Dec. 30, 1947. J. C. TROTTER 2,433,637

SHOCK ABSORBING MACHINE GUN MOUNT

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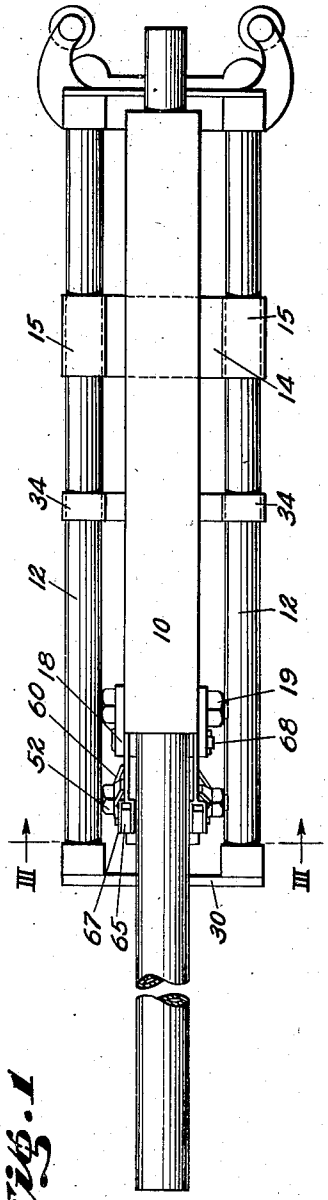


Fig. 1

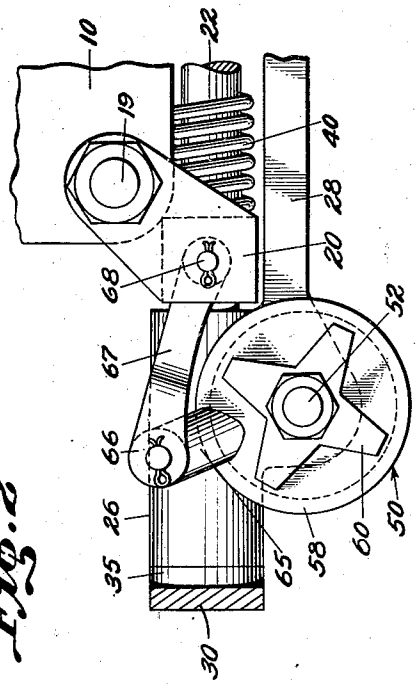


Fig. 2

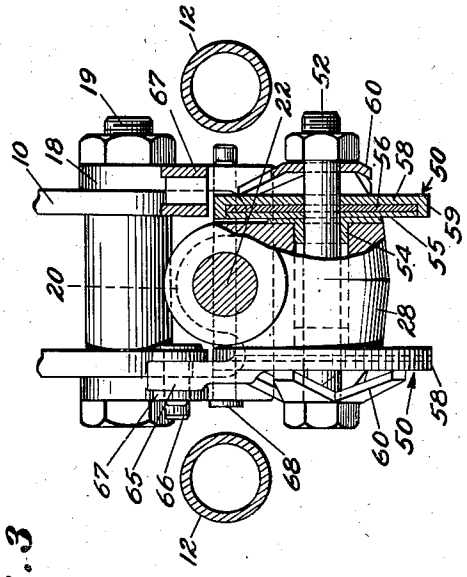


Fig. 3

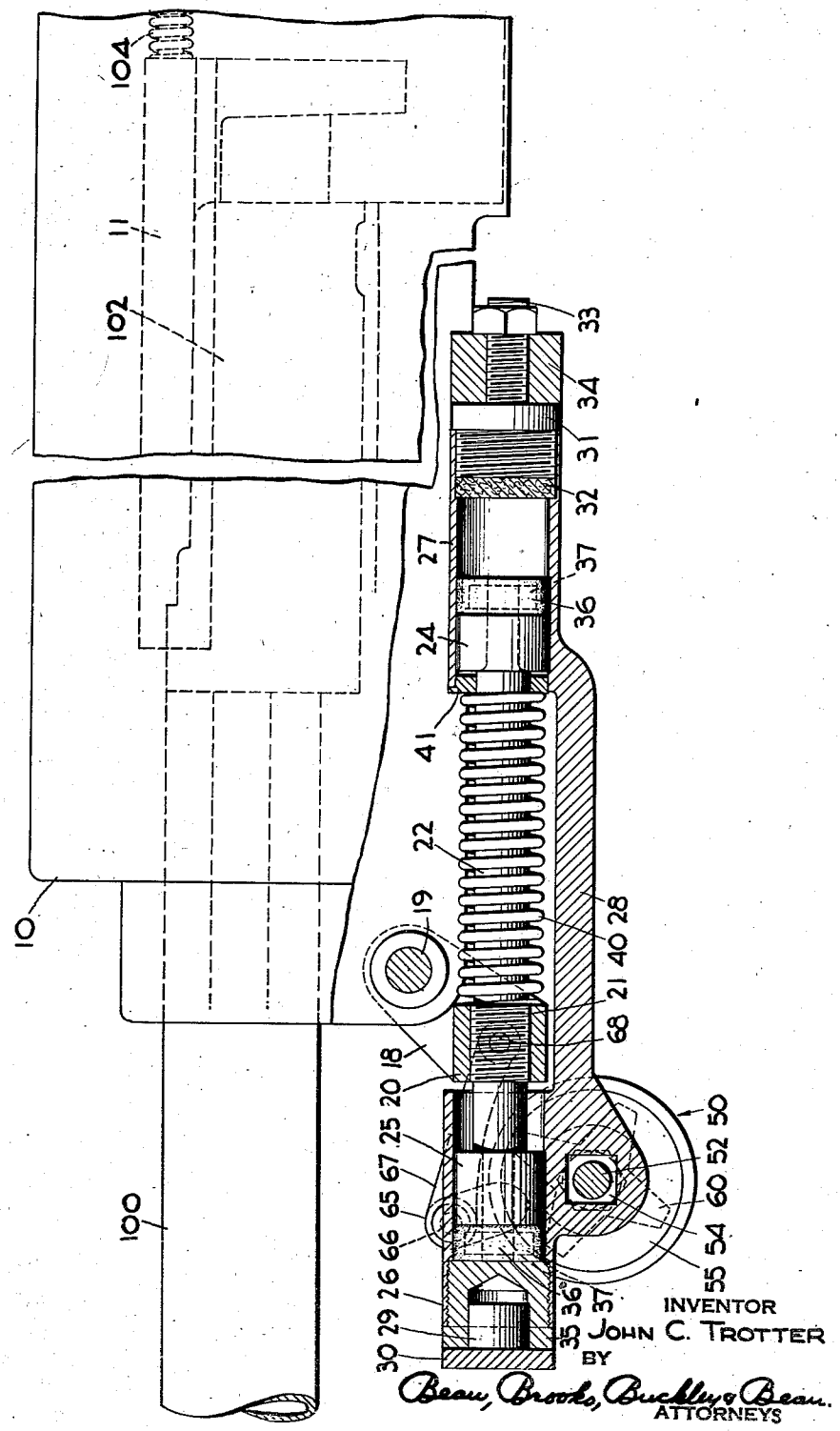
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Fig. 4.



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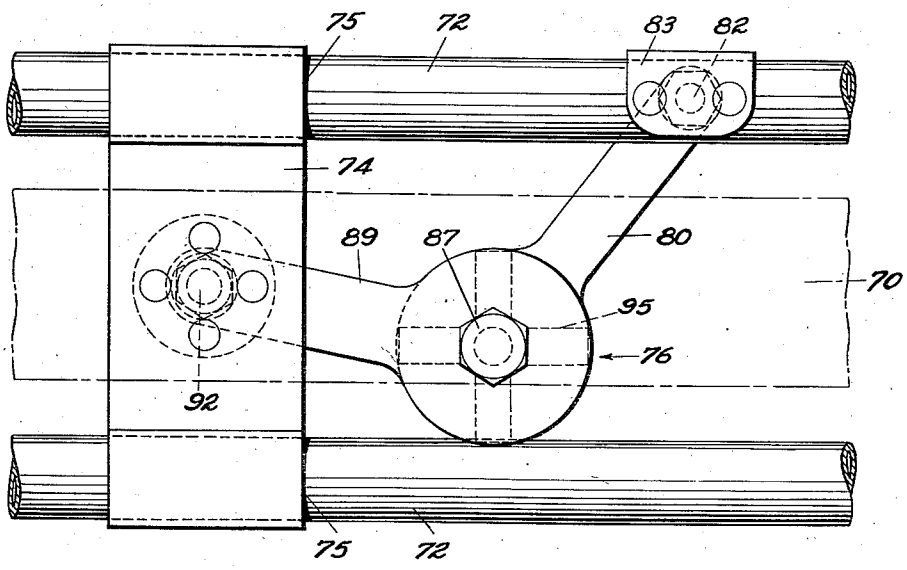


Fig. 5

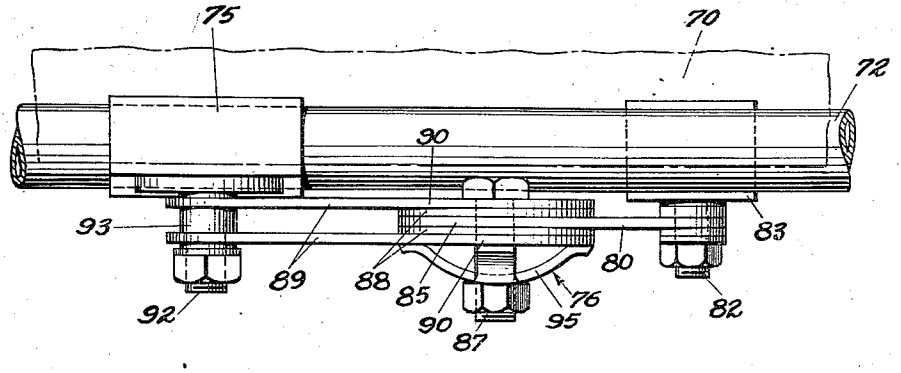


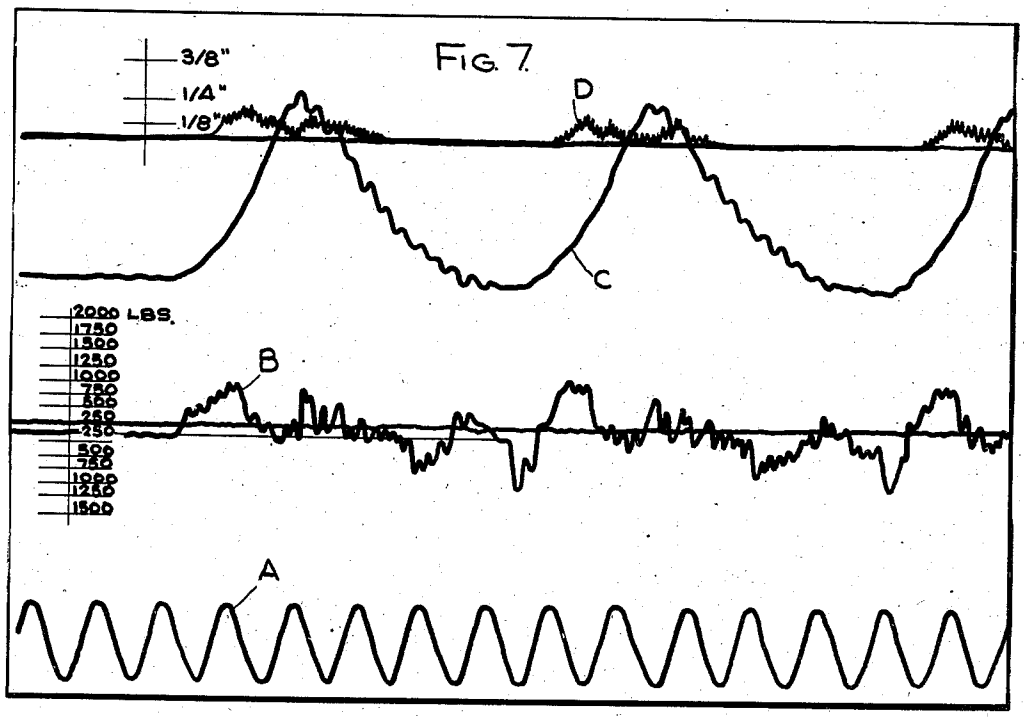
Fig. 6

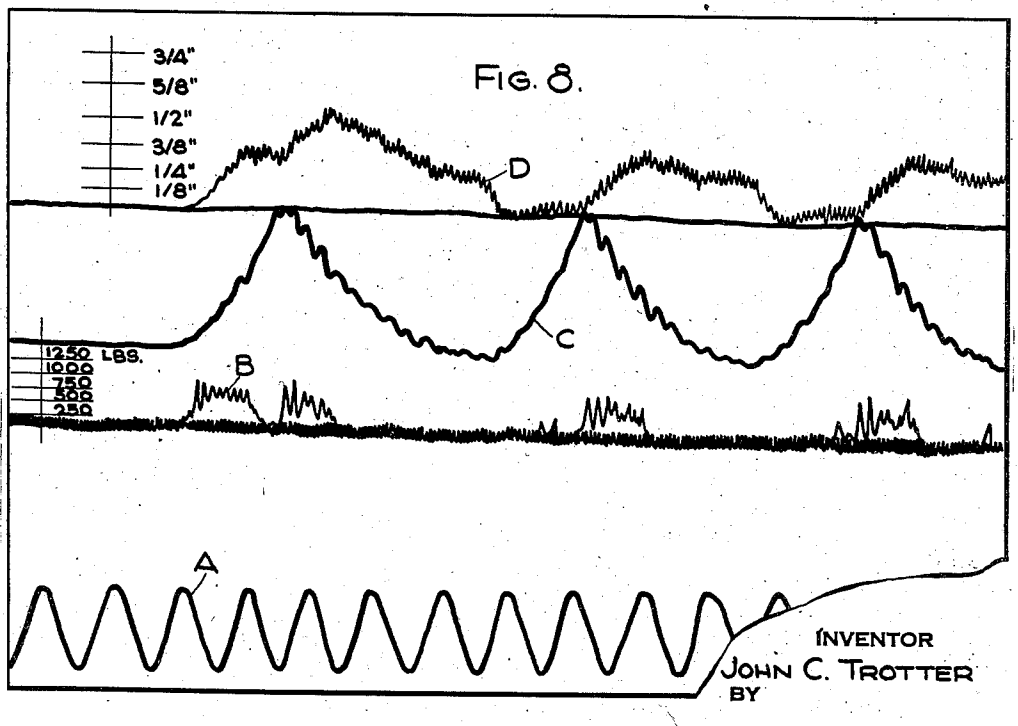
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SHOCK ABSORBING MACHINE GUN MOUNT

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Patented Dec. 30, 1947

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UNITED STATES PATENT OFFICE

2,433,637

SHOCK ABSORBING MACHINE GUN MOUNT

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Application October 19, 1945, Serial No. 623,304

4 Claims. (Cl. 89—42)

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This invention relates to automatic guns, and more particularly to improved recoil shock absorbing and damping mechanisms and gun fire rate and vibration control means therefor; and this present application is a continuation-in-part of my abandoned application Serial No. 382,549 filed March 10, 1941.

One of the objects of the invention is to provide in a reciprocating bolt action type machine gun or the like a novel gun recoil and counter-recoil control mechanism whereby to reduce the reaction forces acting against the gun mounting structure.

Another object of the invention is to provide in conjunction with a gun of the specified type a recoil control mechanism so constructed and arranged as to thereby provide an increased rate of firing for the attached gun. Another object of the invention is to provide an improved and structurally simple and rugged and inexpensively manufactured device for the purpose described.

Another object of the invention is to provide a device of the character described which is capable of dissipating recoil energy of machine guns in an improved manner.

Other objects and advantages of the invention will appear in the specification hereinafter.

In the drawings:

Fig. 1 is a plan of a machine gun provided with a recoil absorbing and damping mechanism of the invention;

Fig. 2 is a fragmentary side elevation, on an enlarged scale, of the recoil damping mechanism of Fig. 1;

Fig. 3 is a section on an enlarged scale, taken substantially along line III—III of Fig. 1;

Fig. 4 is a fragmentary side elevation of the mechanism of Fig. 1, on an enlarged scale, showing the gun bolt diagrammatically and portions of the recoil shock absorbing mechanism thereof in vertical section;

Fig. 5 is a fragmentary plan of another form of recoil damping device of the mechanism of the invention;

Fig. 6 is a fragmentary side elevation of the device of Fig. 5;

Fig. 7 is an oscillograph record reproduction showing results of a test of the gun firing rate and recoil force reactions against the mounting structure in the case of a standard machine gun arrangement; and

Fig. 8 is a view similar to Fig. 7 showing the testing results subsequent to application of the present invention to the same type gun and gun mount arrangement.

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The invention is illustrated in Figs. 1 to 4 in connection with a machine gun having a casing designated generally at 10 and may be of any type or style that employs a reciprocating bolt as indicated at 11. It will be understood that the bolt reciprocates relative to the gun casing 10 incidental to each gun firing operation to effect extraction of the empty cartridge case and to initiate actions of the recharging and loading and cocking mechanisms. The gun is illustrated as being slidably mounted adjacent its rear end upon a support comprising a pair of parallel bearer tubes 12 by means of a transverse bracket 14 having looped portions 15 slidably engaging the bearer tubes 12. Adjacent its muzzle end, the gun 10 is connected to a pair of parallel lugs 18 by means of a bolt 19. The lugs 18 are formed integrally with a transverse bracket 20 which extends into screwthreaded relation at 21 with a piston rod 22. The piston rod 22 is provided with enlarged heads 24 and 25 at its opposite ends which engage in piston-cylinder relationship with corresponding cylinder portions 26 and 27 respectively of a bracket 28 that is mounted at its forward end by means of a boss connection 29 of a bar 30 extending transversely of the tubes 12—12 at their forward ends. The cylinder portion 27 (Fig. 4) is closed at its outer end by means of a screw plug 31, and a shock pad 32 is seated therewithin to protect the plug 31 from impact with the piston head 24 during gun recoil operations. An extending stub portion 33 of the plug 31 is engaged through a transverse bracket 34 which extends between the bearer tubes 12—12 to support the rear end of the cylinder bracket 28. The cylinder portion 26 is closed at its outer end by means of a closure plug 35 which is seated upon the cylinder 26 in substantially airtight fashion. The piston heads 24 and 25 are provided with oppositely directed cup washers 36 which are retained thereon by means of nuts 37. The cup washers 36 are so arranged as to be adapted to expand radially into close fitting relation with respect to the corresponding cylinder walls upon piston movement toward the closed end portions of the cylinders, and to contract upon reverse movements thereof. A compression spring 40 is mounted about the piston rod 22 so as to bear at one of its ends against the bracket 20 and at the other of its ends against an annular shoulder 41 which extends from the cylinder 27.

Thus, starting from a position of rest as illustrated in Figs. 1, 2 and 4, the gun 10 is adapted to move rearwardly relative to the bearer tubes

12—12 under the recoil forces of the gun firing operation, whereupon the recoil forces of the gun are transmitted through the bracket 20 and against the spring 40 which in turn bears against the stationary bracket 28. Thus, the piston moves rearwardly within the cylinder 27 and compresses the air between the piston head 24 and the closure plug 31, and the air trapped within the cylinder 27 functions to cushion the recoil forces of the gun in the manner of the operation of a dash-pot device. Simultaneously, the spring 40 compresses to further cushion the recoil stroke. In the meantime the piston head 25 moves within the cylinder 26 away from the closure plug 35, and air is drawn into the cylinder 26 about the washer 36 of the piston head 25. Upon completion of the recoil stroke of the gun the air compressed within the cylinder 27 and the spring 40 operate to urge the piston rod to move in reverse direction so as to return the gun to its initial position. During the return stroke of the gun the air entrapped within the cylinder 26 behind the washer 36 of the head 25 functions to cushion the return forces so as to prevent damage to the working parts of the mechanism.

To control the rate of gun fire and to reduce the recoil force reactions against the gun mounting structure I provide a novel control mechanism which is illustrated in the drawings as comprising a pair of opposed friction devices 50 which are disposed at opposite sides of the gun. The friction devices 50 are mounted upon a bolt 52 which extends transversely through the cylinder bracket 28 and is mounted thereon by means of a pair of opposed bearing blocks 54. The bearing blocks are externally squared for mounting in keyed relation within a similarly shaped aperture formed in the bracket 28. The bearing blocks 54 are formed with radially extending flange portions 55 which in side elevation are of disc-like form. A friction disc 56 is mounted externally of each of the flange portions 55 and in abutting relation thereagainst, and a housing disc 58 is mounted externally of each of the friction discs 56. The housing discs are peripherally flanged as at 59 so as to provide a substantially enclosed friction disc assembly.

While the bearing blocks 54 are keyed within the bracket 28 against rotation about the bolt 52 as explained hereinabove, the friction discs 56 and the housing discs 58 are mounted upon the bolt 52 so as to be freely rotatable thereon. A spider 60 having radially extending spring finger portions is mounted externally of each of the disc assemblies upon opposite extending end portions of the bolt 52; and the spiders 60 are respectively mounted beneath the bolt head and the bolt nut so as to have their spring finger portions pressed thereby against the corresponding housing discs 58 so as to cause the latter to be urged into frictional engagement with the corresponding bearing block and friction disc devices. A crank arm 65 extends radially from each of the housing discs 58 into pivotal connection at 66 with a link 67 which in turn extends into pivotal connection at 68 with the lugs 18 extending from the gun 10. Thus, upon reciprocation of the gun 10 relative to the bearer tubes 12—12 the links 67 will cause the housing discs 58 to be oscillated relative to the fixed bearing blocks 54 with the friction discs 56 floating therebetween, while the spider devices 60 operate to cause the oscillating disc members to be pressed into frictional engagement against the corresponding stationary

bearing blocks. It will be understood that the magnitude of the frictional forces thus developed will depend upon and may be regulated by adjustment of the nut of the bolt device 52 so that any desired degree of gun movement damping action may be obtained.

As illustrated in Figs. 5 and 6, the damping device of the gun mechanism may be conveniently provided in another simplified structural form, and for this purpose the invention is similarly illustrated in conjunction with a machine gun 70 which is suitably mounted upon a pair of bearer tubes 72 for longitudinal reciprocation relative thereto in response to recoil forces of the gun firing operation, as explained hereinabove in connection with Figs. 1 to 4. For this purpose the gun 70 is illustrated as being mounted upon a bracket 74 which extends transversely of the gun into sliding connection at its opposite ends 75 with the bearer tubes 72. The recoil and return movement damping device is designated generally at 76 as comprising a lever arm 80 which is pivotally mounted at one end by means of a pin connection 82 to a bracket 83 which is fixed to one of the bearer tubes 72. The other end of the lever 80 terminates in an enlarged disc portion 85 which is centrally bored to receive a bolt 87 therethrough. Friction discs 88 are mounted upon the bolt 87 at opposite sides of the disc portion 85, and a pair of crank plates 89 having enlarged disc-shaped end portions 90 are pivotally mounted upon the bolt 87 at opposite sides of the friction disc assembly.

At their opposite ends the crank arms 89 are pivotally connected by means of a bolt 92 to the transverse bracket 74; a spacer 93 being disposed between corresponding outer end portions of the crank arms 89 so as to maintain them in parallel relationship. A spider 95 having radially extending spring fingers is mounted below the nut of the bolt 87 so as to be adapted to be pressed by adjustment of the nut against the disc assembly of the damping device so as to provide frictional resistance therein to oscillation of the lever arm 80 relative to the crank arms 89 about the axis of the bolt 87. Thus, it will be understood that upon development of gun recoil and return movement providing forces, as explained hereinabove, the gun 70 will be caused to oscillate relative to the bearer tube 72, and the lever arm and crank elements of the damping mechanism will be thereby caused to relatively oscillate about the axis of the bolt 87.

Thus, it will be understood that the frictional resistance to relative movement developed within the friction disc assembly portion of the device provides constant retarding and damping of gun movement forces in connection with both the recoil and counter-recoil motions of the gun casing relative to the gun barrel, and that these retarding and damping effects are experienced throughout the entire range of recoil and counter-recoil movements. Thus, as the bolt mechanism of the gun retreats in response to the ammunition gas expansion forces incidental to the firing of each cartridge, the corresponding recoil motions of the gun casing are retarded by the frictional damping mechanism so as to bring the bolt and gun casing reciprocative movements into synchronized but out-of-phase relation. In fact, the operation is such as to bring the bolt and gun casing reciprocative movements into more nearly opposed direction relation, compared to conventional machine gun arrangements. This produces a speeding-up of the

cycles of the bolt actuations of the ejection and recharging mechanisms of the gun; and actual oscillograph tests of guns with and without incorporation of the invention clearly show that the invention results in increasing the rate of bolt reciprocation (which automatically determines the rate of firing) and decreases the gun mount reactions.

For example, Fig. 7 of the drawing is a fragmentary reproduction of an actual oscillograph record of the firing operation of a machine gun without the benefit of the present invention. Line A of the chart designates time elapse; line B records the recoil and counter-recoil force reactions in the gun mounting trunnion structure; line C shows the timing and the amplitudes of the bolt movements; and line D records the timing and the amplitudes of the gun casing recoil movements. A study of this chart reveals that the bolt and gun casing reciprocative movements are (in the case of the conventional machine gun arrangement) substantially synchronized in directionally similar relation, and that the trunnion reaction forces are quite severe. Fig. 8 is a chart corresponding to Fig. 7 but recording similar data in connection with a gun which incorporates the present invention; and a study of Fig. 8 shows that the bolt and gun casing recoil motions have been relatively rearranged and are now synchronized in directionally opposed relation, and comparison of the two charts clearly reveals that in the case of the present invention the time of the bolt movement cycle has been substantially shortened (with a corresponding increase of the rate of gun fire), and that the severity of the gun trunnion reactions have been substantially lessened.

The important advantages and features of the invention explained hereinabove are obtained because of an automatic balancing of the reaction forces of the gun bolt and the gun casing portions; this balancing of the forces being attained by the frictional retarding and recoil damping actions of the mechanism described hereinabove. Thus, it will be appreciated that the invention contemplates a recoil and counter-recoil control mechanism which coacts with both the gun casing and the gun bolt whereby to provide a gun operation of improved rate of fire and of improved stability and steadiness throughout the firing operation.

In the drawing (Fig. 1) the invention is illustrated in conjunction with a U. S. Army designated 50 cal. M_2 machine gun, of the type disclosed in U. S. Patent No. 1,628.226, having a barrel indicated at 100 and a barrel extension indicated at 102. The bolt 11 is backed up by a spring indicated at 104. However, it will be understood that the invention is equally applicable to any other style of machine gun having a reciprocating bolt action.

It will also be understood of course that although only a few forms of the mechanism of the invention have been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited but that various changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In combination, a machine gun having a casing, a reciprocable bolt in said casing, a mount freely slidably supporting said casing, means biasing said casing with respect to said mount in opposition to recoil, means biasing said bolt with respect to said casing in opposition to recoil, and braking means interposed between said casing and mount for exerting a substantially constant resistance to relative movement thereof, said braking means including means for adjusting the value of said resistance with respect to said biasing means to adjust the recoil phase relationship of said bolt and casing.

2. In combination, a machine gun having a casing, a reciprocable bolt in said casing, a mount freely slidably supporting said casing, means biasing said casing with respect to said mount in opposition to recoil, means biasing said bolt with respect to said casing in opposition to recoil, and braking means interposed symmetrically between said casing and mount for exerting a substantially constant resistance to relative movement thereof, said braking means including means for adjusting the value of said resistance with respect to said biasing means to adjust the recoil phase relationship of said bolt and casing.

3. In combination, a machine gun having a casing, a reciprocable bolt in said casing, a mount freely slidably supporting said casing, means biasing said casing with respect to said mount and said bolt with respect to said casing in opposition to recoil, and braking means interposed between said casing and mount for exerting a substantially constant resistance to relative movement thereof, said braking means including means for adjusting the value of said resistance with respect to said biasing means to adjust the recoil phase relationship of said bolt and casing.

4. In combination, a machine gun having a casing, a reciprocable bolt in said casing, a mount freely slidably supporting said casing, independent springs biasing said casing with respect to said mount and said bolt with respect to said casing in opposition to recoil, and braking means interposed between said casing and mount for exerting a substantially constant resistance to relative movement thereof, said braking means including means for adjusting the value of said resistance with respect to said biasing means to adjust the recoil phase relationship of said bolt and casing.

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