum value to disconnect said first means from the first circuit to allow said first means to shut off said fluid under pressure, a second circuit including said second means and a pressure switch normally open to disconnect said second means from the second circuit but constructed and arranged to be closed when the pressure in said device is above a predetermined minimum value, and manually operated means movable from a normal position closing said second circuit to a position of closing the first circuit and opening the second circuit to operate said first means to admit fluid under pressure to said device whereupon said manually operated means is allowed to resume its normal position to operate said second means.

13. In combination with a machine gun having a bolt reciprocable during gun operation, a charging device associated with the gun for reciprocating the bolt to charge the gun, a first

means operable for admitting fluid under pressure to said device, a second means operable for exhausting said fluid under pressure from said device, an electrical system, comprising a first circuit including said first means and a pressure switch normally closed to render said first means operable to admit fluid under pressure to said device but constructed and arranged to be opened when the pressure in said device reaches a predetermined maximum value to render said first means inoperable to thereby shut off said fluid under pressure, a relay in the first circuit, a second circuit including said second means and a pressure switch normally open to disconnect said second means from said second circuit but constructed and arranged to be closed when the pressure in said device is above a predetermined minimum value, said relay including means in the second circuit responsive to energization of the relay for keeping said second circuit open when the first circuit is closed to render said second means inoperable when said first means is operated, and manually operated means in the first and second circuits for controlling charging of the gun.

14. In combination with a machine gun having a bolt reciprocable during gun operation, a charging device associated with the gun for reciprocating the bolt to charge the gun, a first means operable for admitting fluid under pressure to said device, a second means operable for exhausting said fluid under pressure from said device, an electrical system, comprising a first circuit including said first means and a pressure switch normally closed to render said first means operable to admit fluid under pressure to said device but constructed and arranged to be opened when the pressure in said device reaches a predetermined maximum value to render said first means inoperable to thereby shut off said fluid under pressure, a relay in the first circuit, a second circuit including said second means and a pressure switch normally open to disconnect said second means from said second circuit but constructed and arranged to be closed when the pressure in said device reaches a predetermined minimum value, said relay including means in the second circuit responsive to energization of the relay for keeping said second circuit open when the first circuit is closed, and manually operated means in the first and second circuits for controlling charging of the gun, said first circuit including a holding circuit normally open but constructed and arranged to be closed by said relay when said first circuit is closed by said manually operated means, said holding circuit constituted to remain closed when the first circuit is opened by the manually operated means to thereby complete a charging cycle once initiated.

15. In combination with a machine gun having a bolt reciprocable during gun operation, a charging device associated with the gun for reciprocating the bolt to charge the gun, a first means operable for admitting fluid under pressure to said device, a second means operable for exhausting said fluid under pressure from said device, an electrical system, comprising a first circuit including said first means and a pressure switch normally closed but constructed and arranged to open when the pressure in said device is above a predetermined maximum value, a second circuit including said second means and a pressure switch normally open but constructed and arranged to be closed when the pressure in said device is above a predetermined minimum value, manually operated means movable from a normal position closing said second circuit to a position of closing the first circuit and opening the second circuit to operate said first means to admit fluid under pressure to said device whereupon said manually operated means is allowed to resume its normal position, a two-position switch disposed in the electrical system ahead of said manually operated means and constructed and arranged in the first and second circuits to have a first position which energizes said circuits through said manually operated means and a second or safety position which energizes only said first circuit through a shunt around said manually operated means, and means responsive to pressure in the charging device to release only the pressure therein above a predetermined value whereby the bolt stud is held in a preselected position when the two-position switch is in the second position.

16. A mechanism for use with a machine gun having a bolt stud which is to be retracted and released for countermovement when charging the gun is desired comprising a fluid system having a fluid motor therein adapted to engage the bolt stud, electrical means including a device operable for admitting fluid under pressure to said system, a device operable for exhausting said fluid under pressure, a switch constituted to have one position for energizing said first named device for operating the same to admit fluid under pressure into said system and a second position for energizing said second named device for operating the same to exhaust said fluid under pressure, and means responsive to predetermined high and low pressures in said fluid system for respectively deenergizing said first named device and energizing said second named device.

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Certificate of Correction

Patent No. 2,440,071. April 20, 1948.

JOSEPH M. BOSHKA ET AL.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 6, line 45, strike out the word "under" and insert the same after "fluid", line 37, same column; column 8, line 8, claim 5, strike out the words "open said first circuit to" and insert the same before "render", line 7, same claim;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of December, A. D. 1948.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

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