INJECTOR PUMP FOR BREECH COOLING OF GUNS

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The invention relates to means for cooling machine guns by injection of water or other liquids or fluid, and seeks to present a practicable pump device operable by prior gun mechanism for supplying a liquid under pressure to a jet or other device at the gun chamber or bore.

It is a particular purpose to present such a device adapted to supply charges of water to the gun at the rapid intervals corresponding to the frequency of fire of current models of machine guns; which will also be of light weight, and small size, and adapted to be incorporated as a part of the gun without interfering with conventional use of the weapon.

Because of the delicate balance of forces in current models of machine guns, and the fact that any addition to the work required to be performed by the recoil operated mechanism is likely to result in the stoppage from causes that would not otherwise have such effect, it is an object of the invention to present a device which will require a minimum of work by the gun mechanism for its operation. In this particular it is a purpose to cause the pump to function as part of the recoil mechanism, so that it will act as a resilient buffer to absorb some excess of momentum in the present recoiling parts of the gun and to convert a part thereof to counter recoil energy.

A further attainment in view is the perfection of details in the pump by which a minimum impedance of a piston by liquid to be moved will be suffered, and a maximum of energy in the piston applied to compression of liquid at an injector jet, without requiring complicated devices.

Additional objects, advantages and features of invention reside in the construction, arrangement and combination of parts involved in the embodiment of the invention, as will be apparent or understood from the following description and accompanying drawings wherein:

Fig. 1 is a vertical longitudinal section of the rear end of a machine gun in which my invention is embodied.

Fig. 2 is a cross section on the line 2—2 of Fig. 1;

Fig. 3 is a cross section on the line 3—3 of Fig. 1;

Fig. 4 is a rear elevation of the bolt and striker plate;

Fig. 5 is a fragmentary longitudinal section of a modification of the pump.

Referring more particularly to the details in the drawing, there is illustrated a conventional machine gun having a receiver body or case 11, at the rear end of which grips 12 familiar in this gun are mounted on a back plate 13 forming part of the receiver. At the upper part of the back plate a trigger 14 is mounted, operable between the grips as heretofore.

The back plate 13 has the usual buffer disc sleeve 15 in which elastic buffer discs have heretofore been mounted supported rigidly at the rear or outer end of the sleeve, and bearing against a buffer plate set in the back plate and rearwardly yieldable to the bolt of the gun action, a form of which may be found in the patent to Browning 1,628,226. Equivalents of the discs are retained as at 16 and a buffer plate 17 mounted as before, but all the discs and the buffer plate are axially bored, so as to receive freely slide therethrough a piston rod 18 extending through the head 19 of a pump cylinder 20, the head being tenoned and threaded to screw into the rear interiorly threaded end of the sleeve 15 and against the discs as a rigid support or seat therefor. The tenon 21 is bored at its forward end to receive a packing and gland around the rod 18, as at 22, the rod 18 being snugly slidable through a reduced bore in the head. A pin 23 is fixed on the rod, reciprocable in the cylinder 20.

In the present instance the cylinder 20 is shown as a bored piece closed at its rear end by a plug 24. Set in the cylinder and confined between the plug 24 and piston there is a helical spring 25 serving to hold the piston (not shown) yieldingly at the forward limit of its movement. The tension of the spring may be adjustable, if desired, by means of the plug 24. The piston may also be made adjustable on the rod to vary the length of the forwardly extended part of the latter, as will be understood.

The length of the cylinder bore greatly exceeds the length of the rear of the piston, so as to accommodate a spring of adequate length.

The forward end of the rod 18 is in, and longitudinally aligned with, the path of the bolt 26 of the gun; and a striker plate 27 is mounted on the rear end of the bolt, to engage the end of the rod 18, avoiding liability of deformation of the material of the bolt and danger to the parts and protect and retain the rear and side metal against loose movement on impact of the bolt with the rod 18. This plate 27 is held in place by a dovetail bar 28 formed and fixed permanently to the back of the plate 27 and set slidable in a corresponding dovetail groove formed across the extremity of the bolt. The bar 28 is of a length equal to the width of the bolt, and with the latter fits slidably between the side plates of the receiver. In consequence, no fastenings are required for the plate 27, and it may be taken off manually when the bolt is taken out of the receiver by manually pressing the plate 27 toward the other side until the bar 28 clears the groove across the end of the bolt.

The cylinder 20 of Figs. 2 and 3 is formed with an inlet port 30, or more, adjacent the forward end of the piston when in initial position, and two or more ports 31 immediately to the rear of the piston when in said position. The cylinder has fitted and welded there around a manifold ring 32, U-shaped in cross section, into which a supply pipe 33 is set, and a U-bend pipe 34 also has one end set in the manifold and its other end set in the port 30, forming a by-pass between the cylinder spaces at opposite ends of the piston during a limited part of its movement. In a modification of the pump in Fig. 5, four ports 30' and four ports 31' (three of each being shown) are formed in the cylinder, the two series in the same relation to each other and to the piston as the ports 30 and 31, and an internally channelled manifold ring 35 is provided on the cylinder, broad enough to extend over and form common communication between all of the ports 30' and 31'. The supply pipe 33 is engaged in this manifold, but need for pipe 34 is eliminated, at the same time that a reduction of impedance of piston and bolt movements is attained, which will be understood.

At a distance rearwardly of the ports 31 an outlet 36 is formed through the wall of the cylinder, from which a high pressure pipe 37 is extended forwardly alongside or under the receiver 11 and to the chamber of the gun, or to other location, so that liquid carried through the pipe may be discharged into the gun chamber, or one; the last named details not being shown since they comprise no part of the invention claimed herein. It may be stated, however, that it has heretofore been proposed to inject water into the breech of a gun as a cooling expedient, and the use of a jet requiring the water to be
forced therethrough with a spraying effect has been contemplated. It will be seen that some extent of movement of the piston 23 from its initial position, shown in Fig. 1, may occur before it passes beyond the ports 31. Maximum high pressure is not developed in the outlet port 36 until the piston does pass beyond these ports, which may be termed cut-off. In order to utilize this function to produce a very certain measurement and instant high pressure discharge of liquid at whatever nozzle there may be provided at the gun breech, I have located in the pipe 37 a pressure regulating check valve 38, of suitable construction to permit passage of liquid to the gun after the piston 23 passes beyond the ports 31.

The valve 38 may be constructed so as to positively prevent return flow of the liquid toward the pump, and also may be adjustable or provided with a spring of strength sufficient to prevent flow toward the gun chamber until the pressure at the port 36 is higher than the hydrostatic head developed by inertia of the water before the piston in the early movement of the latter toward or to the rear sides of the ports 31.

The pump is so proportioned in relation to the movement of the rod 18 by the bolt that it may be adjusted to supply in the neighborhood of three or more grams of water to the gun on each operation of the piston in the case of a .50 caliber machine gun of the type indicated, and this may be varied by varying the pistons and cylinders of different diameters, or by adjusting the piston on the rod 18 by means of nuts 39 screwed on the rod before and behind the piston. The piston body between the nuts may be of conventional construction, suitable to the use disclosed. The cylinder is shown with a forward shoulder 20, which serves as a stop for the piston and therefore adjustment of the piston longitudinally on the rod 18 with corresponding changes of position of the nuts, determines the extent to which the rod projects into the receiver 11 and the length of stroke of the piston. Parts of the supply pipe 33 and high pressure pipe 37 may be flexible conduit to facilitate removal and replacement of the back plate, and for other purposes.

In a gun of the kind indicated, the bolt by which my rod 18 is operated has a weight in the neighborhood of five pounds and moves by recoil over a total distance of seven and one-half inches, and assuming the diameter of the bore to be 15 mm, the device is constructed in the present illustrated instance to utilize approximately nineteen millimeters of the terminal travel of the piston to produce a discharge of approximately three and one half grams of water. In addition, the initial movement of the piston by the adjustment shown may approximate seventeen millimeters, so that theoretically a stroke of approximately 37 millimeters would be utilized. A longer operation of the piston beyond the ports 31 may be necessary to compensate for elasticity in duct connections.

The initial, as well as final, movement of the piston by the bolt may have some impeding effect on the bolt, which may be compensated for by adjustment of the oil buffer device customarily present in the barrel recoil device in the gun indicated, or other recoil device, and adjustment of the plug 24 to cause more effective recoil function of the spring 25. These adjustments maintain or increase the rate of fire of the gun.

As the rod 18 is pushed rearwardly by the bolt, the piston first displaces water from the rear part of the cylinder through the ports 31, and forwardly through the pipe 34, into the extreme forward part of the cylinder, and against the forward side of the piston 23. At the same time, the spring 25 is progressively compressed, with increasing absorption of inertia of the bolt. As the piston passes rearwardly of the ports 31, cut-off there prevents further displacement of water through the ports 31, and a high resistance to travel of the movement of the piston develops by the inertia of liquid in advance of the piston toward the rear in the cylinder and standing in the pipe 37 to the gun chamber. The momentum of the bolt is assisted in this work by the momentum of the liquid in motion through the bypass pipe 34 to the forward side of the piston and aiding as a liquid piston, in the rearward movement of the piston 23. When cut-off occurs at the ports 31, inflow of water from the supply 33 to the manifold ring will avoid dissipation of the liquid piston energy before it has been materially utilized against the piston 23.

The spring 25 is preferably one capable of countering the inertia of the bolt, less that dissipated in operation of the piston upon the liquid, although the discs 16 may be permitted to perform some part of this function, the plate 27 engaging the buffer plate 17 in the same manner as the bolt itself, has heretofore done. It is my practice, in one manner of utilization of the invention, to maintain the water supply at 33 under pressure, so as to minimize to that extent impedance of the piston after cut off at the ports 31, the pressure supply being formally indicated as a storage reservoir 40 from which the pipe 33 leads, an air chamber 41 being indicated; also a pump 42 having an outlet 43 delivering to the reservoir 40. It will be understood that this is excited to intake. The pump is adapted to be otherwise mounted and connected to a recoiling member, and this is contemplated.

In this type of gun a separate recoil action is provided for the barrel, operatively connected with the cartridge feeding means, the extent of travel of this recoil being only about one and one-eighth inches; and the bolt, utilized for the loading, firing and extracting and cocking, moves in part independently over the greater part of its travel. The operation of my valve may tend to slow the bolt slightly due to the energy applied thereto. However, there is an initial recoil interaction and coupling between the barrel unit and the bolt unit, including an accelerator device on the barrel unit by which impetus may be added to the movement of the bolt, and the recoil of the barrel unit is adjustable so that this increment of motion in the bolt may be increased, to compensate for the energy required in operating the valve. The barrel and barrel also during a small part of their final counter-recoil movement.

While I have disclosed my invention in the best form in which I have constructed and used the same, it will nevertheless be understood that this is exemplarily only, and that improvement in design and proportions is commensurate with requirement of use, strength of material, and other factors; substitution of material and equivalents, mechanical or otherwise and rearrangement of parts, as discretion and the advance of general knowledge may indicate, are within the spirit of the invention in agreement with the claims hereunto appended.

I claim:

1. In an injector pump for cooling a gun having a receiver body, a barrel, a reciprocating bolt and a bolt buffer assembly, comprising, a pump cylinder, closed at its rearward end and provided with a bored, threaded forward head portion, said cylinder adapted to be threadably secured in coaxial relation to the rearward end of said bolt buffer assembly, a piston rod connected at its forward end to said reciprocating bolt and extending axially and rearwardly through said bolt buffer assembly, said axial bore reduced, a bored, threaded forward head portion on said pump cylinder and into the forward portion of said pump cylinder, a piston secured on the rearward end of said piston rod and slideable in said pump cylinder, a spring in said pump cylinder normally biassing said piston in a forward direction, an annular channel surrounding said pump cylinder, a first pipe connecting said annular
channel with a source of liquid coolant, a series of radial ports in said cylinder wall communicating between said annular channel and said pump cylinder, a second pipe communicating between said annular channel and the forward portion of said pump cylinder immediately forward of said piston when said piston is at its full forward position in said pump cylinder; a third pipe communicating between said pump cylinder at a point substantially rearward of said piston, when said piston is in said full forward position, and a barrel on said gun, said piston acting upon recoil to move in a rearward direction to force said liquid coolant into said barrel of said gun and a pressure regulating valve on said third pipe.

2. In an injector pump for cooling a gun having a receiver body, a barrel, a reciprocating bolt and a bolt buffer assembly, comprising a pump cylinder axially secured at its forward end to said buffer assembly, a spring-biased piston slidably mounted within said cylinder and connected to said reciprocating bolt of said gun, an inlet and an outlet port formed on said cylinder, said inlet port connecting with a source of liquid coolant and said outlet port connecting with said barrel, a first port in said cylinder adjacent the extremity of said cylinder secured to said bolt buffer, a second port therein spaced from said first port longitudinally, a by-pass duct outside of said cylinder and attached thereto placing said first and second ports in communication with each other, a manifold mounted on said cylinder connecting said inlet port with said second port, and said piston being initially located between said first and second ports.

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