March 6, 1945. D. S. BELL ET AL 2,370,835

AUTOMATIC GUN

Filed March 15, 1941 3 Sheets-Sheet 1

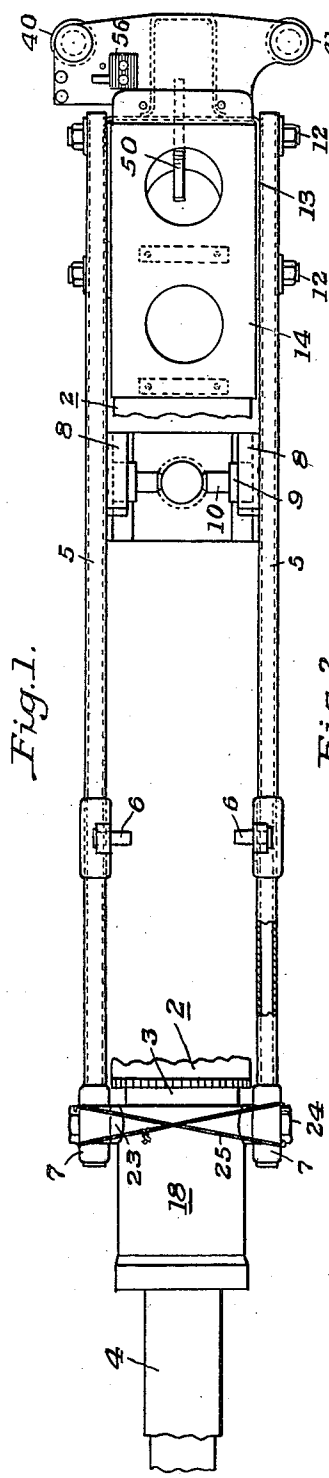


Fig. 1.

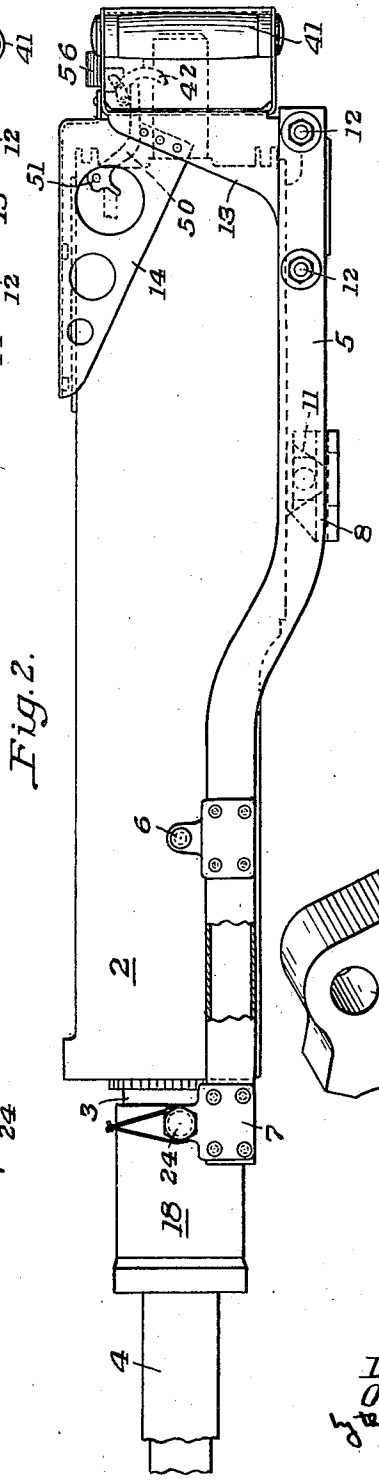


Fig. 2.

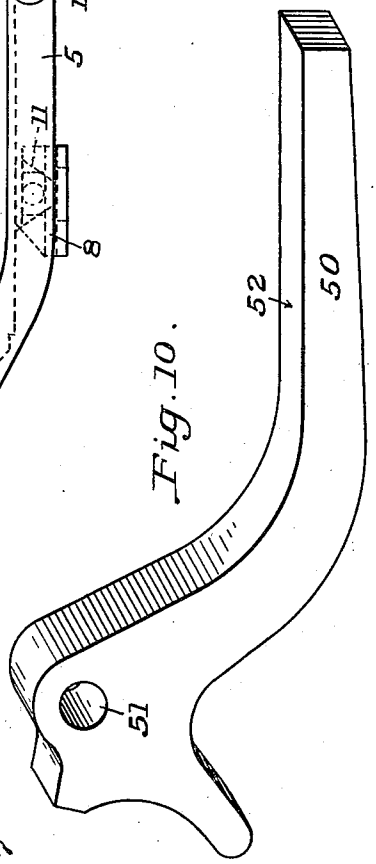


Fig. 10.

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AUTOMATIC GUN

Filed March 15, 1941 3 Sheets-Sheet 2

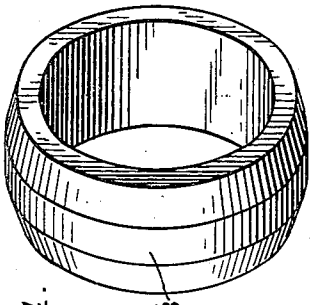


Fig. 4.

Fig. 3.

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AUTOMATIC GUN

Filed March 15, 1941 3 Sheets-Sheet 3

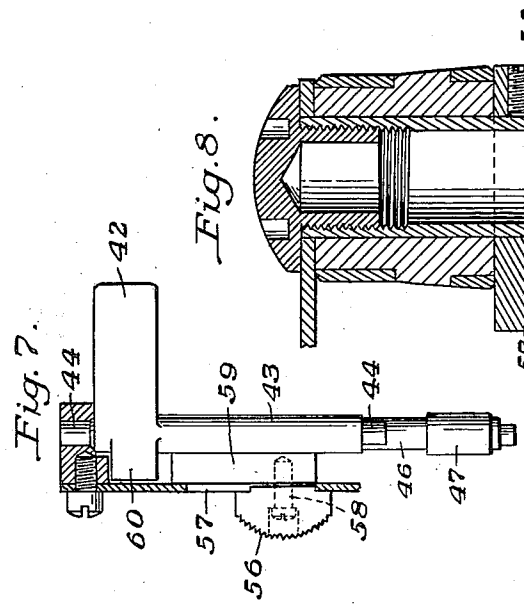


Fig. 7.

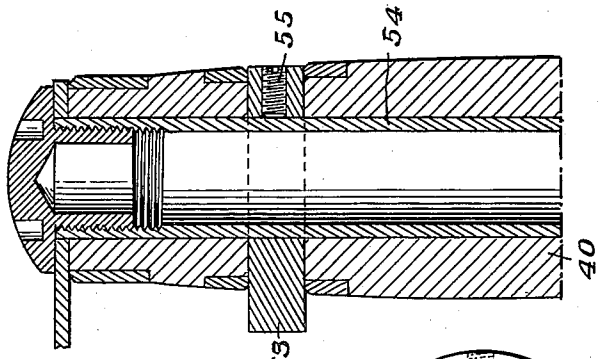


Fig. 8.

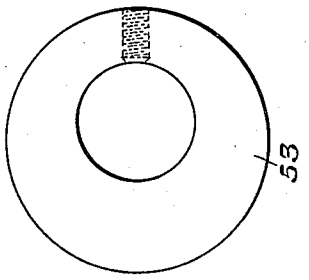


Fig. 9.

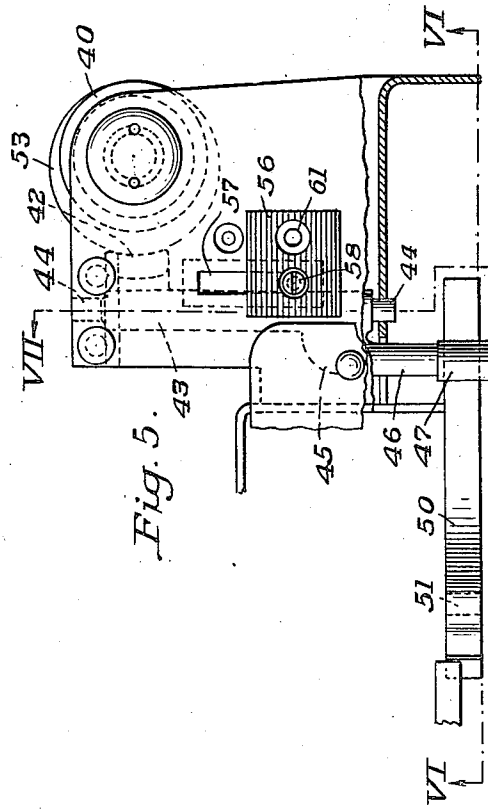


Fig. 5.

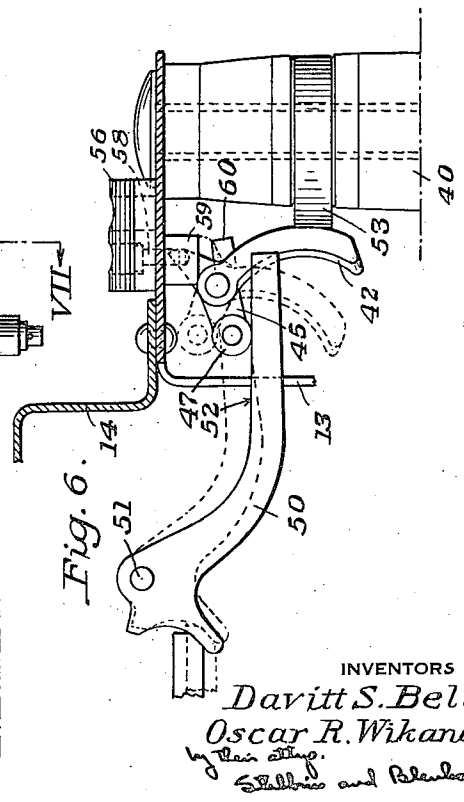


Fig. 6.

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UNITED STATES PATENT OFFICE

2,370,835

AUTOMATIC GUN

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Application March 15, 1941, Serial No. 383,538

10 Claims. (Cl. 89—44)

This invention relates to automatic guns, popularly designated as "machine guns." The characterizing feature of such guns, many types of which are well known, is that so long as the trigger remains pressed and the supply of ammunition continues, they continue to fire, each cartridge being automatically fed to the chamber, discharged and ejected. These guns are widely used on the ground, on airplanes and elsewhere. The automaticity of their operation is obtained (in most cases) by providing for the recoil movement of one or more of the gun elements and the coupling of such elements with the cartridge feeding and firing pin mechanism. Except in this respect, automatic guns have not generally been provided with recoil mechanisms such as are employed on artillery. However, increasing demands for automatic guns of heavier caliber and of higher firing rates have rendered it imperative to provide some form of recoil mechanism for the gun as a whole. It is common, for example, to mount such guns in the wings of an airplane, and the firing thereof sets up stresses and vibrations which it is desirable to minimize or eliminate. In use on the ground, such a mechanism is desirable because it lightens the task of the gunner and enables him to concentrate on directing the gun and to aim it more accurately.

The recoil mechanisms heretofore provided have not been wholly satisfactory for a variety of reasons, of which perhaps the principal one is that they have slowed down the rate of firing of the gun. As above stated, the automatic action of such a gun is based upon the recoil of one or more of the elements of the gun relative to the rest of it. If the entire gun is mounted so that it has a recoil movement, it will be seen that very complex and, in many cases, unpredictable inertia effects will arise. These effects have not heretofore ben satisfactorily compensated.

We have devised a recoil mechanism which has satisfactorily met all requirements. It is simple and compact and may be readily adapted to existing automatic guns. It does not slow down the firing rate and it functions satisfactorily over an extreme range of conditions. It is not affected by temperature changes and does not require periodical lubrication,, filling with oil or other servicing.

We also provide an improved trigger mechanism. This mechanism is placed on the mount and functions to control the firing of the gun with entire satisfaction, despite the fact that the gun is vibrating axially at a rapid rate due to recoil forces.

In the accompanying drawings illustrating present preferred embodiments of the invention,

Figure 1 is a top plan view of a gun partly broken away;

Figure 2 is a side elevation;

Figure 3 is a partial vertical section of a modified construction, and showing the recoil mechanism in detail;

Figure 4 is a perspective view of one of the elements of the recoil mechanism;

Figure 5 is a top plan view to enlarged scale partly broken away illustrating the trigger mechanism;

Figure 6 is a vertical section thereof on the line VI—VI of Figure 5;

Figure 7 is a section on the line VII—VII of Figure 5;

Figure 8 is a vertical section through one of the gun handles showing the adjustable trigger stop;

Figure 9 is a top plan view of the stop; and

Figure 10 is a perspective view of the firing sear.

For purposes of illustration, we have shown our invention as applied to the Browning M—2 automatic gun, which is indicated generally by the reference character 2. This gun is provided near the muzzle end with a threaded boss 3 (see Figure 3) concentric with the barrel 4, which boss ordinarily accommodates a trunnion ring whereby the front end of the gun is secured to a mount. As hereinafter described in greater detail, we utilize this threaded boss for connecting the recoil mechanism to the gun.

In Figures 1 and 2 we have shown a mount consisting of a pair of tubular side members 5 rectangular in cross section and provided with trunnions 6 whereby they may be adjustably mounted on a sub-base, as, for example, the framework of an airplane. At its front end, each of the side members 5 is provided with a trunnion eye 7 for supporting the front end of the gun in the manner above indicated. Toward their rear ends, the side members 5 are each provided with slotted bearing blocks 8 containing slides 9 having trunnion pins 10 integral therewith. The trunnion pins fit into eyes on a lug 11 secured to the bottom of the gun. This construction holds the gun securely to the mount but permits axial movement of the gun relative to the mount due to recoil and return following the recoil. At their rear ends, the side members 5 are connected together by bolts 12 and cross members 13 and 14 formed of sheet metal.

Figure 3 illustrates a modified form of mount

in which the gun 2' is supported at the front end by a rotatable trunnion 15 and at the rear by an elevating screw 16, both well known. In this case, however, the elevating screw 16 carries a slide 17 at its upper end for receiving slide blocks 9' which, like the slide blocks 9 illustrated in Figures 1 and 2, permit recoil and return movement of the gun relative to the mount.

The recoil mechanism is indicated generally by the reference character 18. It is shown in cross section in Figure 3. As above indicated, it is secured to the gun by being threaded onto the boss 3. An internally threaded sleeve 19 is provided for this purpose. At its outer end, the sleeve 19 has a shoulder 20 which constitutes one of two opposed buttresses for a ring spring indicated generally by the reference character 21. The spring is contained within a case 22 which makes a sliding fit on the sleeve 19 and is provided with bosses 23 drilled and threaded to receive trunnion bolts 24 extending through the trunnion eyes 7 in the form of the invention shown in Figures 1 and 2, and through the trunnion 15 in the form shown in Figure 3. The trunnion bolts are semi-permanently secured by a tie wire 25 which prevents them from jarring loose.

In Figure 3, the several parts of the recoil mechanism are shown in the so-called "battery position." It will be noted that the sleeve 19 is counterbored and that at the bottom of the counterbore there is a shoulder 26 which, when the gun is in battery position, registers with the shoulder 20. A floating ring 27 is interposed between these shoulders and the rear end of the ring spring 21. The sleeve 19 is also counterbored and threaded to receive a sleeve 28, a set screw 29 being provided to prevent loosening of the sleeve 28 from the sleeve 19. At its outer end, the sleeve 28 is provided with a flange which forms a shoulder 30. At its outer end, the case 22 is internally threaded to accommodate a ring 31 having an inner shoulder 32. The ring 31 is held against loosening by means of a set screw 33. When the gun is in battery position, the shoulders 30 and 32 lie in the same plane and a floating ring 34 is interposed between them and the outer end of the ring spring.

The ring spring is generally of the type disclosed in Kreissig Patent No. 1,515,346 dated November 11, 1924 and consists of a series of interfitting elastic rings having complemental tapered friction surfaces. In the case illustrated, there are three outer rings 35, 36 and 37, these being uninterrupted annuli having tapered inner faces to accommodate two inner rings 38. The angle of taper on the several rings will, in any case, be greater than the angle of friction for the surfaces employed, and the surfaces are carefully formed and lubricated so that upon the application of the requisite pressure the nest of interfitting rings will foreshorten smoothly.

The recoil spring is arranged substantially coaxially with the barrel of the gun, thus eliminating any eccentric forces.

The recoil mechanism, as illustrated, is a complete sub-assembly or "cartridge" which may be manufactured entirely apart from the gun, may be separately shipped and handled without danger of misplacement or misadjustment of the parts, and may be quickly fitted to existing guns. The use of the recoil mechanism profoundly affects the performance of the gun, making it easier to fire and control, reducing wear and tear on the airplane or other structure on which it is mounted, permitting the use of heavier calibers in such cases and in many cases materially increasing the firing rate of the gun without any other change.

The operation of the recoil mechanism will now be described: Assuming the gun to be in battery position, as shown in Figure 3, and that a cartridge in the chamber is fired, there will be a recoil of the element or elements of the gun which render its firing automatic, but the recoil force will be transmitted to the remainder of the gun and it will, therefore, tend also to recoil. With the combination above described, there will be a movement of the boss 3 and, hence, of the sleeve 19 away from the muzzle of the gun, that is to say, from left to right as viewed in the drawings. The case 22 is held against such movement by the trunnion bolts 24, but the sleeve 28 will move rearwardly with the sleeve 19 to which it is attached and the shoulder 30 will bear against the floating ring 34 and compress the ring spring 21, this compression continuing until the rearward movement of the gun as a whole is completed. A portion of the energy of recoil will be absorbed in friction (heat) in the ring spring, but sufficient will remain to cause the spring to re-expand. In re-expanding, it will again move the gun forward (right to left in the drawings) with respect to the mount. Due to inertia of the gun, it will continue to move forward beyond battery position. Our mechanism permits this. At battery position, the shoulder 20 engages the floating ring 27 and compresses the spring 21, thus building up resistance on the overtravel. The overtravel will be very short if the spring is properly designed, and re-expansion of the spring will promptly return the gun to battery position.

The characteristics of the spring are important. It should have an energy-absorption capacity of at least 50%; that is to say, it should be so designed that at least 50% of the energy imparted to it will be absorbed by friction. This is found to give very satisfactory operating characteristics. It is also desirable that the spring be under an initial compression. This is effected by making the spring with a free length greater than the distance between the floating rings 27 and 34. The provision of an initial compression limits the travel of the gun forwardly of battery position and improves the rate of fire of the gun over installations where there is no substantial initial compression. The period of the spring should be shorter than the desired time interval between successive shots of the gun. By the "period" of the spring we mean the time required for a natural (free) alternation of the spring if it is compressed and then released. This aids in maintaining the desired firing rate of the gun.

While we prefer to use a ring spring for resisting the recoil of the gun, other types of energy-absorbing springs may be used. Ordinary coil springs are not satisfactory because they do not absorb any energy except a minute amount by internal friction within the metal itself when the spring is compressed or extended. This internal friction is so small that it is disregarded in spring computations and we do not include ordinary coil springs either of the tension or compression type within the term "energy-absorbing spring." There are, however, energy-absorbing springs other than the ring type which, if properly designed, should give satisfactory results, as, for example, springs wound with adjacent coils in contact to form rods of such configuration in cross section that the adjacent coils will be on one

another when the spring is compressed and thus absorb energy by friction. Such a spring is shown in Patent No. 758,066. Other types comprise two or more rods concentrically wound and nested so that there is frictional engagement between coils. Such a spring is shown in Patent No. 2,043,566. Springs of both of the types last mentioned are well known and require no detailed description.

The trigger mechanism is illustrated generally in Figures 1 and 2 and in detail in Figures 5 to 10, inclusive. As above stated, the mount has a cross member 13 and this member carries two grips 40 and 41 which may be grasped by the gunner. A trigger 42 is mounted adjacent the grip 40. The trigger is made integral with a rocker shaft 43 which is pivoted in the mount at 44. The shaft 43 has an arm 45 carrying an offset finger 46 having a roller 47 thereon. The roller engages a firing sear 50 which is mounted at 51 on the gun proper and is effective for actuating it. The sear has a surface 52 which is engaged by the roller 47, and the squeezing of the trigger serves to move the sear from its non-firing position, shown in dotted lines in Figure 6, to its firing position, shown in full lines. In the firing position, the surface 52 lies in a plane parallel with the axis of the gun, that is to say, parallel with the direction of movement of the gun on recoil and return. In consequence, the sear may move back and forth under the roller 47 as the gun recoils and returns to battery position after successive shots, but so long as the trigger is squeezed the sear is held in firing position.

The movement of the trigger is limited by a rotatable stop 53 which is caried by the grip 40. The stop 53 is in the form of an eccentric ring which is loosely mounted on a reinforcing tube 54 within the grip 40. A set screw 55 holds it against rotation and in any desired position. By rotating the stop 53 and setting it with the screw 55, the proper depression of the roller 47 can be determined.

A safety catch 56 is provided. It is knurled or serrated for ready movement by the thumb of the gunner and works in a slot 57 formed in the cross member 13. It is connected by a set screw 58 to a pawl 59 which in the "safe" position is engageable with a lug 60 on the rocker shaft 43 and prevents movement of the trigger to firing position. A detent 61 holds the safety catch in either of its desired positions.

We have illustrated and described a present preferred embodiment of the invention. It will be understood, however, that this is by way of illustration only and that the invention may be otherwise embodied or practiced within the scope of the following claims.

We claim:

1. An automatic gun, a mount therefor, the gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement of the gun on firing thereof, and a recoil mechanism operatively connected to the gun and to the mount and comprising a ring spring formed of interfitting elastic rings having complemental tapered friction surfaces.

2. An automatic gun having a barrel, a mount for the gun, the gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement of the gun on firing thereof, and a recoil mechanism operatively connected to the gun and to the mount and comprising a ring spring formed of interfitting elastic rings having complemental tapered friction surfaces, the ring spring being placed substantially coaxially with the barrel.

3. An automatic gun, a mount therefor, the gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement of the gun on firing thereof, and a recoil mechanism operatively connected to the gun and to the mount and comprising a ring spring formed of interfitting elastic rings having complemental tapered friction surfaces, the spring having an energy-absorption capacity of at least fifty per cent as herein defined.

4. An automatic gun, a mount therefor, the gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement of the gun on firing thereof, and a recoil mechanism operatively connected to the gun and to the mount and comprising an energy-absorbing spring having complemental friction surfaces.

5. An automatic gun having a barrel, a mount for the gun, the gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement of the gun on firing thereof, and a recoil mechanism operatively connected to the gun and to the mount and comprising an energy-absorbing spring having complemental friction surfaces, the spring being placed substantially co-axially with the barrel.

6. An automatic gun, a mount therefor, the gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement of the gun on firing thereof, and a recoil mechanism operatively connected to the gun and to the mount and comprising an energy-absorbing spring having complemental friction surfaces, the spring having an energy-absorption capacity of at least fifty per cent as herein defined.

7. An automatic gun, a mount therefor, the gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement of the gun on firing thereof, and a recoil mechanism operatively connected to the gun and to the mount and comprising an energy-absorbing spring having complemental friction surfaces, the spring having a period less than the time interval between successive shots from the gun.

8. An automatic gun, a mount therefor, the gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement of the gun on firing thereof, and a recoil mechanism operatively connected to the gun and to the mount and comprising an energy-absorbing spring having complemental friction surfaces, the spring being under an initial compression.

9. An automatic gun, a mount therefor, the gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement of the gun on firing thereof, a recoil mechanism comprising an energy-absorbing spring having complemental friction surfaces, a case holding the spring under an initial compression, the case being secured to the mount, and two buttresses connected to the gun and respectively engageable with the opposite ends of the spring and effective for compressing the same, one upon rearward movement of the gun from battery position, and the other upon forward movement of the gun from such position.

10. An automatic gun, a mount therefor, the

gun being movable on the mount, the mount being so constructed and arranged as to permit of recoil and return movement on firing thereof, a recoil mechanism comprising an energy-absorbing spring, and a pair of movable buttresses operatively engaging the spring at its opposite ends and effective upon relative movement for transmitting energy to and from the spring, the buttresses being so arranged as to be movable, one upon rearward movement of the gun from battery position, and the other upon forward movement of the gun from such position.

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