Feb. 27, 1945. H. J. LIPPERT 2,370,363

AUTOMATIC FIREARM

Filed July 27, 1939 2 Sheets-Sheet 1

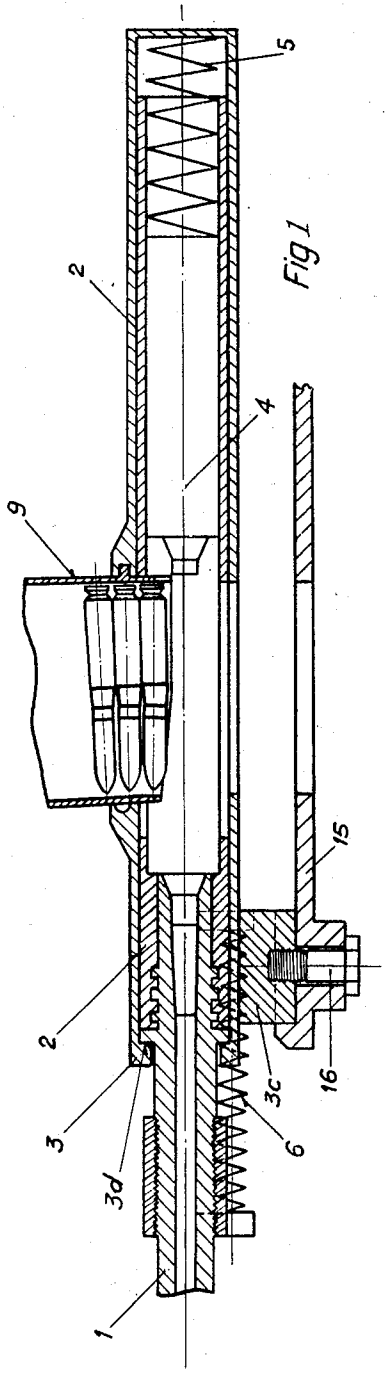

Fig. 1

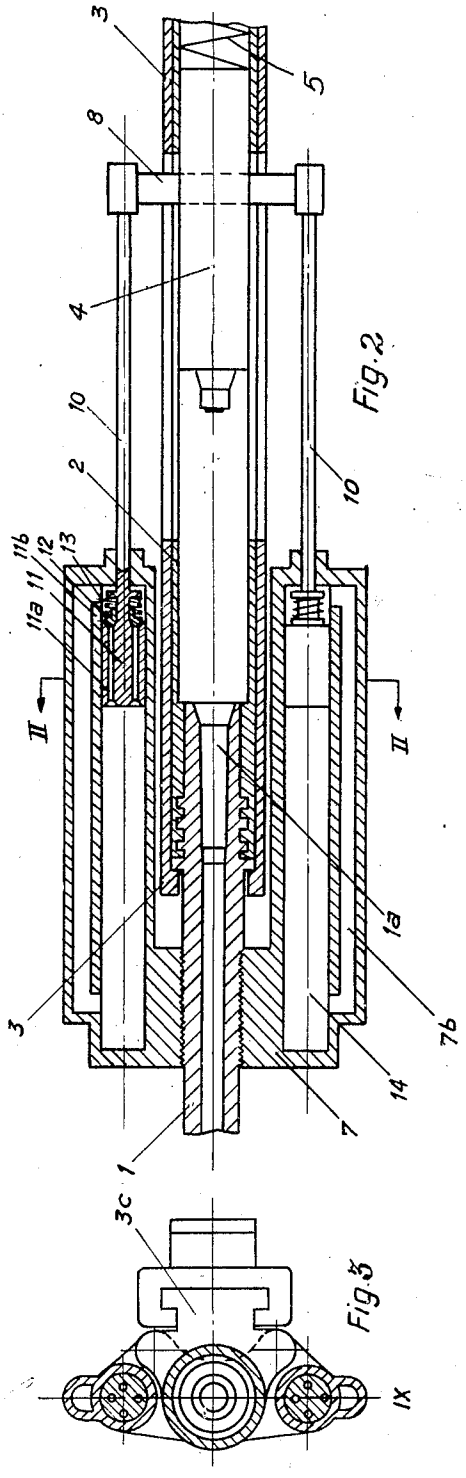

Fig. 2

Fig. 3

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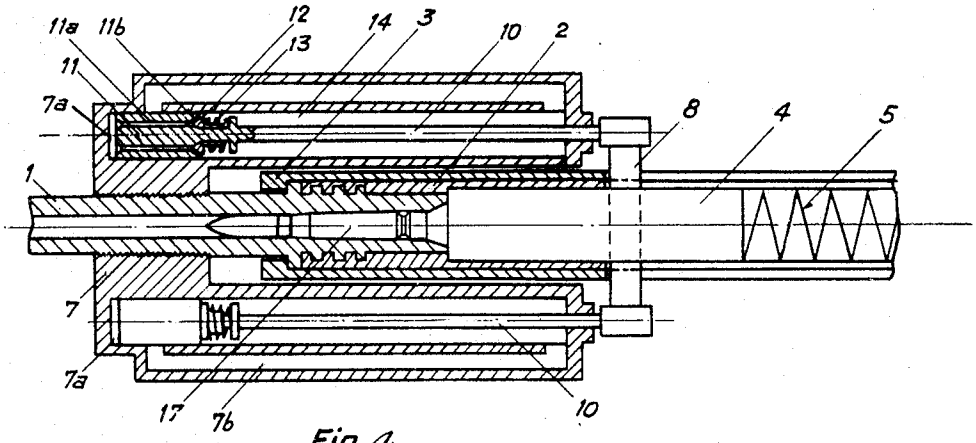

Fig. 4

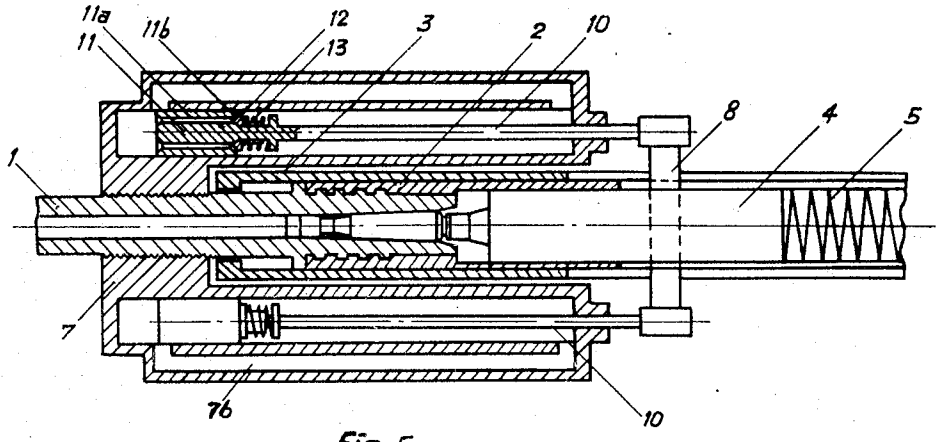

Fig. 5

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AUTOMATIC FIREARM

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8 Claims. (Cl. 89—3)

The requirements which modern warfare makes of automatic arms, particularly machine guns, aim first at increasing the rate of fire as much as possible and secondly at securing the highest possible capacity for withstanding continuity of fire. Both the increase in the performance by increasing the rate of fire and also the withstanding of rather long and continuous fire tests, represent when considered individually an increased stress on the fire-arm. A combination of continuity of fire and an increase in the rate of fire very decidedly involves an increase in the stress.

Mechanically rigidly locked systems in the form of recoil-operated guns with barrel recoil or of gas-operated guns enable the rate of fire to be increased very considerably by a suitable choice of mechanism. A disadvantage which then immediately appears is the fact already quite general with these systems that the more or less complicated mechanism required for the mechanically rigid locking, in so far as it can be rendered serviceable for a high rate of fire, has a tendency to produce stoppages and is by no means equal to long duration of fire.

The system of mass locking, which on account of the absence of any mechanical locking means is very simple and therefore extremely robust has proved itself equal to continuous firing tests in a very outstanding manner. In this system, however, the possibility of military application very soon sets a limit to an increase in the rate of fire for simple reasons. Thus, for example, in the case of an automatic gun of this type with a calibre of 40 mm. a rate of fire of 200 shots per minute would have to be obtained at the expense of a recuperator spring, the tension of which amounts to 700–800 kg. and the corresponding breech block mass would have to have a weight of 130 kg.

If it was desired to fire a gun of this type with a calibre of 20 mm. at a rate of fire of 800 shots per minute, it would be necessary to drive a breech block mass weight of 8 kg. by means of a spring, the tensioning force of which amounts to 500 kg. In view of setting up the gun in the open country, the precision and also the manufacture of springs, it is obvious that such masses, forces and the energies of motion produced at the indicated frequencies far exceed the permissible degree.

To sum up, it may be said that with rigidly locked fire-arms, higher rates of fire may be attained than heretofore, but they are not equal to long continuity of fire. On the other hand, the mass-locked fire-arms withstand long continuity of fire but their rate of fire is limited.

The present invention satisfies both requirements by employing a novel locking system, which makes it possible to effect locking in the same way as in the mass-locking method without mechanical locking means, while at the same time permitting the application of small, rapidly movable breech block masses with recuperator springs of low tension.

This is accomplished in accordance with the invention by uniting the breech block mass with the mass of the barrel through a hydraulic resistance which permits relative movement between the breech block and barrel during the action of the gas pressure forces in order to absorb such forces. Consequently, even with rather large calibres, a small, rapidly movable breech block mass can be used, and in spite of this, the gas forces can be taken up by coupling the itself insufficient breech block mass with the mass of the barrel.

The invention will be further described in detail with the aid of the accompanying drawings which show by way of example an embodiment of the invention. In said drawings,

Fig. 1 is a vertical section through the automatic gun along the longitudinal axis of the barrel;

Fig. 2 represents a horizontal section;

Fig. 3 is a transverse section along the line II—II of Fig. 2; while

Figs. 4 and 5 show the parts in different positions.

The barrel of the gun is shown at 1, and is supported within the casing 3, in which is disposed the breech sleeve 2 connected to the barrel. Within the sleeve 2 the breech block 4 and the recuperator spring 5 are longitudinally guided. The barrel, however, is not rigid with the casing 3 as is usual, but slides in the casing 3 along with the breech sleeve 2 connected therewith. The recuperator spring 6 urges the barrel with the breech sleeve 2 against the stop or abutment 3*d*. The casing 3 is rigidly connected with the gun mount 15 at the extension 3*c* by means of the bolts 16. The cartridge magazine is shown at 9.

Connected with the breech block 4 by way of the connecting bar 8 and the rods 10 are pistons 11 which move in the bores of the two brake cylinders 7. The pistons 11 are provided each with a non-return valve 12 pressed against their seats by the springs 13. The pistons 11 are further provided with through channels 11*a* controlled by the valve 12, and also with slits 11*b* in the

valve seat leading from the channels 11a but not controlled by the valves. The brake cylinders are filled with a suitable liquid indicated at 14.

The cylinders are each provided with a transfer passage 7b connected at its rear with the rear portion of the cylinder but connected at its front end at a point removed from the forward end of the cylinder. By this construction the piston acts as a slide valve covering the forward connection between the cylinder and transfer passage, as will be seen from Figs. 4 and 5; during the initial rearward movement of the pistons, as shown in Fig. 4, flow of fluid through the transfer passages is prevented until the pistons have uncovered the forward connections between the cylinders and transfer passages. During this interval, fluid is transferred from the rearward to the forward portions of the cylinders only through the slits 11b. Upon forward movement of the pistons into the forward extensions 7a of the cylinders, the displaced fluid can escape only through the passages 11a and 11b and against the action of the springs 13 so that a resistance is opposed to the forward movement of the pistons.

The operation of the illustrated fire-arm is as follows: From the open breech position, as shown in Figures 1 and 2, the breech block is projected forwardly by the recuperator spring 6. The two pistons 11 move the liquid 14 rearwardly through the transfer passages 7b. During the whole of the forward stroke, the barrel and breech sleeve 2 in their most advanced position are pressed against the stop 3d by the recuperator springs 6. When the pistons 11 close the forward transfer opening, the hydraulic coupling comes into operation, the liquid being able to escape only through channels 11a and valve 12, until the forward reversing position shown in Figure 4 has been reached. In this way, the forces transmitted by the hydraulic coupling are transmitted directly to the gun mount 15 through the stop 3d. On the following recoil stroke of the breech block, the action of the hydraulic coupling is still further increased to a considerable degree, because the valves 12 are pressed against their seats by the liquid pressure produced and only allow the liquid to pass through the slits 11b. The rearward driving force of the gas pressure is absorbed by the breech block and is transmitted through the hydraulic coupling partly also to the barrel 1 and the breech sleeve 2, which under this influence slide in the casing 3 and move backward against the action of the recuperator springs 6. From the operation described above it follows that the breech block, during the coupling, is driven more rapidly to the rear by the amount of the slippage between the breech block and barrel. The hydraulic coupling is automatically rendered inoperative by the front face of the pistons uncovering the transfer passages 7b. At this moment, the gas pressure has not yet entirely ceased to act, so that a residual gas impulse acts on the breech block alone and drives it into its rear reversing position. After the coupling has been rendered inoperative, the barrel 1 and the breech sleeve 2 are immediately forced forward again by the recuperator springs 6. They will reach their forward position of rest before the breech block passes through its rear reversing position.

From the standpoint of the locking, the brief coupling of the breech block with the movable barrel and breech sleeve signifies an increase in the locking mass during the action of the gas pressures.

In the illustrated embodiment of the invention I have shown a hydraulic coupling; but it will be obvious that any other similarly acting, automatically engaging and releasing electrical or mechanical coupling between the breech block and barrel can be used without departing from the spirit of the invention.

I claim:

1. An automatic fire-arm of the mass-locked type, comprising a casing, a barrel slidable in the casing, a breech block in the casing, and hydraulic coupling means for yieldingly coupling said breech block with said barrel for retarding relative movement therebetween upon firing, whereby the additional inertia of the movable barrel is utilized to resist the action of the gases.

2. An automatic fire-arm according to claim 1, wherein the hydraulic coupling means comprises a liquid-filled cylinder connected to the barrel, a piston movable in the cylinder and connected to the breech block, and means for controlling the flow of the liquid in the cylinder in a manner to cause coupling of the breech block with the barrel approximately from the moment of firing to shortly before the cessation of the gas pressure forces.

3. An automatic fire-arm comprising a casing, a barrel slidable in said casing, a slidable breech block, a liquid filled cylinder rigidly connected with the barrel, a piston slidable in said cylinder and connected with the breech block, and means acting to create a resistance to the movement of the piston within the cylinder during the initial rearward movement of the breech block to compel the cylinder and barrel to move with the breech block, whereby the masses of the breech block, cylinder and barrel are coupled for absorbing the forces created by the gas pressures.

4. An automatic fire-arm comprising a casing, a barrel slidable in said casing, a slidable breech block, a liquid filled cylinder rigidly connected with the barrel, a piston slidable in said cylinder and connected with the breech block, and means acting to create a resistance to the movement of the piston within the cylinder during the initial rearward movement of the breech block to compel the cylinder and barrel to move with the breech block, whereby the masses of the breech block, cylinder and barrel are coupled for absorbing the forces created by the gas pressures, said cylinder including a transfer passage for the liquid from the forward to the rearward part of the cylinder and vice versa, the forward connection between the cylinder and passage being spaced from the forward end of the cylinder, whereby the piston closes such connection in its forward position, said means including a channel in the piston limiting the movement of fluid from the rear to the forward portions of the cylinder during the period that the piston covers the said connection.

5. An automatic fire-arm comprising a casing, a barrel slidable in said casing, a slidable breech block, a liquid filled cylinder rigidly connected with the barrel, a piston slidable in said cylinder and connected with the breech block, and means acting to create a resistance to the movement of the piston within the cylinder during the initial rearward movement of the breech block to compel the cylinder and barrel to move with the breech block, whereby the masses of the breech block, cylinder and barrel are coupled for absorbing the forces created by the gas pressures, said

cylinder including a transfer passage for the liquid from the forward to the rearward part of the cylinder and vice versa, the forward connection between the cylinder and passage being spaced from the forward end of the cylinder, whereby the piston closes such connection in its forward position, said means including a channel in the piston limiting the movement of fluid from the rear to the forward portions of the cylinder during the period that the piston covers the said connection in its rearward movement, and a non-return valve arranged to partially close said channel and to be unseated during the forward movement of the piston.

6. An automatic fire-arm of the mass-locked type, comprising a casing, a barrel slidable therein, a slidable breech block, a hydraulic coupling having parts connected to the barrel and breech block, said coupling including means whereby said coupling connects the barrel and breech block to cause the two to move together during the initial rearward, recoil movement of the block, subsequently effective means for substantially releasing the connection between the barrel and block, and mechanism for returning the barrel and breech block to firing position.

7. An automatic fire-arm, comprising a casing, a barrel and a breech block both slidable in said casing, the barrel being slidable rearwardly from the firing position, a recoil spring acting on the barrel and urging it forwardly to firing position, an automatic hydraulic coupling between the breech block and barrel and acting upon the explosion of a projectile charge to couple the mass of the barrel to that of the breech block, the inertia of the breech block barrel and coupling constituting the only initial resistance to the rearward movement of the breech block, the hydraulic coupling being provided with means for gradually releasing the interlock between the breech block and barrel, whereby relative movement therebetween occurs as the breech block recedes further from firing position, and recoil mechanism for returning the breech block to firing position.

8. An automatic fire-arm, comprising a casing, a barrel and a breech block slidable in said casing, the barrel being slidable rearwardly from firing position, recoil mechanism for returning the barrel and breech block to firing position, and mechanism for utilizing the inertia of the breech block and of the barrel for initially and temporarily resisting recoil movement of the breech block, said mechanism comprising a pair of hydraulic cylinders connected with the barrel, pistons in said cylinders connected with the breech block, means in said cylinders interposing a high resistance to the flow of liquid from the rear to the forward portions of the cylinders, means in said cylinders affording a low resistance path for the liquid after the pistons have travelled a limited distance, whereupon rapid relative movement between the breech block and barrel takes place, said cylinders providing a low resistance path for liquid from the forward to the rearward portions of the cylinder upon forward travel of the pistons.

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