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GUN RECOIL MECHANISM

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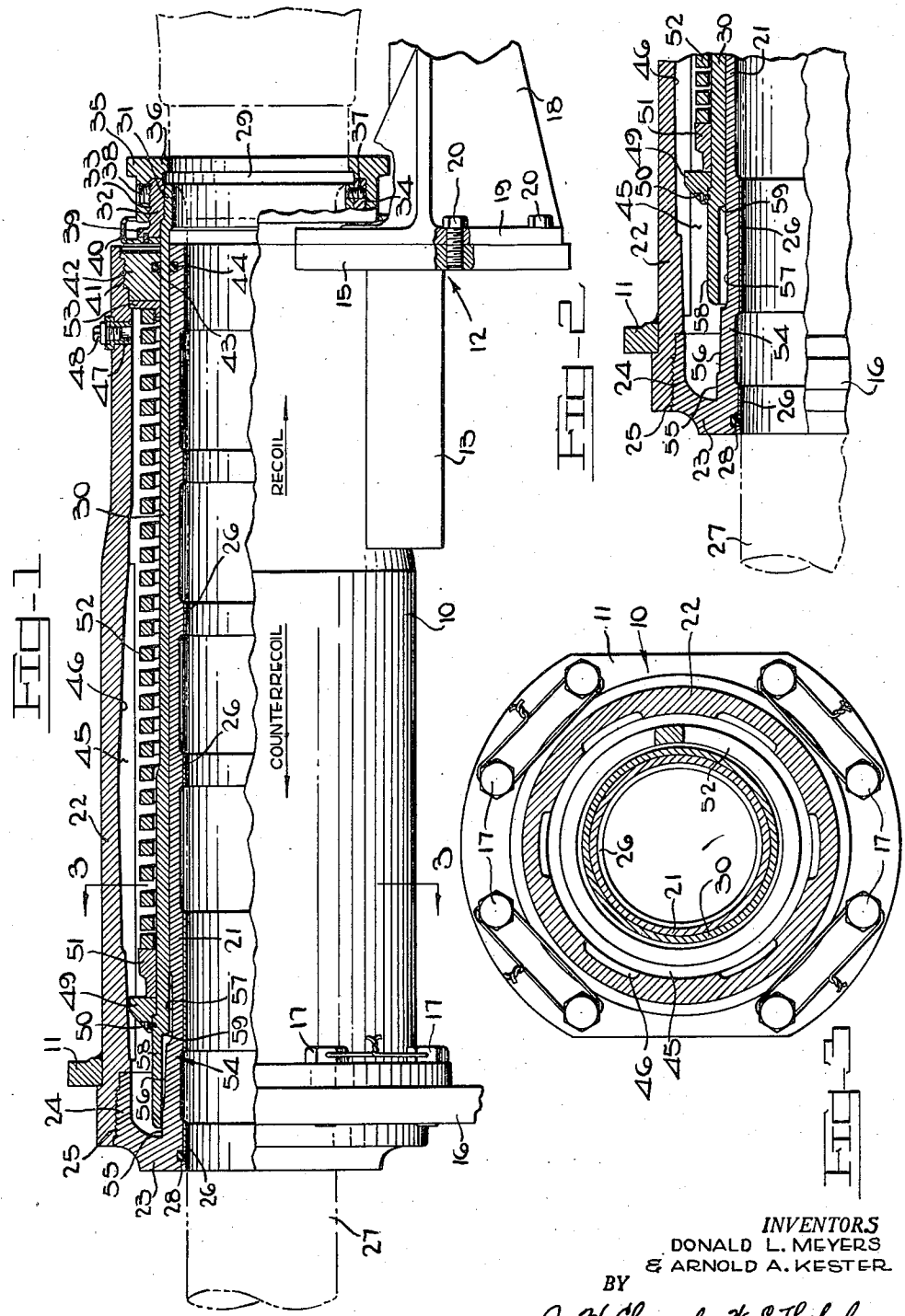


FIG-1

FIG-2

FIG-3

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GUN RECOIL MECHANISM

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The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to us of any royalty thereon.

This invention relates to a recoil mechanism for a gun. More particularly the invention relates to that part of a recoil mechanism that is concerned with the control of the weapon in its action in counterrecoil, or return to battery. In its specific aspects, the invention pertains to improvements in the buffer means in a recoil mechanism of the concentric type, one example of which is shown in the United States Patent to Lucht, No. 2,358,340.

Recoil mechanisms of the concentric type are particularly adapted for use in armored vehicles, turrets and the like and comprise basically a gun tube encased in and slidably carried by a concentrically arranged support having an annular elongated chamber containing the recoil fluid and the recoil spring and piston mechanism. A particular problem attendant upon the design, construction and use of recoil mechanisms of the concentric type is that which arises from the requirement that the mechanism for buffing the counterrecoil stroke of the gun be located within the recoil fluid chamber. This requirement necessarily means that the buffing mechanism must be simple in construction, efficient in operation and comprising relatively few movable parts.

The present invention contemplates and has for its principal object the provision of a recoil mechanism of the concentric type having an improved buffing means in which the cooperable parts are respectively formed on basic stationary and movable parts of the recoil mechanism.

It is an important object of the invention to provide a buffing means in which the cooperable parts are so formed and so arranged with respect to each other as to check efficiently the action of the gun in its final phases of counterrecoil, this result being accomplished by forming one buffer element with an outer periphery having the section of a cone diminishing in the direction of recoil, and a second buffer element as a sleeve having an inner, substantially cylindrical periphery variably cooperable with the conical periphery of the first buffer element as the gun completes counterrecoil.

It is another object of the invention to provide in conjunction with the buffer elements a proximate annular recess or reduced cylindrical portion which cooperates with the buffer sleeve to provide, just prior to completion of counterrecoil, a buffer pocket within which recoil fluid may be trapped and from which the recoil fluid may be exhausted by cooperation of the cylindrical buffer sleeve with the conical or tapered buffer element.

Other objects and features of the invention

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will become apparent to those skilled in the art as the disclosure is more fully made in the following detailed description of a preferred embodiment of the invention as illustrated in the accompanying sheet of drawings in which:

Fig. 1 is a side elevational view, partly in section, of the intermediate portion of a gun mount and recoil mechanism having incorporated therein a preferred form of buffing means constructed according to the present invention, the parts being shown in the positions occupied thereby when the gun is in battery and the gun tube being illustrated diagrammatically;

Fig. 2 is a fragmentary longitudinal sectional view of the upper front portion of the recoil mechanism and gun tube and illustrating the positions of the parts just prior to completion of counterrecoil; and

Fig. 3 is a transverse sectional view taken substantially on the line 3—3 of Fig. 1.

Although the invention has been illustrated and described in connection with the preferred embodiment thereof and in conjunction with a particular type of recoil mechanism, it should be appreciated that the invention may assume other forms and may be otherwise adapted. Accordingly, the present disclosure should be taken as illustrative and not limiting.

The particular type of gun and mount chosen for the purposes of illustration includes a cylindrical or tubular member or cradle 10 formed at its forward or counterrecoil end with an external annular flange 11 and at its rear or recoil end with an integral bracket structure 12 including a longitudinally forwardly extending supporting portion 13 and a rear flange 15. The flange 11 at the forward or counterrecoil end of the cradle cylinder 10 serves as means by which the mechanism may be adequately supported in a gun mount, a portion of such mount being illustrated at 16 as being secured by a plurality of cap screws 17 to the flange 11. The rear flange 15 is likewise adapted to support the gun in a suitable mount. A portion of such mount is indicated by the numeral 18 and is shown as including a front flange 19 secured by a plurality of bolts 20 to the flange 15.

The cradle 10 is of composite construction and comprises a double cylinder supporting structure having an inner hollow cylinder or tubular member 21 and an outer hollow cylinder or tubular member or support 22. The forward end of the inner tubular member 21 is formed as an annular radial wall 23 formed at its peripheral edge with a rearwardly extending threaded cylindrical portion 24. The outer cylindrical member 22 is internally threaded as at 25 and the threaded portions 24 and 25 are screwed together to provide a rigid connection between the two tubular members 21 and 22.

The inner tubular or cylindrical member 21 is provided at axially spaced points along its interior with a plurality of annular internal bearings 26 which serve to mount a gun tube 27 in the cradle 10. The relationship between the gun tube 27 and the cradle 10 is such that the tube may reciprocate in recoil and counterrecoil. The forward end of the gun tube 27 projects through the front radial wall 23 of the inner tubular member 21 and suitable packing 28 is provided at this point in the radial wall 23 for cooperation with the outer periphery of the gun tube 27 to provide means guarding against the entrance of dirt and other foreign matter to the bearings 26.

The rear or recoil end of the gun tube 27 extends axially beyond the rearward end of the cradle structure 10, at which point the gun tube is provided with an annular radial flange 29 (shown diagrammatically). A recoil sleeve or tube 30 encircles and is slidably carried by the outer periphery of the inner tubular member 21. This sleeve, like the gun tube 27, projects axially at the rear or recoil end of the cradle 10 and at that point is provided with an externally threaded end portion 31. An internally threaded ring 32 is threaded on the end portion 31. The ring 32 is also threaded externally as at 33 and receives an internally threaded portion 34 of a securing ring 35. The ring 35 includes an annular cylindrical portion, on which the internal thread 34 is formed, and an integral annular radially inwardly extending flange 36 which cooperates with the flange 29 of the gun tube 27 to connect the gun tube 27 rigidly to the sleeve 30 so that these parts move in unison in recoil and counterrecoil. A locking screw 37 cooperates between the ring 32 and the end portion 31 of the sleeve 30 for preventing loosening of the parts. A locking screw 38 is carried by the ring 35 and is engageable with the exterior of the ring 32 for preventing loosening of those parts. The forward portion of the ring 32 is formed as a radially outwardly extending annular flange 39 on which is rigidly mounted an annular sheet metal shield 40. This shield serves to minimize the probability of the entrance of dust and other foreign matter into the mechanism.

The rear or recoil end of the outer cylindrical or tubular member 22 is internally threaded, as at 41, and receives an externally threaded closure ring 42. The ring 42 is provided at its interior with a suitable packing ring 43 which provides a seal between the ring 42 and the exterior of the recoil sleeve 30. A similar packing ring 44 is carried by the recoil end of the inner cylindrical or tubular member 21 and cooperates between that member and the interior of the recoil sleeve 30. These packing rings may be of any conventional type and serve to prevent the escape of recoil fluid and also the entrance of dirt, grit, etc., to the recoil mechanism.

The relationship between the inner and outer tubular members 21 and 22 is such that there is provided therebetween an elongated annular chamber 45 which may contain any suitable recoil fluid such as the usual recoil oil. The closure between the members 21 and 22 afforded by the radial end wall 23 is fluid-tight, as is the closure afforded at the recoil end of the cradle by the relationship between the closure ring 42, threaded portion 41 of the outer tubular member 22 and packing 43 between the ring 42 and recoil sleeve 30. The interior of the outer tubular member 22 is provided with a plurality of longitudinally running circumferentially spaced fluid or oil grooves

46 which, as best shown in Fig. 1, vary in depth throughout their lengths. The function of these grooves in conjunction with the action of the gun in recoil and counterrecoil will be explained below. The outer tubular or cylindrical member 22 is provided at its recoil end with a filler opening 47 normally closed by a filler plug 48.

The recoil sleeve 30 is provided near its counterrecoil end with a ring piston 49. In the present case this piston is shown as a separate component rigidly secured to the recoil sleeve 30 by a plurality of locking screws 50 (only one of which is shown). The piston 49 and the portion of the recoil sleeve 30 on which it is mounted are appropriately interfitted so that thrust on the piston is taken directly by the sleeve 30 and not by the locking screws 50. Rearwardly of the piston 49 the recoil sleeve 30 is encircled by and carries an abutment ring 51. A counterrecoil compression spring 52 encircles the recoil sleeve 30 and at one end abuts the abutment ring 51 and at its other end abuts a hardened radial ring 53 that faces against the inner radial face of the rear closure ring 42. As is usual when the weapon is fired, the gun tube 27 slides in the bearings 26 of the inner tubular member 21 in recoil against the counterrecoil spring 52 and against the recoil fluid in the chamber 45. The compression spring 52 stores energy upon recoil and serves to return the gun tube in counterrecoil to battery.

It is characteristic of guns mounted for recoil and counterrecoil that variations occur in the travel of the gun tube through its various phases of recoil and counterrecoil. In the event that these variations are not adequately controlled, serious damage to the weapon may result. Such damage is particularly likely if, for example, the weapon is allowed to return violently to battery. Consequently, it is desirable that the final phases of counterrecoil action be checked or buffed. At the same time, it is desirable that the weapon be permitted to return to battery as rapidly as possible, since such result is consonant with rapidity of fire.

According to the present invention, the means for checking or buffing the final phases of counterrecoil, so that the gun is eased into battery, comprises a pair of cooperable buffing elements so constructed and arranged as to provide for the trapping of a portion of the recoil fluid and a variable exhausting of this fluid between the pair of buffing elements as the weapon completes its counterrecoil action. In the preferred embodiment of the invention shown in the drawings, the first buffer element is designated generally by the numeral 54 and includes an integral annular enlarged portion formed at the counterrecoil end of the exterior of the inner tubular member 21. This buffer element includes a first annular portion 55 relatively short in axial extent and a second buffing portion 56 which extends rearwardly from the portion 55 and has its outer periphery tapered or formed as a frusto-conical surface diminishing in diameter rearwardly, or in the direction of recoil. Adjacent the rear or recoil end of the conical or tapered buffer portion 56 forming a part of the buffer element 54, the exterior of the inner tubular member 21 is grooved or cut out to provide an annular recess 57 which provides in effect a cylindrical portion of reduced diameter extending rearwardly from the second buffing portion 56.

The counterrecoil end of the recoil sleeve 30 is provided with an integral, forwardly directed cylindrical extension or buffer sleeve 58 which,

when the gun is in battery, closely encircles the conical surface or second buffing portion **56** of the buffer element **54**. It will be noted that the extreme forward or counterrecoil portion of the buffer sleeve **58** has an inner periphery that has a relatively close fit with the annular portion **55** on the buffer element **54** when the gun is in battery. At its juncture with the recoil sleeve **30**, buffer sleeve **58** is reduced internally to a diameter approximately the same as the external diameter of tubular member **21**, to thereby form an annular radial wall or shoulder **59** of relatively short radial extent. This radial wall or shoulder cooperates with the buffer sleeve **58** and annular recess **57** to provide a buffer pocket for the trapping of a portion of recoil fluid as the gun tube approaches battery position on completion of counterrecoil.

In the operation of the gun described herein, recoil occurs in the usual manner after the weapon is fired and the gun tube **27** and its connected recoil sleeve **30** are driven rapidly rearwardly against the counterrecoil spring **52** and against the coil in the chamber **45**. Because of the cooperation between the ring piston **49** and the longitudinal grooves **46** in the interior of the outer tubular member **22**, the oil is throttled in such a manner that the initial action of the gun in recoil is relatively rapid and increases in rapidity until a point near the end of the recoil stroke, at which point the throttling grooves **46** are of reduced depth and serve to further restrict the flow of oil forwardly over the periphery of the ring piston **49**. This construction and function prevents jarring of the weapon as the gun reaches maximum recoil position. During recoil the spring **52** is placed under compression and after the end of the recoil stroke is reached the spring **52** reacts to drive the gun tube forwardly in counterrecoil. Because of the forward tapered face on the piston **49**, counterrecoil action will be relatively rapid, which result is desirable from the standpoint of returning the weapon to battery as quickly as possible so that it may be fired again. However, it is undesirable that the gun be permitted to slam back into battery.

As the gun tube **27** and recoil sleeve **30** reach the final phase of counterrecoil (Fig. 2), a relatively small portion of recoil oil is trapped in the pocket formed by the inner periphery of the buffer sleeve **58** the radial wall or shoulder **59**, and recess **57**. Since the aforesaid pocket decreases in volume as the recoil sleeve **30** approaches battery position, oil trapped therein will now be forced out between the proximate edges of the buffer element **54** and buffer sleeve **58**. As the buffer sleeve **58** continues forwardly in counterrecoil, it cooperates with the conical surface **56** to gradually reduce the area through which the trapped oil may escape from the buffer pocket. Consequently, movement of the gun tube **27** and recoil sleeve **30** will be gradually slowed as the gun reaches battery and the gun will be eased into its final postion as the forward end of buffer sleeve **58** slips over the annular portion **55** in closely fitting relation therewith.

It will be seen from the foregoing description that the buffing means provided according to the present invention adequately checks the final stage of counterrecoil and absorbs the final shock of the weapon as the gun returns to battery. It will also be noted that this desirable result is achieved by the two simple elements that are formed respectively on a stationary and a moving part of the assembly. It will be appreciated, of course, that the relationship between the parts **56** and **58** may be varied to achieve different degrees of shock absorption. The particular design illustrated has been found suitable for the type of weapon in connection with which it has been shown and described; although, this design may be modified to suit different requirements. It will be understood, of course, that various other alterations and modifications may be made in the preferred form of the invention illustrated herein without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. Recoil mechanism for a gun, comprising: a double cylinder support including an inner hollow cylinder and an outer hollow cylinder concentrically arranged with the outer periphery of the inner cylinder spaced radially from the inner periphery of the outer cylinder to provide an annular, elongated chamber for containing recoil fluid; a gun tube slidably carried within the inner cylinder for recoil and counterrecoil; a cylindrical sleeve disposed concentrically between the cylinders and extending exteriorly thereof at the recoil end of each; means connecting the sleeve at its recoil end to the gun tube for recoil and counterrecoil therewith; an integral, annular enlarged portion formed on the outer periphery of the inner cylinder at its counterrecoil end and providing, within the chamber, a concentric buffing element having its outer periphery formed as a section of a cone diminishing in the direction of recoil; means forming an annular recess in the outer periphery of the inner cylinder adjacent the buffing element at the recoil side thereof; and a concentric buffer ring formed on the sleeve at its counterrecoil end within the chamber and including a generally cylindrical inner periphery having a diameter slightly greater than the largest diameter of the conical buffer element and extending in the direction of recoil and positioned to encircle the buffer element, when the gun tube is in battery, and to move away from and to return to the buffer member upon recoil and counterrecoil of the gun tube, the buffer ring forming with the annular recess, at a point in counterrecoil just prior to completion thereof, an annular buffer pocket.

2. Recoil mechanism for a gun, comprising: a gun tube; a tubular support encasing the gun tube and mounting the gun tube for recoil and counterrecoil; means between the outer periphery of the gun tube and the inner periphery of the tubular support forming an annular chamber for containing recoil fluid; means on the tubular support and within the chamber at the recoil end thereof forming an annular concentric buffer element having its outer periphery formed as a section of a cone diminishing in the direction of recoil; means on the buffer element, at the recoil side thereof, forming an adjacent coaxial ring portion of a diameter smaller than the smallest diameter of the buffer element; and a concentric buffer sleeve encircling and connected to the gun tube for movement therewith in recoil and counterrecoil and positioned in the chamber in concentricity with the buffer element, the buffer sleeve having a generally cylindrical inner periphery that closely encircles the buffer element when the gun tube is in battery and forms with the adjacent ring portion, just prior to completion of counterrecoil, a buffer pocket adapted to trap recoil fluid.

3. Recoil mechanism for a gun, comprising: a gun tube; a tubular support encasing the gun tube and mounting the gun tube for recoil and counterrecoil; means between the outer periphery of the gun tube and the inner periphery of the tubular support forming an annular chamber for containing recoil fluid; means within the chamber forming a coaxial annular extension of the tubular support projecting from the counterrecoil end of the chamber toward the recoil end thereof and encircling the gun tube, the extension including a buffer element having an outer periphery formed as a section of a cone diminishing in the direction of recoil and an adjacent coaxial annular portion of reduced diameter at the recoil side of the buffer element; and a buffer sleeve encircling and connected to the gun tube for recoil and counterrecoil therewith and positioned in the chamber to closely encircle the buffer element when the gun tube is in battery and to variably encircle the buffer element as the gun tube completes counterrecoil, the buffer sleeve cooperating with the annular reduced portion to provide a buffer pocket just prior to completion of counterrecoil of the gun tube.

4. Recoil mechanism for a gun, comprising: a gun tube; a tubular support encasing the gun tube and mounting the gun tube for recoil and counterrecoil; means between the outer periphery of the gun tube and the inner periphery of the tubular support forming an annular chamber for containing recoil fluid; means within the chamber forming a coaxial annular extension of the tubular support projecting from the counterrecoil end of the chamber toward the recoil end thereof and encircling the gun tube, the extension including a buffer element having an outer periphery formed as a section of a cone diminishing in the direction of recoil and further including means forming an adjacent coaxial annular recess at the recoil side of the buffer element; and a buffer sleeve encircling and connected to the gun tube for recoil and counterrecoil therewith and positioned in the chamber to closely encircle the buffer element when the gun tube is in battery and to variably encircle the buffer element as the gun tube completes counterrecoil, the buffer sleeve cooperating with the annular recess to provide a buffer pocket just prior to completion of counterrecoil of the gun tube.

5. Recoil mechanism for a gun, comprising: a gun tube; a tubular support encasing the gun tube and mounting the gun tube for recoil and counterrecoil; means between the outer periphery of the gun tube and the inner periphery of the tubular support forming an annular chamber for containing recoil fluid; and including a coaxial annular extension projecting from the counterrecoil end of the chamber toward the recoil end thereof and encircling the gun tube, the extension including a buffer element having an outer periphery formed as a frusto-conical surface diminishing in diameter in the direction of recoil and an adjacent annular portion of reduced diameter continuing rearwardly from the recoil end of said buffer element; and a buffer sleeve encircling and connected to the gun tube for recoil and counterrecoil therewith and positioned in the chamber to closely encircle said buffer element when the gun tube is in battery position said buffer sleeve having an internal annular shoulder, said sleeve and shoulder cooperating with said annular portion of reduced diameter to form a fluid-trapping pocket which decreases in volume as said buffer sleeve moves forwardly over said frusto-conical surface, said sleeve and frusto-conical surface cooperating to reduce the effective area through which fluid may escape from said pocket into said chamber.

6. Recoil mechanism for a gun, comprising: a gun tube; a tubular support encasing the gun tube and mounting the gun tube for recoil and counterrecoil; means between the outer periphery of the gun tube and the inner periphery of the tubular support forming with said support, a closed annular chamber for containing recoil fluid; and including a tubular member projecting from the counterrecoil end of the chamber toward the recoil end thereof and encircling the gun tube, said tubular member including a buffer element having an outer periphery formed as a frusto-conical surface diminishing in diameter in the direction of recoil and further including means forming an annular recess rearwardly of and adjacent the recoil side of said buffer element; and a buffer sleeve encircling and connected to the gun tube for recoil and counterrecoil therewith and positioned in the chamber to closely encircle said buffer element when the gun tube is in battery, said buffer sleeve having an annular inwardly extending shoulder cooperable with said sleeve and annular recess to provide a buffer pocket in which a quantity of buffer fluid is trapped, the volume of said pocket and the area of escape therefrom diminishing as said sleeve slides forwardly over said frusto-conical surface in counterrecoil.

7. Recoil mechanism for a gun, comprising: a support; a gun tube mounted on the support for recoil and counterrecoil; means on the support forming a recoil cylinder extending generally in parallelism with the gun tube and adapted to contain recoil fluid; means within the cylinder at the recoil end thereof forming an annular buffer element having its outer periphery formed as a section of a cone diminishing in the direction of recoil; means on the buffer element, at the recoil side thereof, forming an adjacent coaxial annular portion of a diameter smaller than the smallest diameter of the buffer element; means mounted in the cylinder and connected to the gun tube for movement in unison therewith in recoil and counterrecoil and including a buffer sleeve positioned coaxially with the buffer element, the buffer sleeve having a generally cylindrical inner periphery that closely encircles the buffer element when the gun tube is in battery and forms with the adjacent annular portion, just prior to completion of counterrecoil, a buffer pocket adapted to trap recoil fluid.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
522,508	Canet	July 3, 1894
2,332,520	Lucht	Oct. 26, 1943
2,358,340	Lucht	Sept. 19, 1944
2,395,488	Lucht	Feb. 26, 1946