July 15, 1941. R. BRAUN ET AL 2,249,310

GUN MOUNTING FOR MACHINE GUNS ADAPTED TO RECOIL

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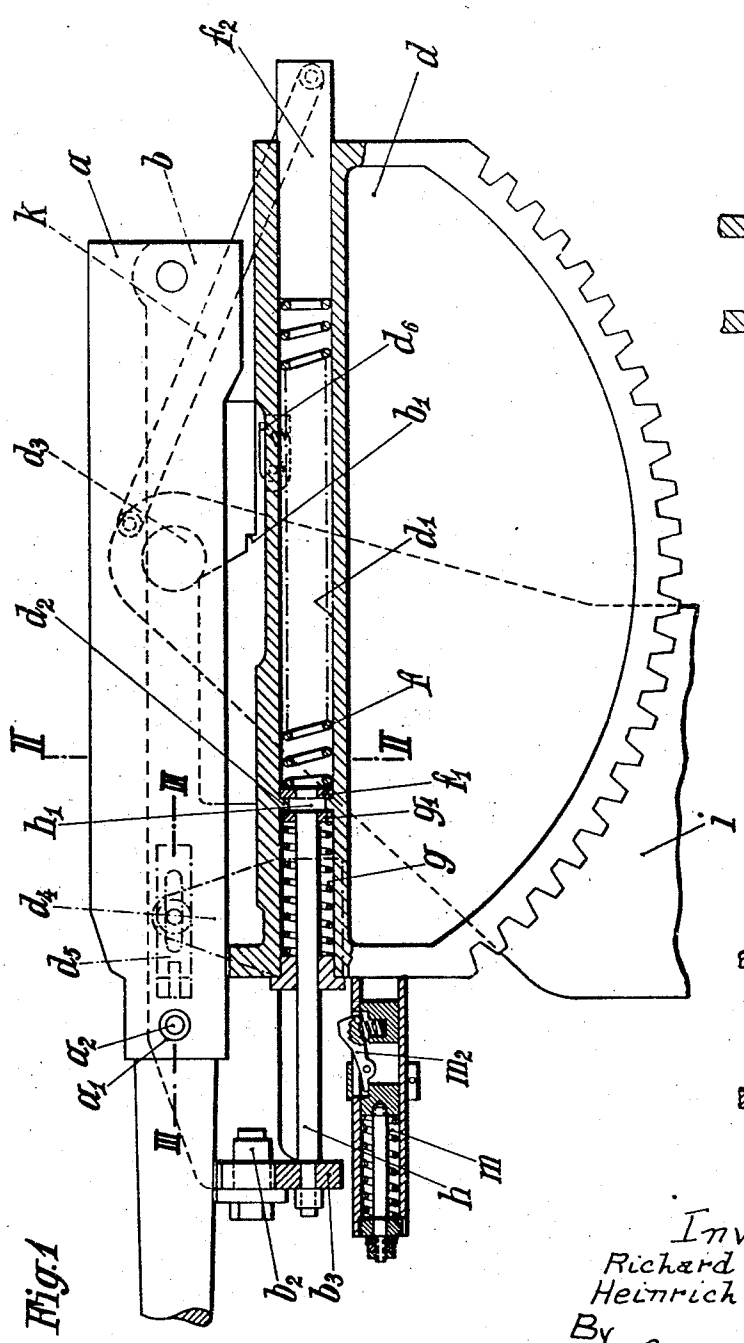


Fig.1

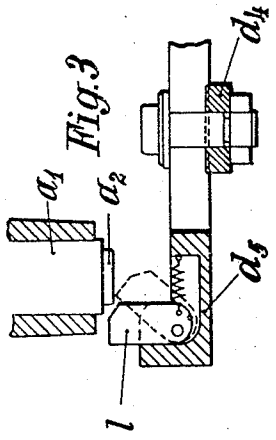


Fig.3

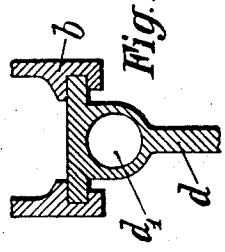


Fig.2

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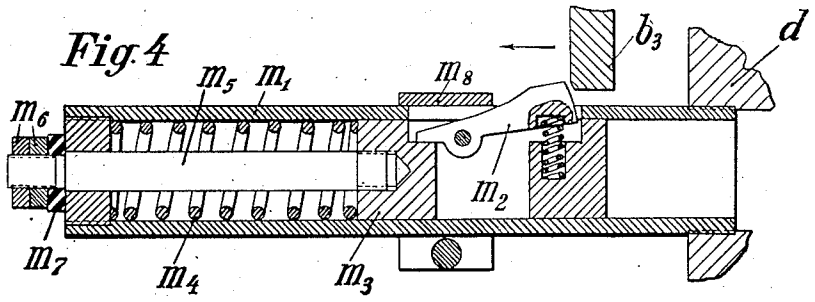
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Fig. 4



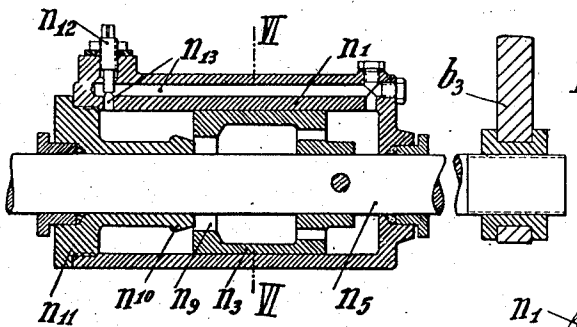


Fig. 5

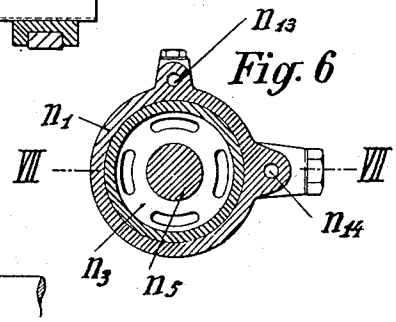
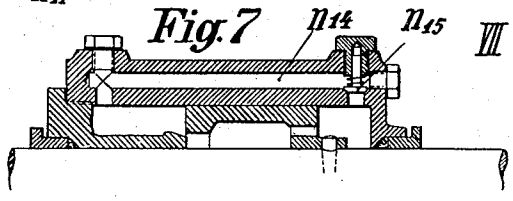


Fig. 6

Fig. 7



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UNITED STATES PATENT OFFICE

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GUN MOUNTING FOR MACHINE GUNS ADAPTED TO RECOIL

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5 Claims. (Cl. 89—42)

In order that precision of fire may be increased, mounted machine guns have, according to a recent practice, been arranged to recoil on the gun mounting. This insures steadiness of the gun mounting during firing. It was recognised however, that each shot in a series should be fired as far as possible under like conditions, and particularly with one and the same longitudinal position of the gun on the gun mounting and that buffer and "running-out" devices should have as far as possible an equal and impact-free action.

Attempts have hitherto been made to obtain those conditions by constructing the firing devices so that they, after firing the first shot, are prevented from again firing the gun until it has returned into firing position. In such construction however, the gun, in order to avoid injurious impact, should return into its normal, initial or firing position with reduced speed and only after the recoil force had been overcome and this resulted in a serious decrease in the speed of fire.

On the other hand higher firing-speeds were attained with an arrangement in which the gun was supported in a floating, intermediate position between two sets of opposing springs, one of which served as a recoil-braking device, and the second operated as a counter recoil braking device at the end of the running home or return movement of the gun. In this latter arrangement, moreover, a finger on the gun mounting which partially follows the recoil of the gun, comes into operation when the gun runs-out for the second and each subsequent shot in a series and produces an early-detonation effect as occurs in guns of the type having a recoiling barrel, and thus, is able to utilize the running-out energy of the gun in order to dissipate the subsequent recoil energy. But the requirement that there should be the same conditions for each individual shot was not thereby fulfilled, as firing occurred when the gun was still, while the subsequent shots occurred during the forward movement of the gun. Accordingly the recoil was taken up at the first round fired by the recoil buffer device alone, but thereafter with the assistance of the absorbing effect of any available running-out energy. It is hardly possible by such arrangement to obtain a constant firing position for the gun on the mounting, and this is particularly so in the case of large-calibre machine guns, and the considerable deviations from the first firing position impairing the accuracy of fire.

In order to attain high precision of fire, the main object of the invention is therefore to procure uniform firing positions of the gun on its mounting, and also of the movement of the gun, when each shot is fired. The attainment of such conditions, diminishes to a certain extent the reduction in the speed of fire of machine guns which are movably carried on their mountings as compared with the speed attainable when the guns are rigidly mounted. In a gun subjected to the action of oppositely operating springs according to the present invention and wherein the recoil energy is absorbed by running-out energy, the firing of the first and every subsequent shot is controlled according to the position of the gun on the gun-mounting. Before each shot is fired the gun is in a rear cocked-position on the gun mounting, and moves forward from this position in order to be fired. The gun is fired when it reaches a certain position during this forward movement, by the action of a member of the gun-mounting acting on the trigger of the gun. Then the recoil energy generated when the shot is fired is absorbed partially by the available running-out energy of the gun, while leaving a reserve of energy which suffices to return the gun to its initial position in preparation for the next shot. Thus, with only small braking forces, the path of recoil of the gun is short, the operation is substantially completely free from jars, and its speed of firing is to no appreciable extent inferior to the speed of firing of the gun when mounted rigidly. Further advantages of the invention will be explained by reference to the example of construction shown in the accompanying drawings in which;

Fig. 1 shows a side elevation of the mounted gun, the essential parts being in section,

Fig. 2 is a partial cross-section along the line II—II of Fig. 1,

Fig. 3 shows, on an enlarged scale, a sectional plan of the firing device along the line III—III of Fig. 1,

Fig. 4 shows, in sectional elevation, an additional running-out buffer-device in the form of a spring brake, and

Figs. 5–7 show fragmentary sectional views of a modification of the buffer device in the form of a hydraulic brake.

The gun *a*, which may for example be a machine gun of 3.7 cm. caliber, is carried on the gun mounting by a slide *b* which in turn is mounted for longitudinal displacement on a cradle member *d* having bore d_1, which serves as a guide. In this upper longitudinal bore d_1 of the cradle member *d* there are enclosed the buffer device for the slide *b* in the form of a

recoil buffer spring f together with a front buffer spring g. These springs act in opposite directions on the slide b by way of displaceable abutment washers f_1 or g_1 at either side of the intermediately disposed fixed collar h_1 on a piston rod h which is bolted at b_3 to the slide b. An abutment d_2 in the bore d_1 having an opening of approximately the same diameter as the collar h_1 of the piston rod h limits the forward movement of the washer f_1 of the recoil spring f and also the rearward movement of the washer g_1 of the buffer spring g and the arrangement is such that only one of the two springs f and g acts on the spring bar h at a time, and in their action they therefore cannot mutually overcome the action of each other. The rear washer f_2 of the recoil spring f is displaceable and adapted to be adjusted, by means of a link k which is connected to the lower gun mounting i eccentrically to the trunnion d_3, in dependence on the elevation of the gun barrel, in such a manner that by an increase or decrease in spring compression, the weight component of the gun and its slide b which may be resolved in the direction of recoil of the gun, is compensated for.

An arm d_4 on the cradle d (see Figs. 1 and 3) projects upwardly at the side of the gun and carries on a bar d_5 a spring actuated firing finger l which protrudes into the path of a trigger actuating member a_2 of the gun, which member in the form illustrated in the drawings projects from a bearing pin a_1. The firing finger l, on its supported bar d_5 is adapted to move out of the path of the trigger actuating member a_2 against the action of a spring, in order, when the gun recoils, to allow the latter to pass by uninfluenced. In order that the firing position may be fixed as desired, the bar d_5 is made adjustable in the direction of the path of movement of the gun.

For making the gun ready for firing, the sliding system consists of the gun a and the slide b is drawn back on the cradle d into the rear cocked position, where it is held firmly by the trigger plate d_6 of the cradle d engaging the notch b_1 in the slide b. The recoil spring f is thus compressed and the actuating member or plunger a_2 passed to the rear of the firing finger l of the cradle d.

In order to fire the gun the slide b is released by moving the retaining member or trigger plate d_6, whereupon the gun a with the slide b quickly moves forward actuated by the recoil spring f. When it reaches the firing finger l the plunger a_2 is pressed inwards and the firing mechanism of the gun is set in operation. As soon as a shot has been fired as for instance from the gun a and slide b are in the position shown in Fig. 1 on the cradle d, when the action of the recoil spring f ceases upon the abutment washer f, striking against the abutment d_2 and the forward moving parts, the gun a and the slide b have attained their greatest speed. Thereupon the gun a and the slide b continue their forward motion a further distance against the counter action of the buffer spring g, until the gun recoil which first sets the slidable parts inside the gun mechanism in motion, is able to act upon the gun and its slide b as a whole, and after dissipating the stored energy, with its remaining force, partly aided by the spring g, throws the gun a and the slide b back into the initial position thus compressing the recoil spring f. If then the trigger plate d_6 is moved back into the path of the slide b for interrupting fire, the slide is arrested and held fast in the rear cocked position. Otherwise the described cycle of operations is continued and the gun is run forward, a shot is fired and the gun recoils until eventually the trigger plate d_6 is brought into action as a locking device.

This locking device d_6 is so disposed that the notch b_1 on the gun slide b, after a shot has been fired is thrown to the rear by the recoil past the locking member d_6, before the gun, under the influence of the recoil spring f, again runs forward. Thus the result is obtained that also for the shots following the first one in continuous fire, at the moment when the gun trigger a_2 is influenced, there is always one and the same condition of movement and speed. As a precaution, the recoil of the gun beyond the arresting position provided by the locking device d_6, may also be limited by a buffer b_2, preferably of rubber and mounted, for example, at the front end of the slide b and arranged to strike against the front face of the cradle d.

Unavoidable differences in the recoil energy give rise to different speeds at the moment when the trigger is released and at the moment when the projectile leaves the gun. Such irregular conditions impairing the accuracy of fire may be due to difference in ammunition and process of combustion and also to varying frictional conditions, in spite of the release of the gun trigger a_2 which takes place with the gun always in the same position.

According to the invention there is also provided an additional buffer device m which has an equalising effect on the recoil and counter-recoil movements of the gun, which obviates at the outset any differences between the speed of one running-out movement and the others due to the circumstances explained above. This damping device may be fixed at the front end of the cradle member d, but could also be incorporated in the device f, d_1. The additional buffer device acts only at the beginning and at the first part of a recoil movement of the gun. For this purpose as shown in Fig. 1 and on an enlarged scale in Fig. 4, there is mounted in a buffer casing m_1 which is secured to the cradle d, a plunger m_3 carrying a pivotal catch m_2, so as to be displaceable forwardly against the action of a pre-tensioned spring m_4. A plunger rod m_5 which protrudes through the front end wall of the casing, limits by means of an abutment formed by the nuts m_6 in conjunction with a flexible washer m_7, the rearward displacement of the catch m_2 which projects into the path of a projecting lug b_3 on the gun slide b. Shortly before the gun reaches the rear end position on the cradle d when it recoils after a shot has been fired, the slide lug b_3 passes the catch m_2 and comes into position behind the lug. A subsequent running-out movement of the gun, by the cooperation of the members b_3, m_2 causes the plunger m_3 to join in the forward movement but counteracted by the spring m_4 and thus the recoil spring f is subjected to a damping force which moderates or eliminates any speed irregularities. After recoiling a certain distance, the end of the catch m_2 enters under a control ring m_8 placed around the buffer m, thus being moved out of the path of the slide lug b_3, whereupon the further forward movement of the gun is effected solely by the action of the running out spring f. The plunger m_3 with the catch m_2 returns into its rear initial position and is ready to come into operation again the next time the gun recoils. The fact that the control ring m_8 is adapted to be dis-

placed on the casing m_1 makes it possible to modify as desired the duration and magnitude of the force exerted by the buffer while by means of the nuts m_8 on the plunger rod m_5 the length of the stroke of the plunger can be adjusted.

A device which is more advantageous than the spring buffer shown in Fig. 4 is the hydraulic device shown in Figs. 5 to 7. In this case the projecting lug b_3 is in firm and constant connection with a plunger rod n_5 which controls a hollow plunger n_3 fixed thereon and which reciprocates in the hydraulic cylinder n_1. During a definite portion of the recoil of the slide b on the cradle d (Fig. 1), the front wall of the plunger n_3 which is provided with an enlarged bore n_9 moves over a collar n_{10} on the inwardly prolonged cylinder cover n_{11} fitting closely therein so as to make a seal at this point. The liquid from the front end of the piston is thereby forced to the rear of the piston through a narrow by-pass n_{13} which is adapted to be throttled by means of an adjusting screw n_{12}. Thus the recoil of the gun is opposed by a damping force the magnitude of which may be controlled by means of the throttle screw n_{12} and which, depending on the actual recoil speed at any time automatically, controls and checks any undesired excess of speed. The conical shape of the collar n_{10} ensures that the damping force is produced smoothly without jar. In order to eliminate any braking effect when the gun recoils there is provided as shown in Fig. 7 a second liquid by-pass n_{14} which, when the plunger bore n_9 passes over the collar n_{10}, causes the liquid behind the plunger to flow unthrottled into the free space in front of the plunger. A non-return valve n_{15} then closes the bore m_{14} in order to prevent liquid from passing in the reverse direction when the gun runs out.

The throttling control of the damping force can also be utilized advantageously in order to change the speed of fire, while the adjustability of the point of engagement of the slide lug b_3 with the plunger rod n_5 renders it possible to adjust the range of action of the device during the running out of the gun.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:

1. An automatic gun and carriage in which it is recoilably mounted comprising means on the carriage for firing the gun during its forward run-out movement, a recoil and run-out spring and a buffer spring operative on said gun in opposite directions, means for retaining the gun under the tension of said run-out spring in a position rearward of normal forward position whereby the first shot of a series after release of the gun by said retaining means will be fired by said firing means under conditions of gun movement similar to those of succeeding shots of the series, and brake means operative upon the gun only during the first part of its forward run-out movement and including a member temporarily engaged by a recoiling part of the gun during the forward run thereof, and means for adjusting the range of such engagement.

2. An automatic gun and carriage in which it is recoilably mounted comprising means on the carriage for firing the gun during its forward run-out movement, a recoil and run-out spring and a buffer spring operative on said gun in opposite directions, a brake device co-operating with a recoiling part of the gun in said run-out movement, means in said brake device limiting effective braking action to a restricted range in said movement, co-acting stop means on said brake device and the recoiling part and means for adjusting the stop means on the brake device to time said range of effective braking action with respect to the firing means.

3. An automatic gun and carriage in which it is recoilably mounted, comprising means on the carriage for firing the gun during its forward run-out movement, a recoil and run-out spring and a buffer spring operative on said gun in opposite directions, means for retaining the gun under the tension of said run-out spring in a position rearwardly of normal forward position whereby the first shot of a series after release of the gun by said retaining means will be fired by said firing means under conditions of gun movement similar to those of succeeding shots of the series, brake means operative upon the gun only during the first part of its forward run-out movement, said brake means including a buffer piston carrying means temporarily engaged by a recoiling part of the gun during the forward run thereof, and means for adjusting the range of such engagement.

4. An automatic gun and carriage in which it is recoilably mounted comprising means on the carriage for firing the gun during its forward run-out movement, a recoil and run-out spring and a buffer spring operative on said gun in opposite directions, means for retaining the gun under the tension of said run-out spring in a position rearward of normal forward position whereby the first shot of a series after release of the gun by said retaining means will be fired by said firing means under conditions of gun movement similar to those of succeeding shots of the series, and brake means operative upon the gun only during the first part of its forward run-out movement and including a member temporarily engaged by a recoiling part of the gun during the forward run thereof.

5. An automatic gun and carriage in which it is recoilably mounted, including means on the carriage for firing the gun during its forward run-out movement, a recoil and run-out spring and a buffer spring operative on said gun in opposite directions, a spring brake device adapted to equalize the velocities of individual run-out movement of a recoiling part of the gun and including means for timing its action on the recoiling part of the gun, and a stop member adjustable on said brake device for timing the action thereof.

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