

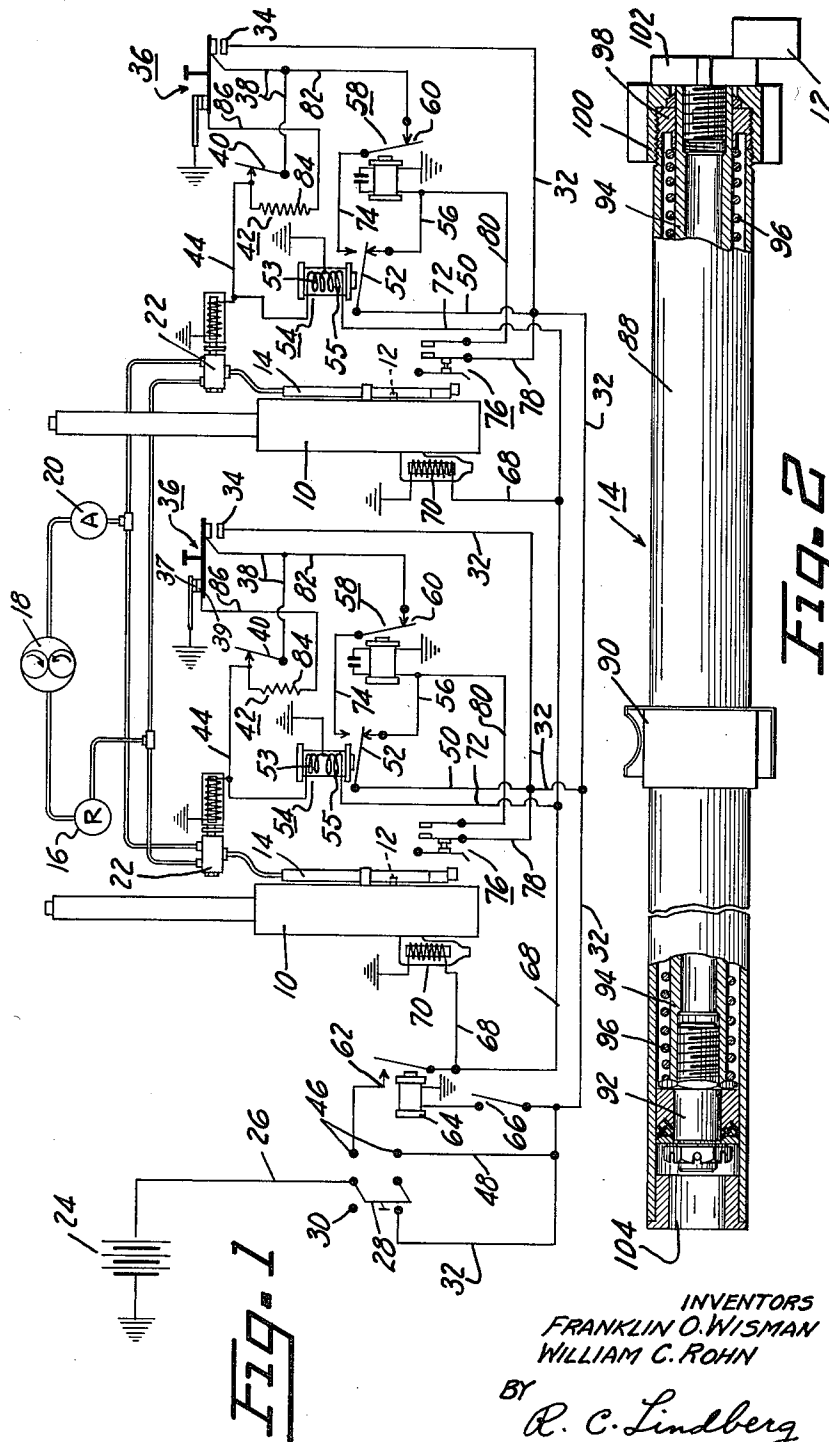
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AUTOMATIC MACHINE GUN CHARGER

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AUTOMATIC MACHINE GUN CHARGER

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This invention relates to automatic charging systems for automatic guns, and is particularly adaptable to both small and large caliber automatic guns.

As is known to those skilled in the ordnance are, guns of this type will not re-load automatically for automatic firing whenever a "dud" round has been inserted into the firing chamber, since no force will be obtained to eject the unfired round and insert a fresh round into the firing chamber. Guns of the automatic type may also fail at times to effect an automatic re-loading operation because the parts thereof become misaligned or otherwise inoperative. Accordingly, it is desirable to furnish means to effect a re-loading operation in the event that the gun fails to re-load because of defective ammunition or for some other reason. Since guns of this type are oftentimes located remotely from the operator, as for example, in the wings of an aircraft, it is desirable that the re-loading operation be effected automatically without requiring the operator to initiate and bring to completion a re-charging operation.

Many devices have been proposed for effecting a re-loading operation of an automatic gun upon failure to operate, but they have generally employed electro-mechanical means, or electro-pneumatic means. Devices employing electro-mechanical means have been open to the objection that they are oftentimes as heavy as the automatic gun which they are to re-load. In aircraft, where space and weight are at a premium, devices of this nature are obviously wholly unsatisfactory. So too, are electro-pneumatic devices, since they require for their successful operation a source of gaseous pressure, which must either be stored in cylinders furnished with the aircraft, or supplied by compressors driven from the aircraft engine. The instant invention avoids the objections to both electro-mechanical and electro-pneumatic charging or re-loading devices, since it employs in its operation the usual fluid pressure system incorporated with most military aircraft. Since the pressures employed in these systems are quite high, the usual pressure values being maintained between 500 and 1,500 pounds per square inch, the motors used in the recharging or re-loading operation need not be unduly large, nor need they add much to the weight of the aircraft, since high power to weight ratios are obtainable where the motivating fluid is kept between the values mentioned above.

The automatic charging system disclosed in the present invention is a further improvement

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over the prior art in that it is readily adaptable for use with different kinds of automatic guns, i. e., both small caliber guns, and the larger caliber guns. As is known to those skilled in the fire arms art, the small caliber automatic guns, for example, the caliber 30 and the caliber 50 machine guns effect the re-loading operation for automatic fire by reciprocation of the breech blocks in the following manner. The recoil operation of the gun causes the breech block to be moved rearwardly to eject the fired round and simultaneously to pick up a live round, which is forced into the firing chamber by the forward movement of the breech block, whereupon, if the sear is still released, the firing pin moves forward to fire the fresh round.

In the larger types of automatic guns employed in modern warfare, as for example, the 37 mm. cannon, which has been used in certain types of pursuit aircraft, and different types of ordnance vehicles, the re-loading operation is accomplished in a manner different from that had with the caliber 50 machine guns referred to above. In guns of this type the re-loading operation is accomplished by the recoil forces of the fired round causing the gun barrel to be moved rearwardly, carrying with it during such movement the breech block, which then continues to move rearwardly to complete its retractive movement after the gun barrel has finished its recoil movement and has moved forwardly to the firing position. The two movements just described effects the ejection of the fired round with the practically concurrent insertion of a new round into the feed way. Upon forward movement of the breech block, the new round is moved into the firing chamber, and if the sear is in the firing position, the gun continues to fire automatically.

With the foregoing problems in mind, it is an object of this invention to provide an automatic charging system for both the smaller caliber and larger caliber automatic weapons, the latter being adapted to fire explosive rounds, as for example, the 37 mm. cannon which has been referred to above.

A further object is to provide an automatic charging system for one or a plurality of guns of the type mentioned above which will employ in its operation fluid supplied by any suitable fluid pressure system.

A still further object of the invention is to provide an automatic charging system, which, after having been serviced for automatic operation,

will not require the further attention of the pilot or operator.

Still another object is to provide a charging system for manual charging of the guns to make them ready for automatic operation, the manual charging being generally effected by the service crew before the aircraft or other vehicle is engaged in combat.

Yet another object of the invention embodies the provision of a novel circuit for one or more of such guns, said control circuit being adapted to manual charging of the guns during servicing operations, and to automatic charging of the guns after the servicing operations have been completed.

A feature of the invention lies in the provision of automatic cutout means in a charging system for a gun should it become jammed in such a fashion that neither manual nor automatic charging restore the gun to a firing condition.

The foregoing and other objects of the invention will be apparent from the study of the description hereinafter, reference being had to the drawing which shows a preferred embodiment of the invention. It is to be understood, however, that the invention is not limited by the embodiment here shown, nor otherwise than by the terms of the claims appended hereto.

In the drawing which illustrates the invention:

Figure 1 is a schematic diagram showing a pair of guns of the types referred to above, the circuit for controlling the automatic operation and the manual recharging operation being shown schematically;

Figure 2 is a view part in elevation and part in longitudinal section of a charging cylinder, particularly of the type adapted for use with larger caliber automatic guns.

Referring now to Figure 1 of the drawing, there is shown a plurality of automatic guns 10 each having a breech block pin 12 which is secured to the breech block (not shown) of each gun 10, and adapted to reciprocate therewith during normal operation of the gun. Each gun is furnished with a fluid motor 14 which is adapted to retract the breech block pin 12 upon failure of normal reciprocation of the breech block, under conditions later to be described.

For supplying fluid under pressure to the fluid motor 14, there is a reservoir 16 which supplies fluid to a pump 18, which passes the supplied fluid under pressure to an accumulator 20, where it is stored for use as needed by the fluid motors 14.

In order to pass fluid simultaneously to each of the fluid motors 14 there are provided solenoid operated valves 22, which when energized, under conditions later to be described, opens to pass fluid from the accumulator 20 to the charging motor 14 to effect a retracting operation of the breech block stud 12, and when deenergized operates to exhaust fluid from the motor 14 back to the reservoir 16. The solenoid operated valve 22 is not claimed as a part of this invention, and has been described and claimed in Pontius et al. application, Serial No. 464,610, filed November 5, 1942, said application being a division of Pontius et al. application Serial No. 371,742, filed December 26, 1940.

Means are provided for effecting a manual charging operation of each or both of the guns 10. This operation may be indicated whenever a fresh supply of ammunition is desired to be provided for the guns 10. As shown in Figure 1,

the circuit for effecting a manual charging operation includes a source of electric power indicated generally at 24 which is connected by means of a lead 26 through a switch 28, which when closed on contact points 30 passes current to lead 32 to a contact point 34 of a manual charging switch indicated generally by the ordinal 36. It may be noted that the manual charging switch is not a conductor of current, and when the switch is moved downwardly, as seen in Figure 1, the ground of the switch 36 is broken by the separation of contacts 37 and 39, and current is then passed from the lead 32, through contact point 34 through a lead 38, and thence through a thermo-sensitive switch element 40 of a thermal switch 42, whence the current passes through a lead 44 to the solenoid of the solenoid operated valve 22. Simultaneous with the energization of the solenoid operated valve 22 is the energization of a winding 53 of a compound wound relay 54. It will be seen that the circuit just described causes the solenoid operated valve 22 to operate, thereby admitting fluid from the accumulator 20 to the fluid motor 14 to effect a retracting movement of the breech block pin 12. Deenergization of the solenoid of the solenoid operated valve 22 is effected by releasing the manual charging switch 36, which then causes the fluid in the fluid motor 14 to be exhausted back to the reservoir 16. Completion of the operation just described then places the guns 10 in condition for automatic operation and automatic charging.

As shown in Figure 1, the switch 28 is adapted to be closed upon a contact point 46, which performs two functions. The first of these functions is to pass current from the source 24 through the switch 28 to a lead 48 which is connected to the lead 32, which has branching therefrom a lead 50 which is connected to one terminal of an armature 52 of the compound relay 54, whence it passes through a lead 56 to energize the winding of a time delay mechanism, indicated generally by the ordinal 58, thereby attracting the armature thereof to the left breaking contact at a contact point 60. The second function taking place upon the closing of the switch 28 upon the contact point 46 is to pass current to a contact point 62 of a firing relay 64. The system thus far described has placed the guns ready for automatic operation, and has placed the system in readiness for automatic firing.

A trigger switch 66 is provided, and is common to both of the guns 10 shown, but it may be noted that the system is readily adaptable, where desired, to use with a trigger switch for each gun, instead of a single switch for a plurality of guns as shown. Closing the trigger switch 66 causes the firing relay 64 to be energized, at the same time causing the armature thereof to be attracted to the left upon contact point 62. It will be seen that this operation causes current to be passed through leads 68 to energize a solenoid of a trigger motor 70 associated with each of the guns 10. The function of the trigger motor 70 is well known to those skilled in the art, i. e., to actuate the sear, not shown, of the gun 10 to effect automatic firing.

Simultaneous with the closing of the trigger switch 66 is the energization of a winding 55 of the compound relay 54 which receives current by means of a lead 72 which branches from the lead 68. It will be remembered that energization of the compound relay 54 was had when the manual charging switch 36 was closed, when current was

supplied to the other winding 53 of the relay 54 simultaneously with the energization of the solenoid of the solenoid operated valve 22 which was operated to effect a manual charging operation. Energization of the compound wound relay 54 causes the armature 52 thereof to be attracted upwardly, when current is passed through leads 32 and 50 to a lead 74 to one end of the armature of the electrical time delay mechanism 58.

In order to prevent charging operations upon a gun which is operating properly, a gun switch 76 is provided near the rearmost point of travel of the breech block pin 12, and is adapted to close each time the breech block pin 12 moves rearwardly during operation of the gun 10. Closing of the switch 76 causes current to be received by a lead 78 which branches from the lead 50, whence it is passed through the switch 76 to a lead 80 to energize the time delay mechanism 58 causing the armature thereof to be attracted to the left. However, when the breech block pin 12 fails to reciprocate, because of improper gun operation, the switch 76 will fail to close, and the time delay mechanism 58 will be deenergized. It may be noted that the period of discharge of the time delay mechanism 58 is greater than the cyclic time of reciprocation of the breech block pin 12; thus, it will be noted, that during automatic firing and during normal operation of the gun 10, the time delay mechanism 58 will be in energized condition, and the armature thereof will be attracted to the left. Now if the breech block pin 12 fails to reciprocate and remains in static position long enough, the time delay mechanism will be deenergized, and the armature thereof will close upon contact point 60. A circuit is thus made to effect an automatic recharging operation.

The circuit is made from the source 24, through the switch 28, through leads 48, 32, 50, 74, and thence through a lead 82 to a juncture with the lead 38. The current then passes through the thermal responsive element 40 of the thermal cut-out switch 42 through the lead 44 through the solenoid of the solenoid operated valve 22 and thence to ground. Simultaneously with this operation, the winding 53 of the compound relay 54 is energized. The solenoid operated valve 22 then operates to retract the breech block pin 12, thereby reloading the gun 10 for automatic operation once more.

As soon as the breech block pin 12 has moved rearwardly to close the switch 76, the time delay mechanism 58 will be again energized, thereby breaking contact at contact point 60 and thus deenergizing the solenoid operated valve 22 to pass the motivating fluid to the reservoir 16.

Means are thus provided to insure the completion of a charging cycle or stroke regardless of the condition of the trigger switch 66, i. e., whether it be closed or opened during a charging operation. It was noted that the winding 55 of the compound relay 54 was energized as soon as the trigger switch 66 was closed, at which time the current was passed through the armature of the firing relay 64, through the leads 68 and 72 and thence to the compound relay 54. However, it may be noted that as soon as the charging operation thus described was initiated, the winding 53 of the compound wound relay 54 was energized also. With the winding 53 energized, the armature 52 of the compound wound relay 54 remained in the upward position, thereby passing current through the lead 74, lead 82, and thence through leads 38 and 44 to operate the solenoid operated valve 22. Since the winding 53 of the compound wound relay 54 will remain energized even after

the trigger switch 66 is opened it will be seen that the charging operation is brought to completion irrespective of the condition of the trigger switch 66.

Means are provided in the system described above to prevent the operation of the gun whenever it is impossible to carry to completion a retracting or reloading operation. The thermal cutout switch 42 is provided with a resistance element 84 which receives current from the lead 38. The circuit of resistance element 84 is completed by lead 86 and a pair of contacts of manual switch 36 to ground. These contacts are closed when the switch is not depressed. Since resistance element 84 is in parallel with the solenoid operated valve 22, it will be seen that any prolonged energization of the winding of the solenoid operated valve 22 will heat the resistance 84 to an amount whereby the thermal responsive element 40 breaks the circuit supplying current to the valve 22. The thermal cutout switch 42 is of the snap variety and once opened must be reset manually. When the circuit has been opened by the thermal responsive element 40, it will be impossible thereafter to pass current to the solenoid operated valve 22. It will be seen, therefore, that successive retracting operations will not be performed upon the gun 10.

The electrical system may be conveniently divided into a first and a second circuit. The first circuit comprising the battery 24, switch 28, contact 62, trigger motor 70, and the coil 55 of the compound relay 54. The second circuit comprises the battery source 24, switch 28, trigger switch 66, firing relay 64, normally closed means 52, time delay relay 58, wire 74, thermal cut-out device 42, electrically operated valve 22, coil 53 of the compound relay, normally open means for switch 76, and a manually operated switch 36.

Referring now to Figure 2 of the drawing there is shown an embodiment of the fluid motor 14 which has been found particularly adaptable to effect the retracting operation upon the larger types of automatic guns, as for example, the 37 mm. cannon. The fluid motor 14 comprises a cylindrical tube 88 which is secured to the gun by means of a mounting bracket 90 as shown. Reciprocable within the cylinder 88 is a piston 92 which has a skirt portion 94, encompassed by a spring 96 which is bottomed at one end against the piston 92, and which is bottomed at the other end by a threaded member 98 which is held to the cylinder 88 by means of a threaded element 100. The rearward end of the skirt 94 has threaded thereto a flanged member 102 which is adapted to engage the breech block pin 12 as shown. Fluid is supplied to the cylinder 88 at an entrance port 104 whence it impinges against the piston 92 to drive it rearwardly to effect a retracting movement of the breech block and the breech block pin 12. When the solenoid operated valve 22 is moved to the exhaust position, the cylindrical spring 96 moves the piston forwardly, and the exhaust fluid back to the reservoir 16.

Thus has been described a system adaptable for recharging automatic guns of both the smaller types, as for example, the caliber 30 and caliber 50 machine guns, and the larger type, as for example, the 37 mm. cannon, which will automatically charge or re-load said guns upon failure of automatic operation. While the invention has been described with particular reference to a proved embodiment thereof it is to be distinctly understood that the invention is not limited in terms of the system hereinabove described, nor

otherwise than by the terms of the claims appended hereto.

We claim:

1. A gun charging apparatus for retracting the breech bolt of a gun to charge the same comprising a fluid pressure motor adapted to be mounted on the gun and constructed and arranged to engage the breech bolt, an electrical system including a source of current and a first and a second circuit, a switch constructed and arranged for connecting said source of current to the first and second circuits, an electrically operated valve in the second circuit for controlling the fluid under pressure to the motor, a time delay relay, a normally closed means connecting said time delay relay to the second circuit, a normally open means in the second circuit adapted to be mounted on the gun and constructed and arranged to be closed by the breech bolt when retracted for connecting said time delay relay to the second circuit, a compound relay in the first and second circuits, a trigger switch in the second circuit, and means in the second circuit responsive to closing of the trigger switch for closing the first circuit to energize the compound relay, said compound relay being constructed and arranged so that when it is energized it will open the normally closed means connecting the second circuit to said time delay relay and tend to connect the valve and compound relay to said second circuit, whereby a charging cycle once initiated will be completed irrespective of the position of the trigger switch, said time delay relay being constructed and arranged to disconnect said compound relay and said valve from the second circuit during normal gun operation.

2. A gun charging apparatus for retracting the breech bolt of a gun to charge the same comprising a fluid pressure motor adapted to be mounted on the gun and constructed and arranged to engage the breech bolt, an electrical system including a source of current and a first and a second circuit, a switch constructed and arranged for connecting said source of current to the first and second circuits, an electrically operated valve in the second circuit for controlling the fluid under pressure to the motor, a time delay relay, a normally closed means connecting said time delay relay to the second circuit, a normally open means in the second circuit adapted to be mounted on the gun and constructed and arranged to be closed by the breech bolt when retracted for connecting said time delay relay to the second circuit, a compound relay in the first and second circuits, a trigger switch in the second circuit, means in the second circuit responsive to closing of the trigger switch for closing the first circuit to energize the compound relay, said compound relay being constructed and arranged so that when it is energized it will open the normally closed means connecting the second circuit to said time delay relay and tend to connect the valve and compound relay to said second circuit, whereby a charging cycle once initiated will be completed irrespective of the position of the trigger switch, said time delay relay being constructed and arranged to connect said electrically operated valve to the second circuit in the event of gun failure to cause the bolt to be retracted for charging the gun, and a thermal cut-out device in the second circuit including a thermal responsive element in series with the second circuit and a resistor disposed adjacent said element and connected in parallel with said electrically operated valve, said cut-out device being constructed and arranged to disconnect the valve from circuit after a predetermined number of successive attempts at charging the gun have failed.

3. A gun charging apparatus for retracting the breech bolt of a gun to charge the same comprising a fluid pressure motor adapted to be mounted on the gun and constructed and arranged to engage the breech bolt, an electrical system including a source of current and a first and a second circuit, a switch constructed and arranged for connecting said source of current to the first and second circuits, an electrically operated valve in the second circuit for controlling the fluid under pressure to the motor, a time delay relay, a normally closed means connecting said time delay relay to the second circuit, a normally open means in the second circuit adapted to be mounted on the gun and constructed and arranged to be closed by the breech bolt when retracted for connecting said time delay relay to the second circuit, a compound relay in the first and second circuits, a trigger switch in the second circuit, and means in the second circuit responsive to closing of the trigger switch for closing the first circuit to energize the compound relay, said compound relay being constructed and arranged so that when it is energized it will open the normally closed means connecting the second circuit to said time delay relay and tend to connect the valve and compound relay to said second circuit, whereby a charging cycle once initiated will be completed irrespective of the position of the trigger switch, said time delay relay being constructed and arranged to disconnect said compound relay and said valve from the second circuit during normal gun operation and to connect said valve and said compound relay to the second circuit in the event of gun failure to cause the bolt to be retracted for charging the gun.

4. A gun charging apparatus for retracting the breech bolt of a gun to charge the same comprising a fluid pressure motor adapted to be mounted on the gun and constructed and arranged to engage the breech bolt, an electrical system including a source of current and a first and a second circuit, a switch constructed and arranged for connecting said source of current to the first and second circuits, an electrically operated valve in the second circuit for controlling the fluid under pressure to the motor, a time delay relay, a normally closed means connecting said time delay relay to the second circuit, a normally open means in the second circuit adapted to be mounted on the gun and constructed and arranged to be closed by the breech bolt when retracted for connecting said time delay relay to the second circuit, a compound relay in the first and second circuits, a trigger switch in the second circuit, means in the second circuit responsive to closing of the trigger switch for closing the first circuit to energize the compound relay, said compound relay being constructed and arranged so that when it is energized it will open the normally closed means connecting the second circuit to said time delay relay and tend to connect the valve and compound relay to said second circuit, whereby a charging cycle once initiated will be completed irrespective of the position of the trigger switch, said time delay relay being constructed and arranged to connect said valve to the second circuit in the event of gun failure to admit fluid to said fluid motor to cause the bolt to be retracted for charging the gun, a

thermal cut-out device in the second circuit including a thermal responsive element in series with the second circuit and a resistor connected in parallel with said electrically operated valve, said cut-out device being constructed and arranged to disconnect the valve from circuit after a predetermined number of successive attempts at charging the gun have failed, and a manually operated normally open switch in the second circuit constructed and arranged to connect the electrically operated valve to said second circuit through a shunt around said normally closed means to thereby charge the gun at will.

5. A gun charging apparatus for retracting the breech bolt of a gun to charge the same comprising a fluid pressure motor adapted to be mounted on the gun and constructed and arranged to engage the breech bolt, an electrical system including a source of current and a first and a second circuit, a two-position switch disposed between the source and the first and second circuits and constructed and arranged to connect the source to the first and second circuits when in one position and to connect the source to the second circuit only when in one position and to connect the source to the second circuit only when in the other position, said positions being battery and safety positions respectively, an electrically operated valve in the second circuit for controlling the fluid under pressure to the motor, a time delay relay, a normally closed means connecting

said time delay relay to the second circuit, a normally open means in the second circuit adapted to be mounted on the gun and constructed and arranged to be closed by the breech bolt when retracted for connecting said time delay relay to the second circuit, a compound relay in the first and second circuits, a trigger switch in the second circuit, means in the second circuit responsive to closing of the trigger switch for closing the first circuit to energize the compound relay, said compound relay being constructed and arranged so that when it is energized it will open the normally closed means connecting the second circuit to said time delay relay and tend to connect the valve and compound relay to said second circuit, whereby a charging cycle once initiated will be completed irrespective of the position of the trigger switch, said time delay relay being constructed and arranged to disconnect said compound relay and said valve from the second circuit during normal gun operation, and a manually operated normally open switch in the second circuit constructed and arranged to connect the electrically operated valve to said second circuit through a shunt around said normally closed means to charge the gun irrespective of whether the two position switch is in battery or safety position.

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