Nov. 14, 1933. G. C. DAVISON 1,934,700

ARTILLERY

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Fig. 1.

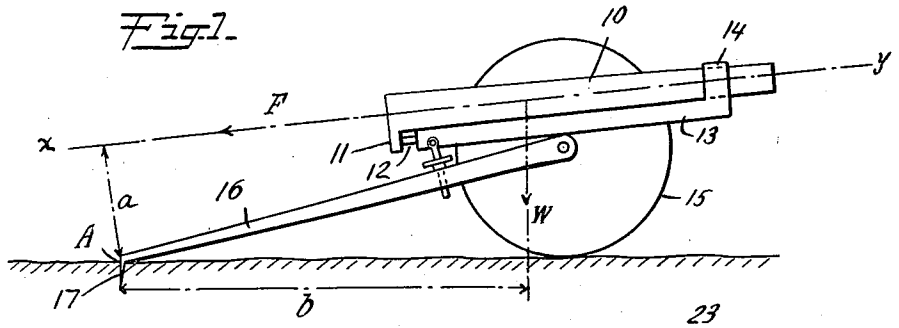
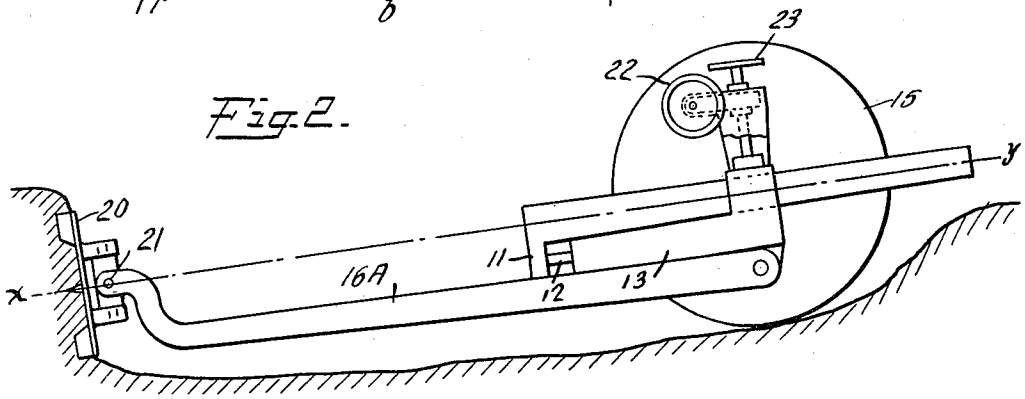


Fig. 2.



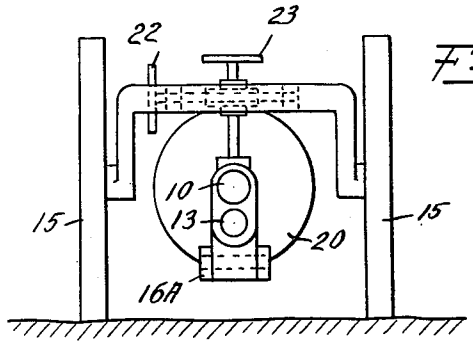
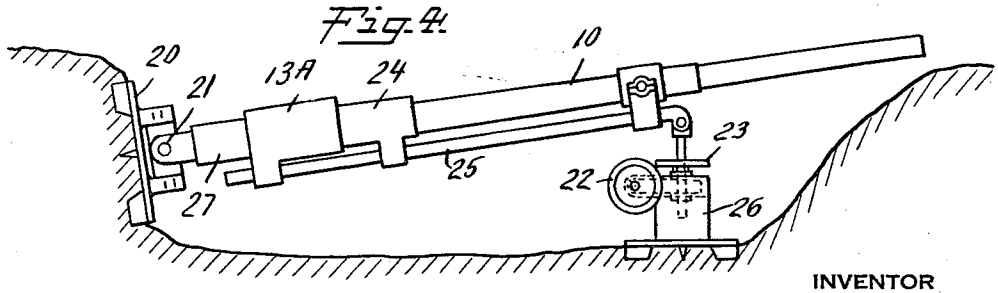


Fig. 3.

Fig. 4.



INVENTOR
Gregory C. Davison
BY
Marshall & Hawley
ATTORNEYS

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Fig. 5.

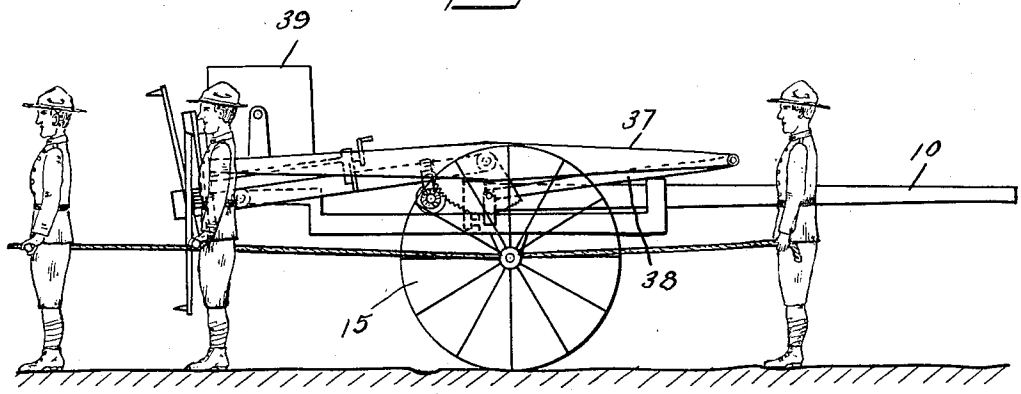
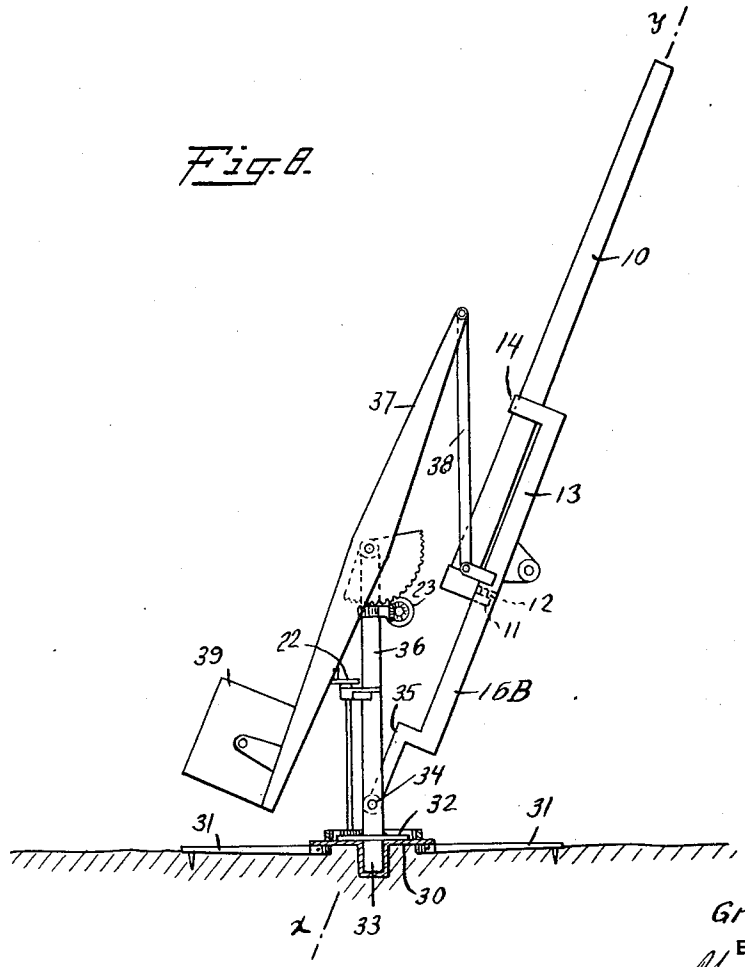


Fig. 6.



INVENTOR
Gregory C. Davison
BY
Marshall & Hawley
ATTORNEYS

Nov. 14, 1933. G. C. DAVISON 1,934,700

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Fig. 6.

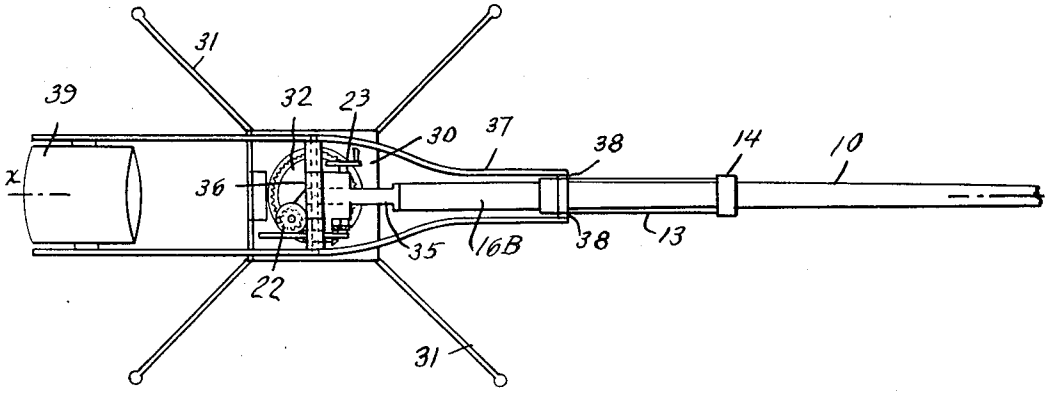
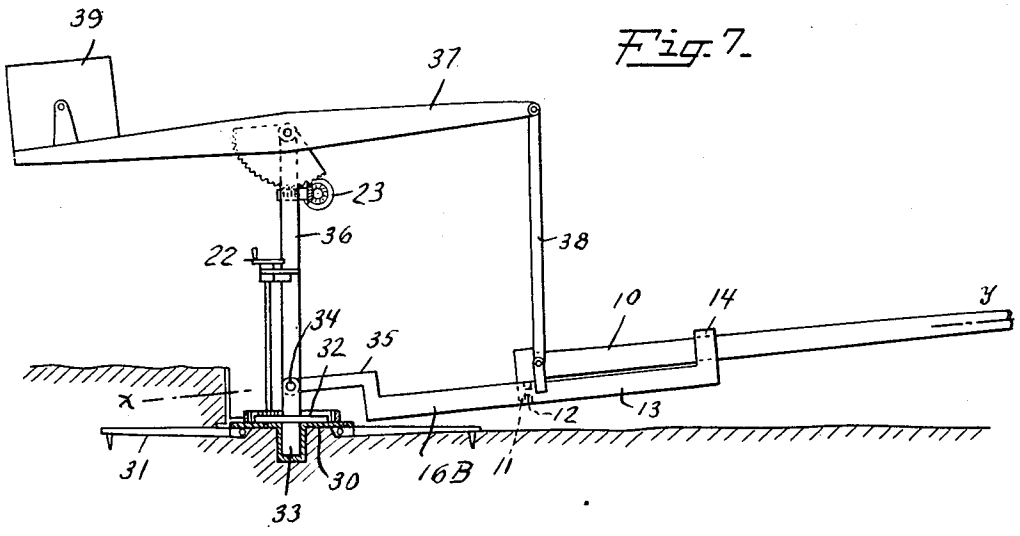


Fig. 7.



INVENTOR
Gregory C. Davison
BY
Marshall & Hawley
ATTORNEYS

Patented Nov. 14, 1933 1,934,700

UNITED STATES PATENT OFFICE

1,934,700

ARTILLERY

Gregory C. Davison, Huntington, W. Va.

Application May 16, 1932. Serial No. 611,531

19 Claims. (Cl. 89—40)

This invention relates to improvements in artillery, and its object is to provide a simple and inexpensive mounting which will enable the building of guns of maximum force with minimum weight and cost.

More specifically, its object is to provide an arrangement for resisting the recoil of a gun at a point in alinement with its axis.

A further object is to provide a balance for the gun so that it may be trained or elevated with little effort and to so mount it that it may be used for either field work or anti-aircraft work.

These and other objects will appear from the following specification in which I will describe the invention, the specific features of which I will point out in appended claims.

Referring to the drawings,

Fig. 1 is a side elevation of a field gun mounted in accordance with former practice, which illustrates some of the objectionable features which I have overcome;

Fig. 2 is a similar elevation of a gun and its mounting which embodies one of the features of the present invention;

Fig. 3 is a front elevation of the structure shown in Fig. 2;

Fig. 4 is a side elevation of a modified structure which also embodies the same feature of the invention;

Fig. 5 is a side elevation of another embodiment of the invention, a portable gun and balancing mounting therefor, dismounted and packed for transportation upon wheels;

Fig. 6 is a plan view of the gun and mounting of Fig. 5 set up and in position to be used for field work;

Fig. 7 is a side elevation of the structure shown in Fig. 6; and

Fig. 8 is a side elevation of the structure shown in Figs. 5 and 6, with the gun elevated for anti-aircraft work.

Like characters of reference designate corresponding parts in the various figures of the drawings.

Referring to Fig. 1, 10 designates the gun barrel which has a lug 11 attached to a piston rod 12, which in turn is attached to a piston inside a recoil cylinder 13. The recoil cylinder is attached to the axle of the carriage. At the forward end of the recoil cylinder is a collar 14 through which the barrel 10 slides when the gun is fired. The whole system is supported at three points, the wheels 15 and end of the trail 16, the end of which is provided with a spade 17 which is driven into the ground to take up the force of the recoil.

x—y designates the axis of the barrel 10. F represents the force of the recoil acting in the line x—y. This causes a moment about the point A at the spade. The arm about which the force F acts is represented by the line a drawn from the center of resistance A, of the spade 17 perpendicular to the line x—y. Therefore, Fa expresses the moment caused by the recoil of the gun. This results in a tendency of the gun and mounting to jump or to turn a back somersault, which is prevented by a counter moment Wb in which the weight of the gun is represented by a vertical line drawn downwardly from the center of gravity and the line b is the distance from this line to the point A.

When these two moments just balance each other,

$$Fa = Wb \quad \text{or,} \quad F = \frac{b}{a}W$$

In practice the moment Wb is made somewhat greater than moment Fa.

Now the force F is a measure of the power of the gun. If a greater powder charge be used, with consequently a greater muzzle velocity of the projectile, the force F will be increased. The arm a is determined by the original design of the gun and carriage, and also by the angle of elevation at which the gun is fired. The arm b is fixed by the design of the gun and carriage, and will vary with the position of the gun during recoil. Looking upon b and a as fixed quantities, it is therefore seen that the power of the gun, or the force F that can be used, is limited by the weight W.

The momentum of projectile and powder gases leaving the muzzle is equal to the momentum imparted to the gun and moving parts, in the case of free recoil. But in order to reduce the amount of momentum imparted to the gun, the recoil is retarded by the recoil cylinder 13 generally by forcing a liquid through a set of grooves or other orifices in the walls of the recoil cylinder. In field guns, the practice is to make the length of recoil as great as practical, and to make the checking force of the recoil cylinder constant, and as small as possible.

If it is desired, to increase the power of the gun by the use of a stronger steel, the weight of the gun proper may be reduced, but no saving in weight for the gun and carriage as a whole can be made, because the total weight W bears a fixed relation to the force F, which in turn has a relation fixed by the design to the power or muzzle energy of the projectile.

Therefore, regardless of any improvement in design of such gun, the total weight cannot be

decreased for any given power. This results in an exceedingly heavy gun and carriage. A three-inch field piece, firing a 15 pound projectile with a muzzle velocity of 2200 feet per second, weighs approximately 3200 pounds. Its power cannot be increased without also increasing the total weight. This rule holds true for practically all mobile field artillery mounted as shown in Fig. 1.

In Figs. 2 and 3, the trail 16A upon which the recoil cylinder 13 is mounted is connected to a recoil pad 20 by a universal joint 21. The recoil pad rests in the earth in an excavation made to receive it and to position it and the universal joint in the line *x—y*. Training and elevating mechanisms are indicated at 22 and 23 respectively.

By this arrangement the moment which tends to cause the gun to jump is entirely eliminated. The force of recoil passes through the center of the pad 20 so there is no arm *a*, such as that shown in Fig. 1. Consequently, the weight of the gun and its mount is not needed to counteract any turning moment. Therefore, the weight of the gun may be made small and the force of recoil large. As an example of what can be accomplished by this invention, the following figures are given: The regular army 75 m/m field piece has a gun which weighs 1010 pounds. The weight of gun and carriage totals, as I have said, over 3200 pounds. By using modern alloy steel a gun can be built with the same power weighing only 260 pounds. The mount to go with such gun, with other mechanism will weigh only 300 pounds. So the total weight of gun and mount built in accordance with my invention will be only 960 pounds, as compared with the regular 75 m/m army gun weighing over 3200 pounds. This saving in weight is very important, both in connection with the cost, and also in connection with transportation in the field.

This principle of mounting guns may be used with many variations of structure. In Fig. 4 I have shown an arrangement in which the gun, its breach mechanism 24 and recoil cylinder 13A are slidably mounted upon a track 25, the forward end of which is supported upon a pedestal 26 with intermediate train and elevation mechanism 22, 23. The recoil plunger 27 is in this case connected directly with the universal joint 21. The operation of this arrangement is similar to that described in connection with Figs. 2 and 3.

The apparatus illustrated in Figs. 5 to 8 embodies the aforesaid principle of resisting the recoil at a point approximately in line with the axis of the gun, but is also provided with equilibrator or balancing mechanism, whereby it may be pointed with minimum effort at any angle of elevation or train, thus providing a gun which may be used for field work and which may be instantly elevated for anti-aircraft use.

This apparatus comprises a recoil pad 30 pivoted to which are horizontal arms 31 by means of which the apparatus may be given a firm connection with the ground. 32 is a base plate rotatable upon the upper central part of the recoil pad. 33 is a vertical pin extending from the base plate through the recoil pad into a bearing. 34 is a horizontal shaft supported on the base plate to which the trail or track 16B is connected by an arm 35. The gun barrel 10 slides through the collar 14 and has a lug 11, piston rod 12 and recoil cylinder 13 similar to the arrangement shown in Fig. 2.

36 is a post or column which rises vertically from the base plate. Its lower end is bifurcated to support the shaft 34. Near its upper end a beam 37 is pivoted. One end of this beam is connected by a link 38 with the trail 16B and at its other end is a receptacle 39. This is to be filled with rocks, gravel or any other available material to balance the weight of the gun and its associated parts. The dimensions of the parts of this equilibrator are such as to produce a true parallel motion so that the beam 37 is always parallel with the axis *x—y* of the gun 10. Train and elevation mechanisms are shown at 22 and 23. The parts are also so proportioned and designed that the center of gravity of the apparatus as a whole passes in any of its positions through the pin 33.

This apparatus enables the use of the same gun for field work, as shown in Fig. 7, or for anti-aircraft work, as shown in Fig. 8. It may be folded up compactly and small units up to guns of two-inch bore may be carried on men's shoulders or on motorcycles. Larger guns may have wheels 15 attached to trunnions on a suitable part of the mechanism to form a light carriage, as shown in Fig. 5.

By thus providing a pivotal ground support back of the gun barrel in substantial alinement with its axis, arranged to resist the force of recoil at a point in the same line and providing an equilibrator which balances the gun and brings the center of gravity of the system directly above the center of its ground support, a gun with its mount can be built with a minimum weight which can be handled with minimum effort.

No attempt has been made herein to describe details of constructions as the basic principles involved may be carried out in many ways. Several modifications have been illustrated and described to show that this invention is not limited to any specific construction and I intend no limitations other than those imposed by the appended claims.

What I claim is:—

1. A gun barrel, a recoil mechanism and a recoil pad therefor in alinement with the axis of the barrel.

2. A gun barrel, a universal joint support therefor at the rear of, in substantial alinement with the axis of the barrel and symmetrically disposed in relation to said axis, a recoil mechanism interconnecting the barrel and said pivotal support, and another support for the barrel having train and elevation mechanisms, said other support being longitudinally spaced from said pivotal support.

3. A gun barrel, a universal joint support therefor at the rear of, in substantial alinement with the axis of the barrel and symmetrically disposed in relation to said axis, a recoil mechanism interposed between the barrel and said universal joint support and in alinement therewith, and another support for the barrel having train and elevation mechanisms, said other support being longitudinally spaced from said pivotal support.

4. A gun barrel, a recoil mechanism therefor, a recoil pad, and a universal joint connection between said mechanism and pad in alinement with the axis of the barrel and symmetrically disposed in relation to said axis.

5. A gun barrel, a recoil mechanism therefor, a recoil pad, and a universal joint connection between said mechanism and pad, said pad, pivoted connection and mechanism being in alinement with the axis of the barrel and said uni-

versal joint connection being symmetrically disposed in relation to said axis.

6. A gun barrel, a recoil mechanism parallel with but laterally spaced from the axis of the barrel, means for resisting the force of the recoil at a point in substantial alinement with the axis of the barrel, and a universal joint connection between said mechanism and said recoil resisting means symmetrically disposed in relation to said axis.

7. A gun barrel, a trail parallel with but offset from the axis of said barrel, a recoil cylinder mounted on said trail, a slidable connection between the gun barrel and the recoil cylinder, a recoil pad, and a universal joint between the trail and the pad in substantial alinement with the axis of the gun barrel.

8. A gun barrel, a universal joint support therefor at the rear of, in substantial alinement with the axis of the barrel, and a recoil mechanism interconnecting the barrel with said universal joint support and symmetrically disposed in relation to said axis.

9. A gun barrel, a pivotal support therefor at the rear of and in substantial alinement with the axis of the barrel, a vertically movable support for the barrel spaced longitudinally from said pivotal support, and a counterpoise acting upon the vertically movable support to impart thereto an upward force.

10. A gun barrel, a pivotal support for said barrel at the rear thereof, a vertically movable support for the barrel spaced longitudinally from said pivotal support, a beam pivoted intermediate its ends at a point over said pivotal barrel support, a weight on said beam at one side of its pivot, and a connection from the other end of the beam to said vertically movable support.

11. A gun barrel, a pivotal support therefor at the rear of and in substantial alinement with the axis of the barrel, a vertically movable support for the barrel spaced longitudinally from said pivotal support, a beam pivoted intermediate its ends at a point over said pivotal barrel support, a weight on said beam at one side of its pivot, and a connection from the other end of the beam to said vertically movable support.

12. A gun barrel, a pivotal support therefor at the rear of and in substantial alinement with the axis of the barrel, a vertically movable support for the barrel spaced longitudinally from said pivotal support, a counterpoise acting upon the vertically movable support to impart thereto an upward force, and a recoil mechanism interconnecting the barrel and said pivotal support.

13. A gun barrel, a vertical rotatable post, a frame for the gun barrel pivoted near the lower end of said post, a beam pivoted intermediate its ends near the upper end of the post, a link between one end of the beam and a point on said frame spaced from its connection with the post, and a counterpoise near the other end of the beam.

14. A gun barrel, a vertical rotatable post, a frame for the gun barrel pivoted near the lower end of said post, a beam pivoted intermediate its ends near the upper end of the post, a link between one end of the beam and a point on said frame spaced from its connection with the post, and a receptacle near the other end of the beam adapted to hold weighting material.

15. A gun barrel, a vertical rotatable post, a frame for the gun barrel pivoted near the lower end of said post, a beam vertically over said frame pivoted intermediate its ends near the upper end of the post, a link between one end of the beam and a point on said frame spaced from its connection with the post a distance substantially equal to that of the corresponding end of the beam from its connection with the post, and a counterpoise near the other end of the beam.

16. A vertical rotatable post, a frame pivoted near the lower end of the post, a beam vertically over the frame pivoted intermediate its ends near the upper end of the post, a substantially vertical link interconnecting an end of the beam with said frame, a counterpoise near the other end of the beam, and a gun barrel slidably supported in the frame.

17. A vertical rotatable post, a frame pivoted near the lower end of the post, a beam vertically over the frame pivoted intermediate its ends near the upper end of the post, a substantially vertical link interconnecting an end of the beam with said frame, a counterpoise near the other end of the beam, a recoil mechanism on the frame, and a gun barrel slidably supported on the frame and connected with the recoil mechanism.

18. A vertical rotatable post, a frame pivoted near the lower end of the post, a beam vertically over the frame pivoted intermediate its ends near the upper end of the post, a substantially vertical link interconnecting an end of the beam with said frame, a receptacle near the other end of the beam, and a gun barrel slidably supported in the frame.

19. A vertical rotatable post, a frame pivoted near the lower end of the post, a beam vertically over the frame pivoted intermediate its ends near the upper end of the post, a substantially vertical link interconnecting an end of the beam with said frame, a receptacle near the other end of the beam adapted to hold weighting material, a recoil mechanism on the frame, and a gun barrel slidably supported on the frame and connected with the recoil mechanism.

GREGORY C. DAVISON.