

Jan. 7, 1947.

H. C. FISCHER

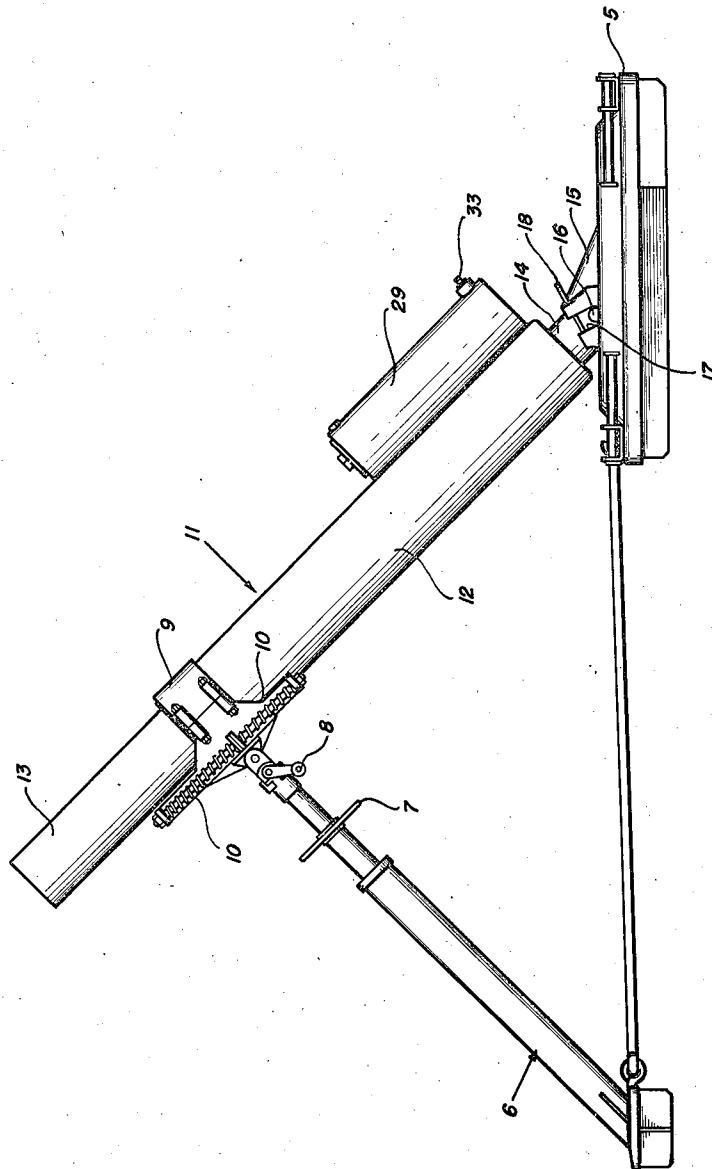
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Filed July 24, 1943

4 Sheets-Sheet 1

FIG. 1



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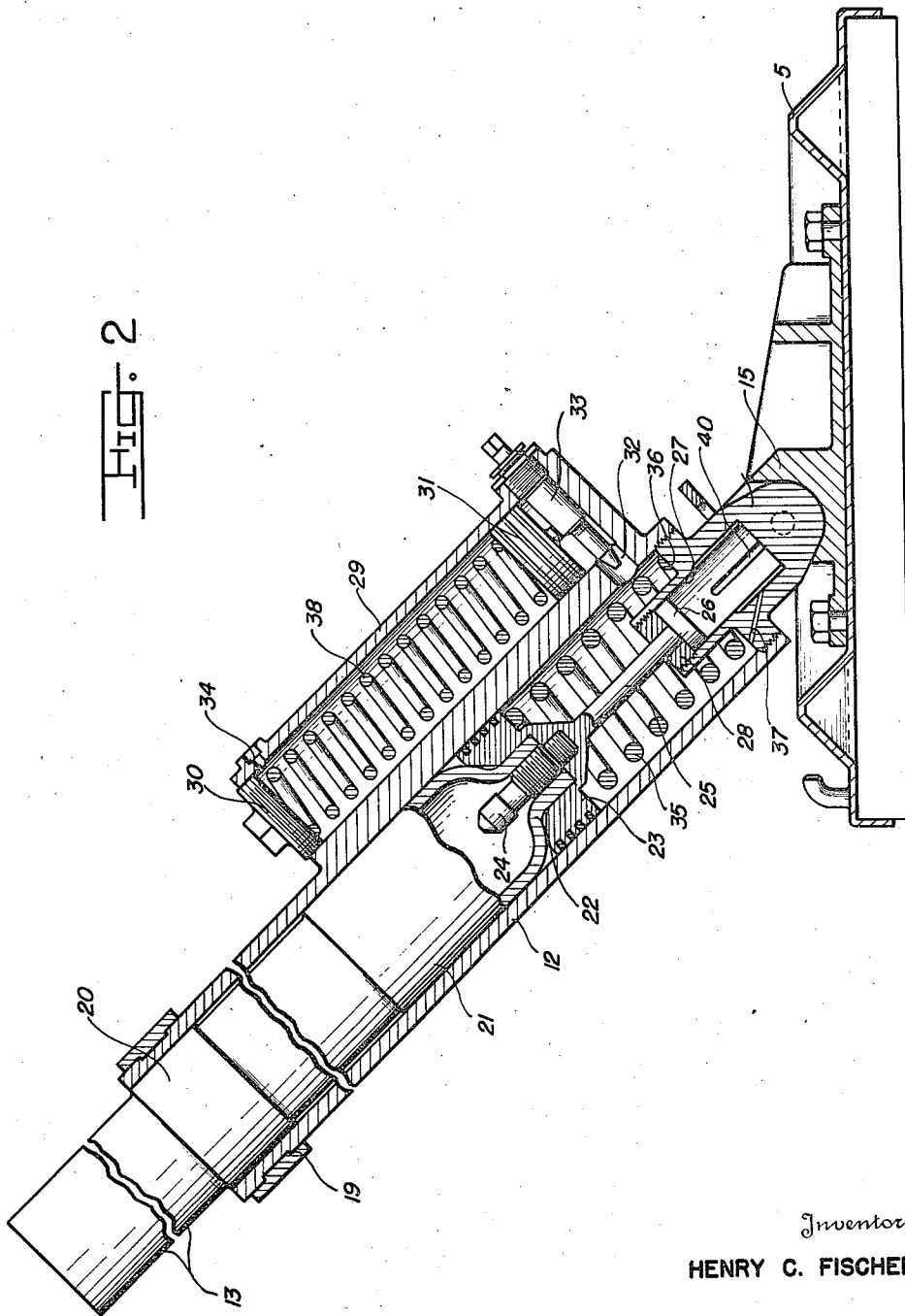
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Filed July 24, 1943

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2.



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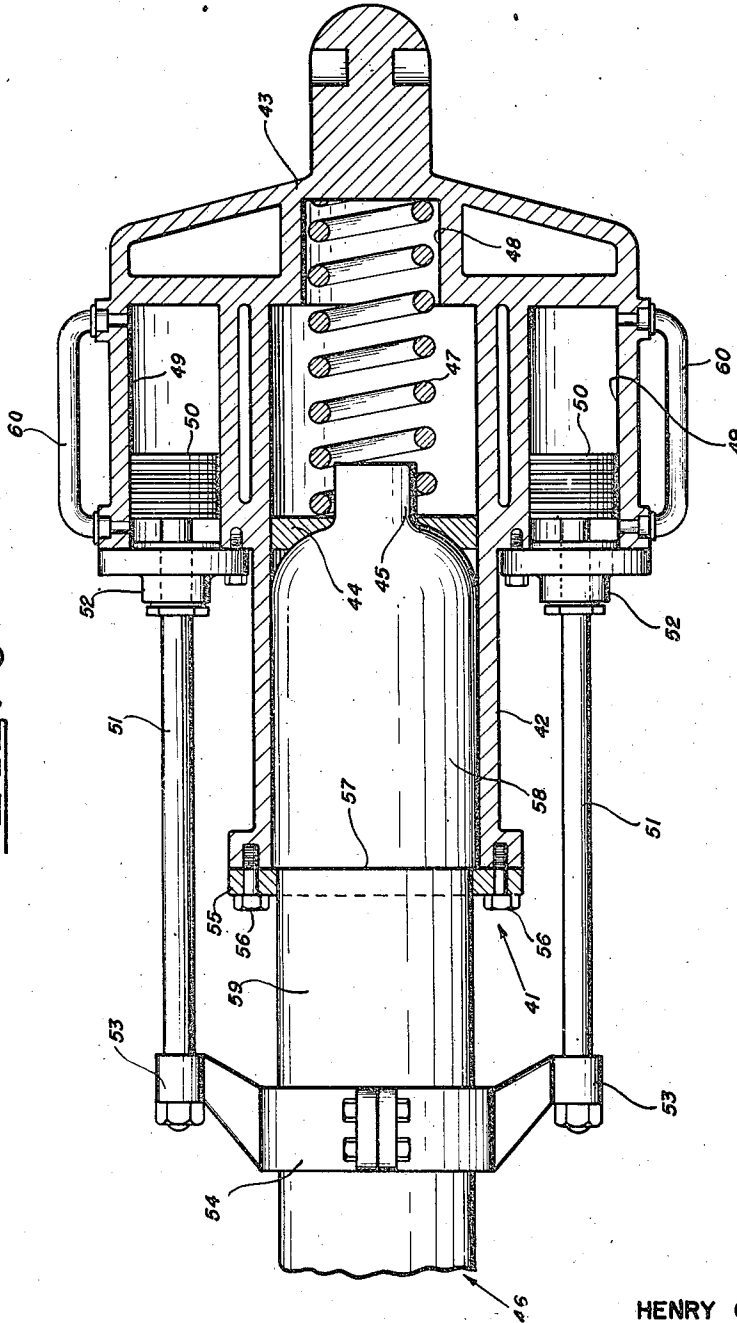
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Filed July 24, 1943

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FIG. 3



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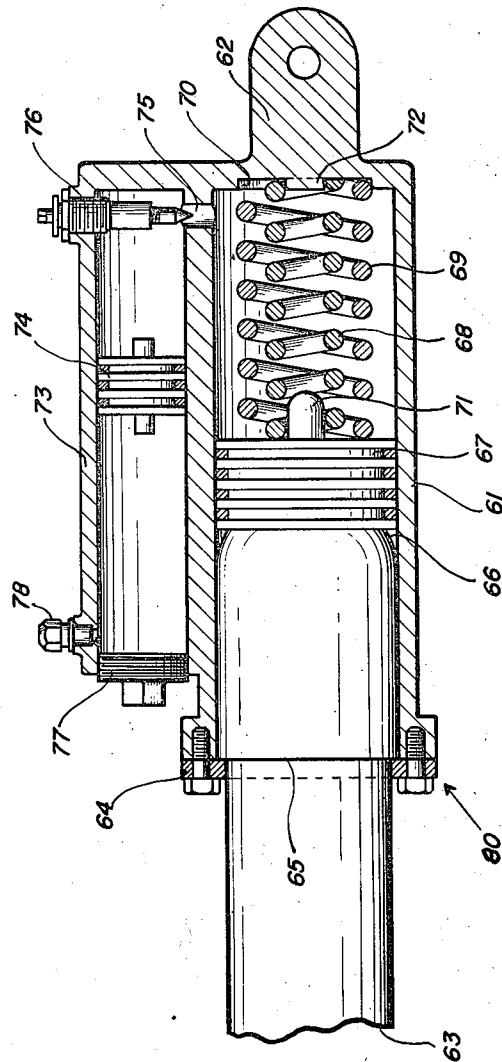
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Filed July 24, 1943

4 Sheets-Sheet 4

FIG. 4



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## UNITED STATES PATENT OFFICE

2,413,703

## PIECE OF ORDNANCE

Henry C. Fischer, Baltimore, Md.

Application July 24, 1943, Serial No. 495,995

2 Claims. (Cl. 89—1)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

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

This invention relates generally to muzzle loaded ordnance pieces, and more particularly to chemical mortars.

The chemical mortar, as is well known, is a relatively light mobile weapon for firing a chemical shell of 4.2-inch caliber. Such a mortar may be quickly set up in the field and is fired by dropping the shell into the elevated muzzle or barrel of the weapon, the ignition and propelling charge being fired by impact of the shell on a stationary firing pin in the closed breech of the barrel. Usually the mortar barrel is provided at its breech with a base to engage the ground, while a front supporting structure for the front portion of the mortar barrel is provided and includes means for adjusting the barrel for altitude and traverse for pointing the weapon. Usually between the front supporting structure and the barrel a shock-absorbing connection is provided which will take up the shocks occasioned by firing and recoil.

It is an object of this invention to provide an improved mortar having generally the features of construction and assembly above referred to, but which is characterized over the present known types of mortars by a construction and assembly whereby additional effective provision is made for absorbing the shocks incident of firing and recoil.

In accordance with the present invention the muzzle or barrel of the mortar embodies what may be termed an outer and stationary barrel member and an inner sliding barrel, the latter having in the breech thereof the firing pin; together with a recoil mechanism associated with the stationary and sliding barrel elements for absorbing the force of the discharge or setback on the barrel and ground-engaging base of the weapon.

The invention, together with its object and advantages will be best understood from a study of the following description, taken in connection with the accompanying drawings, wherein:

Figure 1 is a side elevational view of a mortar set up for use and illustrating one embodiment of the invention.

Figure 2 is a sectional view through the mortar of Figure 1, with certain parts shown in elevation, and with the front supporting structure omitted.

Figure 3 is an enlarged detail view, partly in

2

section and partly in elevation, of an alternate form of barrel and recoil assembly.

Figure 4 is a view similar to Figure 3 and illustrating a third form of barrel and recoil assembly.

The invention is illustrated and will be described as applied to a well known type of 4.2-inch chemical mortar. Accordingly only such structural and operational features of the mortar as deemed necessary for a complete understanding of this invention will be herein specifically referred to and described.

Of the mortar herein illustrated the conventional parts which may necessarily be referred to generally are:

The ground-engaging base 5; the front supporting structure 6 for the front portion of the mortar barrel, and which structure includes an elevating mechanism of a well known type and embodying a coil spring assembly (not shown) which, when the mortar is fired, allows downward motion of the barrel in the direction of the axis of the support thus reducing the stresses on the standard of the supporting structure together with an elevating screw wheel, and which latter is indicated at 7, for adjusting the barrel for altitude; the traversing mechanism, the operating crank of which is indicated at 8, for moving the barrel transversely; and the two-part clamp connection 9 between the front supporting structure 6 and the barrel, and designed, in a manner well known, that shock from recoil of the barrel during firing is cushioned by coil springs 10, 10, instead of being transmitted to the standard of supporting structure 6 through a rigid connector.

In accordance with this invention, and as characterizes each of the several alternate forms shown, the barrel, herein indicated generally by the reference numeral 11 is composed of two telescoping tubes, one of which may be termed the outer or stationary barrel section, and the other of which may be termed the inner or sliding barrel section.

In the form of the invention detailed in Figure 2, the outer stationary barrel section of barrel 11 is designated by the numeral 12, and the sliding barrel section telescopically fitted in the barrel section 12, is denoted by the reference numeral 13.

The outer barrel section 12 at its lower or breech end is threaded or otherwise fitted with a base cap 14 which rests in the cup 15 provided therefor on base plate 5. Pivot or base cap pins 16 are engaged in U-shaped slots 17 at opposite

sides of cup 15; cap 14 being held securely from jumping out of the cup 15 by a suitable and well known type of locking device which includes a retaining fork 18 the legs of which bridge the open ends of slots 17, as shown in Figure 1.

The upper end of barrel section 12 is provided as at 19 to complementarily fit within the clamp 9 whereby proper connection is made between the front supporting structure 6 and the barrel to permit transverse and vertical adjustment for aiming the weapon.

The inner barrel section 13, intermediate its ends as at 20, and also at its inmost or breech end as at 21, is diametrically enlarged externally in order to have at 20 and 21 a snug working-fit within the outer barrel section 12, with the enlargements 20, and 21 acting as guiding surfaces for section 13, and enlargement 20 additionally functioning as a support for the adjacent upper or outermost end of section 13.

At the inmost or breech end barrel section 13 is swaged in to form a bottleneck 22, upon which is fitted a piston 23. The bottleneck 22 is threaded on the inside to receive a conventional or standard firing pin 24 that is also screw-threadedly engaged with the piston 23, as shown in Figure 2.

Piston 23 has rigidly associated therewith a rod 25 connecting piston 23 with a piston 26 on the lower end of rod 25. Piston 26 has a working fit in auxiliary cylinder 27 formed integrally with base cap 14; rod 25 working through an opening provided therefor in plug 28 threaded into one end of cylinder 27.

Outer barrel section 12 and piston 23 form a main expansible oil chamber that, through the medium of port or ports 37, is in communication with a smaller expansible oil chamber formed by cylinder 27 and piston 26.

Formed integrally with, or otherwise provided on, the periphery of barrel section 12 is a secondary cylinder 29 provided at one end with a screw plug 30. A piston 31 has a working fit within cylinder 29 and forms therewith a secondary expansible oil chamber that is in communication with the oil chamber of barrel section 12 through the medium of a port or passage 32. Port or passage 32 is controlled by a suitable needle valve 33 adjustable to regulate the flow of oil between the chambers. A bleeder port 34 is formed in the wall of cylinder 29 adjacent the plug-equipped end thereof.

Inner barrel section 13 is yieldably urged to an extended or projected position with respect to outer barrel section 12 through the medium of a coil spring 35 circumjacent rod 25 and interposed between piston 23 and shoulder 36, the latter being formed on cap 14 circumjacent cylinder 27. A coil spring 33 housed within cylinder 29 acts on piston 31 in opposition to the pressure of oil entering the secondary oil chamber through the valve controlled port 32.

The operation and advantages of the construction and arrangement as thus far detailed will now be explained. The projectile, as is common to ammunition for mortars of the general character herein considered, has its propelling charge attached to the base of the shell. To fire the weapon, the projectile is inserted in the muzzle and is fired by means of the shell impinging against the firing pin 24, all in a manner well known in the art.

When the shot is fired the setback force drives barrel section 13 downward and inward of barrel section 12, in the direction of the axis of the bar-

rel, and against the resistance of the oil and springs 35 and 33 so that shock of recoil of the barrel is cushioned instead of being transmitted directly to the base plate through the connection between the barrel and base plate. In this connection it is apparent that as barrel section 13 moves downwardly when the shot is fired, oil in the auxiliary cylinder 27 is forced by piston 26 through port 37 into the main oil chamber of barrel section 12, and under action of piston 23 oil from this main chamber is forced through port 32 past valve 33 into the secondary oil chamber to act on piston 31 therein in opposition to spring 38. After the setback force has spent itself, spring 35 acts to return barrel section 13 to extended or normal position, and spring 38 acts on piston 31 to force a return flow of oil from cylinder 29 to the referred to main and auxiliary oil chambers, so that the mortar is again ready for loading and firing.

Shock incident to the return of barrel section 13 is adsorbed by reason of the resistance of oil in cylinder 27 to piston 26 on the return stroke of the latter. In this connection it will be observed that cylinder 27 is provided with a series of circumferentially spaced internal grooves or passages 40 that terminate short of the plug-equipped end of the cylinder. Thus, as piston 26 moves downwardly in response to the setback force some of the oil in cylinder 27 will flow through the passages 40 to seek a level behind piston 26, and upon the return stroke of the piston offer sufficient resistance thereto to absorb the shock incident to return of barrel section 13 to normal position.

From the foregoing it will also be appreciated that when the shot is fired the barrel recoils, so that the barrel section 13 slides parallel to its own axis, without appreciably moving the base plate which penetrates into the ground a material extent at the commencement of firing. Thus the sudden movement of the entire mortar assembly (base plate, barrel, and front supporting structure) under the effect of the recoil is prevented; the rearing action of the entire assembly taking place a little later, after the projectile has been discharged.

It will be noted from the above that this invention effectively supplements the usual shock absorbing instrumentalities (the spring associated with the elevating mechanism, and the springs forming part of the connection between the barrel and front supporting structure) hereinbefore referred to generally as being presently conventional or standard equipment, to the greater protection against severe jars of such sensitive mechanisms, as for example, the collimator sight, with which such weapon is usually equipped, and to the prevention of such rearing action as is prejudicial to accurate firing.

Alternatively, and as shown in Figure 3, the barrel, therein indicated generally at 41, may have the outer barrel section 42 thereof formed with an integral base cap 43, provided, as is cap 14 of Figure 2, for engagement with and retention in the cup 15 of base plate 5 of the mortar.

Also in this second form of the invention, outer barrel section 42 at the breech end thereof forms with piston 44 on the bottleneck 45 of inner barrel section 46 a main expansible chamber which houses coil spring 47. Spring 47 has one end portion thereof seated within an internal recess formed at the junction of barrel section 42 and base cap 43, and an end disposed about bottleneck 45 and impinging against piston 44. In this connection it will be noted that piston 44 of Figure 3

is of considerably less depth than piston 23 of Figure 2 and exposes a considerable portion of bottleneck 45 so that the latter functions somewhat as a pilot for spring 47.

This alternate form of the invention is also characterized by secondary cylinders 49, 49 at diametrically opposite sides of barrel section 42, and which, with pistons 50, 50 having snug working fit therein, provide secondary expansible chambers adapted to contain oil if so desired. Pistons 50, 50 have rods 51, 51, working through gland assemblies 52, 52, at one end of cylinder 49, 49, and rigidly secured to ears 53, 53, on the complementary parts of a two-part clamp 54 that rigidly embraces the forward outer end of barrel section 46.

Outward movement of barrel section 43 relative to barrel section 42 is limited by a stop collar 55 secured as at 56 to the forward end of barrel section 42, and against which an external shoulder 57, formed at the junction of diameters 58 and 59 of barrel section 46, abuts.

Each cylinder 49 is provided with a by-pass 60 that at its ends connects with the cylinder adjacent opposite ends of the cylinder so that oil passes there-through first in one direction and then in a reverse direction in response to reciprocatory movement of the piston.

The operation of this form of the invention as just detailed may be explained as follows: When the shot is fired the setback force drives barrel section 46 downward and inwardly of barrel section 42 in the direction of the axis of the barrel and against the resistance of spring 47, pistons 53 moving therewith against the resistance of oil in cylinders 49 and forcing the oil through the by-passes 60 back into cylinders 49 behind pistons 50, absorbing the shock. After the setback force has spent itself, spring 47 acts to return barrel section 46 to extended or normal position, and shock incident to return of barrel section 46 is absorbed by reason of the resistance of the oil in cylinders 49 to pistons 50 as on the return stroke thereof these pistons force the oil back through the by-passes 60.

If desired by-passes 60, 60, may be dispensed with and air check valves substituted therefor in an obvious manner so that the desired cushioning effect is obtained by action of the pistons 50 drawing air into the cylinders behind the pistons and forcing air from the cylinders in advance of the pistons, on each stroke thereof.

In the third illustrated embodiment of the invention, Figure 4, the barrel, indicated generally by the reference numeral 80, and similarly to the embodiment of Figure 3, has the outer section 61 thereof at the breech end formed with an integral base cap 62 for use, in a manner believed obvious, in attaching the base plate of the mortar to the barrel.

The inner barrel section 63, like to the inner barrel section of Figure 3, is limited in its outward movement by a collar 64 and a shoulder 65, and at its bottleneck 66 is equipped with a piston 67.

As shown, piston 67 is preferably of the ring-equipped type, and forms with barrel section 61 a main expansible oil chamber housing a pair of concentric coil springs 68, 69. Springs 68, 69, impinge at one end against piston 67 and at the other end are seated in a recess 70 provided in the breech end of the barrel section 61. Pilot elements 71, 72, are provided for the springs as shown.

Formed or otherwise provided on the periphery of barrel section 61 is a cylinder 73 in which a

floating piston 74 has a working fit and forms therewith a secondary expansible oil chamber that is in communication with the main expansible chamber by a port or passage 75 controlled, like to the passage 32 of Figure 2, by an adjustable needle valve 76.

At the end thereof remote from valve 76, cylinder 73 is provided with a screw plug 77, and at this last named end is provided with a lateral check valve-controlled port 73 through which air is quickly admitted at one side of piston 74 on the down stroke of the latter and emitted slowly from the cylinder on the return stroke of the piston.

Explaining now the operation of this embodiment of the invention: The weapon is loaded and fired in the manner hereinbefore set forth with reference to the embodiment of Figure 2. The setback force, when the shot is fired, drives barrel section 63 downwardly in the direction of the axis of the barrel against the resistance of oil and the springs 68, 69, in the barrel section 61, absorbing the shock; oil in the main expansible chamber passing into the secondary expansible chamber of cylinder 73 through passage 75 to raise piston 74 against the pressure of air in the cylinder above the piston and which air is emitted slowly through valve-controlled port 73 as piston 74 moves toward end 77 of the cylinder. After the setback force has spent itself, springs 68, 69, plus the pressure exerted by the return flow of oil slowly return barrel section 63 to forward position, the air pressure built up in cylinder 73 being sufficient to return piston 74 to its normal position, air being rapidly drawn into the cylinder behind piston 74 by suction during this return stroke of the piston.

As regards the alternate forms of the invention shown respectively in Figures 3 and 4, it is apparent from the respective descriptions thereof herein that in so far as the factors pertaining to the effective absorbing of the shocks incident of firing and recoil are concerned all the desirable features noted in connection with Figure 2 are retained. It will also be apparent that the invention is not limited to what has been detailed herein by way of explanation, but is to be considered as embracing all forms of apparatus and variants of method falling within the scope of the appended claims.

Having thus described the invention what is claimed as new is:

1. In a mortar of the character described, a barrel comprising a pair of telescoping sections, the inner one of which is movable relative to the outer section in the direction of the axis of the barrel, a piston on the inner end of the inner barrel section and having a working sliding fit in the outer barrel section to provide therewith a main expansible chamber, pressure responsive means arranged within said chamber and acting on the piston to normally urge the inner barrel section to a projected position with respect to the outer barrel section, a cylinder mounted on the outer barrel section, a piston having a working fit in said cylinder and forming therewith a secondary expansible chamber, a valve controlled port establishing communication between the main and secondary expansible chambers, and pressure responsive means in the breech end of the outer barrel section to act on the inner barrel section in opposition to the first named pressure responsive means during the return stroke of the inner barrel section to projected position.

2. A mortar of the class described, comprising

7

in combination, a barrel formed by a pair of telescoping sections, the inner section being reciprocally movable within the outer section, said telescoping sections being closed at their breech ends, a compression spring disposed within said outer telescoping section between the breech ends of the sections so as to resiliently space the breech end of the inner section away from the breech end of the outer to provide an expansible chamber adapted to be filled with a hydraulic fluid, means forming a counter recoil cylinder in the breech end of said outer section, said counter recoil cylinder being closed at its upper end, another expansible chamber intercommunicating through a restricted opening with said first 15

8

mentioned expansible chamber, piston means in said second mentioned expansible chamber adapted to oppose flow of said hydraulic fluid thereinto, a piston mounted on the breech end of said inner section, a second piston disposed within said counter recoil cylinder, a piston rod interconnecting said pistons, restrictive port means interconnecting said first mentioned expansible chamber with said counter recoil cylinder adjacent the lower end of the latter, and means provided to permit partial leakage of hydraulic fluid past said piston in the lower portion of said counter recoil cylinder.

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