

No. 801,877.

PATENTED OCT. 17, 1905.

W. S. ISHAM.
GUN CARRIAGE.

APPLICATION FILED DEC. 17, 1902.

3 SHEETS—SHEET 1.

WITNESSES:

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3 SHEETS—SHEET 2.

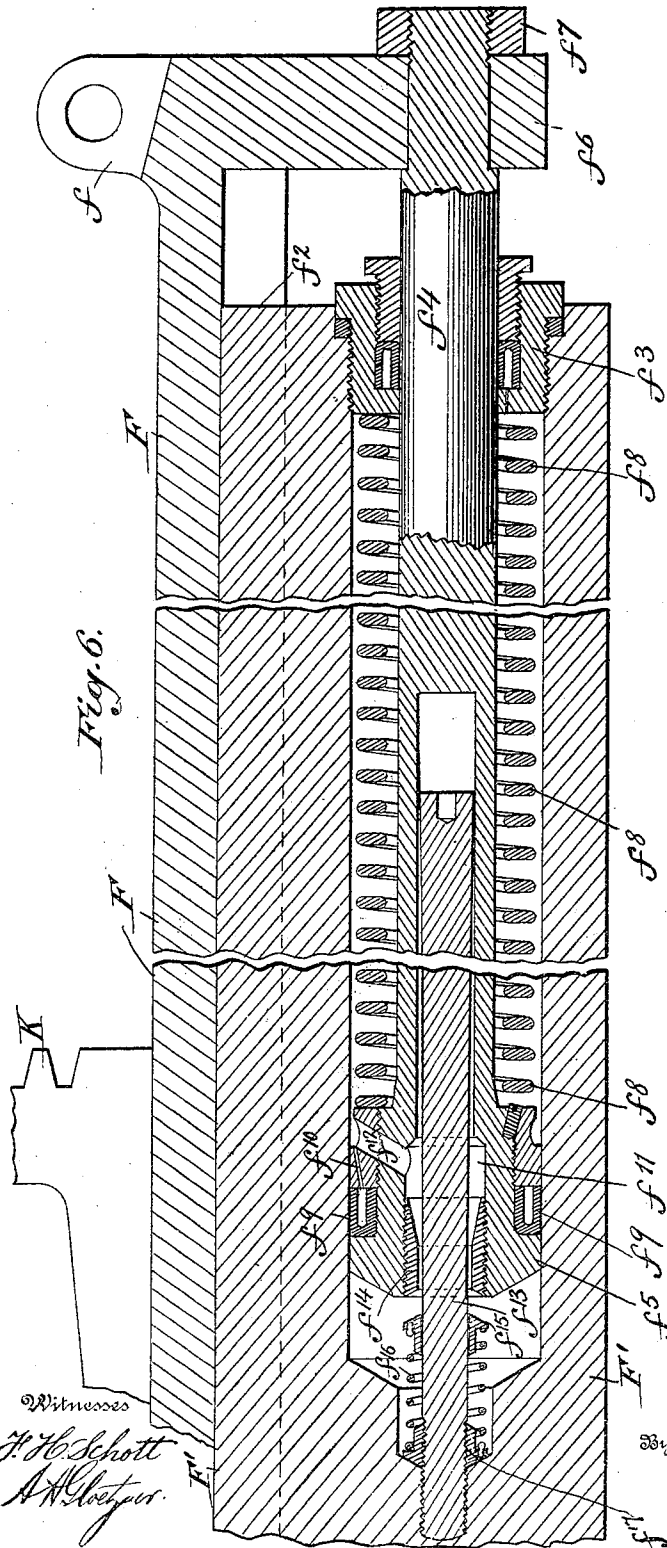


Fig. 6.

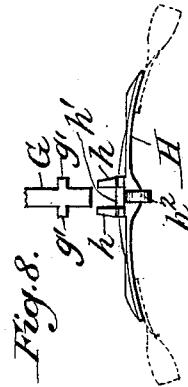
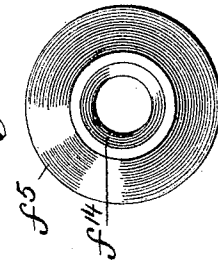


Fig. 8.

Fig. 7.



Witnesses
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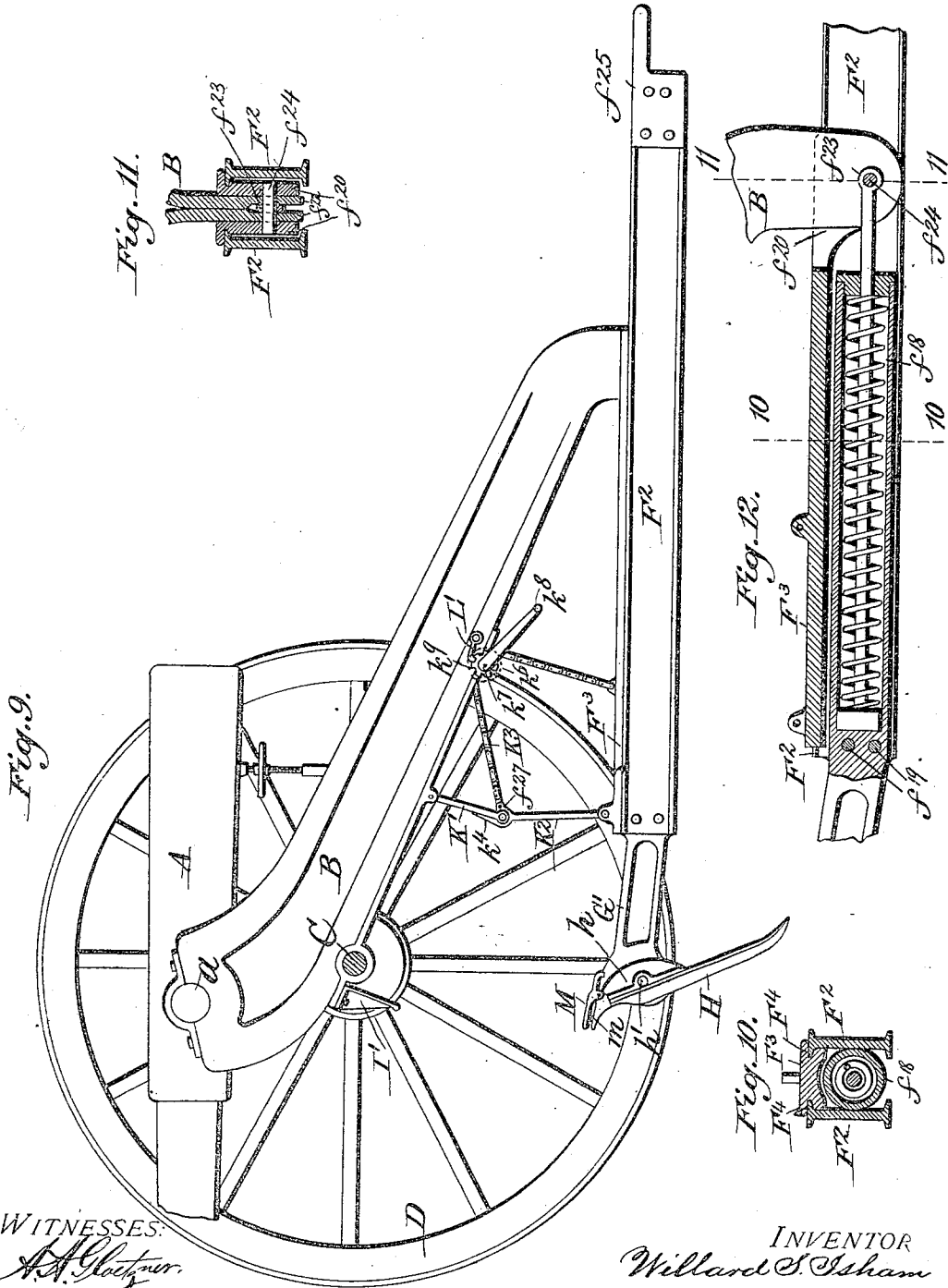
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3 SHEETS—SHEET 3.



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GUN-CARRIAGE.

No. 801,877.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WILLARD SMITH ISHAM, a citizen of the United States of America, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Gun-Carriages; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in gun-carriages, and in particular to recoil mechanism for mobile guns—such, for example, as field and siege guns.

The object of my invention is to provide a construction for mobile guns which will prevent the gun from jumping, will allow it to have but a short recoil, and during its recoil and return to the original position will maintain the gun in its alinement to an extent sufficient to avoid affecting the intended flight of the projectile, these advantages being attained with a minimum weight of gun and carriage and a minimum length of trail.

With this general object in view, and some others which will be obvious to those skilled in the art from the description hereinafter, my invention, broadly considered, consists in the features, details of construction, and combination of parts, which will first be described in connection with the accompanying drawings in specific embodiments, then explained in a generalized manner, and finally pointed out in the claims.

In the drawings, Figure 1 is a side elevation of one form of structure embodying my invention; Fig. 2, a front elevation, partly in section, of the same; Fig. 3, a detail sectional view, partly in elevation, of the recoil device and spade; Fig. 4, a detail transverse section of the two members of the recoil device; Fig. 5, a detail section on the line 5 5 of Fig. 1; Fig. 6, an enlarged detail view of the recoil device; Fig. 7, an enlarged end view of the piston; Fig. 8, a detail plan view of a spade and a part of the spade-holder; Fig. 9, a side elevation of another modification of my invention; Figs. 10 and 11, detail sections on the lines 10 and 11, respectively, of Fig. 12; and Fig. 12, a detail sectional view, partly in elevation, of the recoil device employed with said modification.

Referring to Figs. 1 to 8 of the drawings, A is a gun of any usual or desired construction provided with trunnions *a*, mounted on a trail B, whose lower end, as usual, forms

the rear bearing of the carriage. This trail is carried by the axle C and wheels D. Any suitable elevating mechanism may be employed—as, for example, an elevating-screw and hand-wheel, (indicated at E.)

To the trail B at a suitable distance above its lower end are attached two ears *b*, between which is pivoted a lug *f*, formed on the end of a rear member F of a recoil device, this rear member having two inward-extending flanges, as shown at *f'*, Fig. 4, whereby a substantially dovetailed guideway or groove is formed in said rear member, into which guideway extends a dovetailed guiding-rib on a hollow cylinder F', provided at one end with a removable head *f*³, which may be packed in any suitable way, as shown, said head being threaded into the open end of said cylinder and provided with an axial opening through which passes a piston-rod *f*⁴, whose inner end is attached to a piston *f*⁵, movable in the cylinder, while its outer end is attached to an arm *f*⁶, projecting downward from the rear end of the rear member F of the recoil device, the said attachment being made, preferably, by inserting the piston-rod through an opening in said arm *f*⁶ and providing said rod with a nut *f*⁷ outside the arm.

Inside the cylinder is located a helical spring *f*⁸, surrounding the piston-rod and bearing at one end on the piston *f*⁵ and at the other end on the cylinder-head *f*³.

The cylinder is preferably arranged to contain a fluid serving to delay the rearward movement of the piston in a well-known manner, and in this case the construction is as follows: The piston *f*⁵ is provided with a peripheral groove, as shown in Fig. 6, in which groove is located a packing-ring *f*⁹, entirely encircling the piston, formed of flexible material, such as rubber, folded upon itself, the line of fold being placed toward the front of the piston. The space between the folds is made accessible to the fluid at the rear of the piston by providing the piston with holes *f*¹⁰, arranged longitudinally, the purpose of which is to keep the packing tight. The piston is also provided with a bore or opening *f*¹¹, accessible to the fluid in the cylinder at the rear of the piston through the passages or parts *f*¹², which extend in a substantially radial direction from the bore or opening *f*¹¹, the latter being preferably arranged substantially at the axis of the piston, but in any case so as to be wholly encircled by the packing-ring *f*⁹. To the front end of the cylinder and inside the same

is secured one end of a throttling-rod f^{13} , which projects through the bore or opening and also extends some distance into the piston-rod, which is made tubular for a portion of its length in order to receive said throttling-rod.

The piston is provided with a bushing f^{14} around the throttling-rod, as shown in Fig. 6, and this bushing has its forward face formed as a valve-seat arranged to cooperate with a valve f^{15} , movably mounted on the throttling-rod and pressed rearward to a certain extent by a spring f^{16} , the rearward movement of said valve being limited by the spring itself, which has one end riveted to the valve and the other secured to the throttling-bar by a nut f^{17} .

The throttling-bar serves to limit the flow of fluid through the piston-opening from one side of the piston to the other and is so dimensioned that it will tend to maintain a substantially uniform pressure of the fluid in the cylinder during the recoil of the gun, being slightly larger in diameter at its rear end than at a point just rearward of the extreme rear position of the valve, tapering uniformly between these points.

To the front of the cylinder or forward member of the recoil device is attached a spade-holder G, preferably made integral with the cylinder and so arranged as to present a minimum obstruction to the upward movement of the earth, this being attained, at the same time with the necessary strength, preferably by making the spade-holder narrow and deep. The forward end of this spade-holder G is preferably formed as shown in Fig. 3 and is provided with a slot g extending substantially in a vertical direction and also has a pair of ears g' extending outward, as shown, one on each side of the body of the spade-holding device. These are preferably slightly beveled, as shown.

To the spade-holder is movably connected a spade H, provided with two lugs h , between which the spade is apertured, as shown in Fig. 2, into which aperture the end of the spade-holder extends, a pivot-pin h' being passed through the lugs and through the slot g in the spade-holder. The lugs h of the spade are provided with notches arranged to receive the ears g' of the spade-holder, whereby the spade is locked securely at a fixed angle relative to the spade-holder and yet is collapsible with relation thereto. Owing to the slot g in the said spade-holder the spade has a limited amount of movement relative to said spade-holder, so that as the latter is moved upward, as hereinafter described, the notches in the spade will be freed from the ears g' , and the spade will then be capable of angular movement about the pivot-pin h' . The upper part of the spade is provided with a nose h^2 , and to the carriage is secured a tripping device I, arranged to engage said nose when the spade

is moved upward, as hereinafter described, and thereby swing said spade angularly with relation to the spade-holder, thereby folding the spade rearward and upward closely against the under side of the spade-holder. The spade preferably has its front surface formed somewhat convex in a horizontal direction from a line just below the lugs h to the top edge, and the lower end is turned rearward to a slight extent for a purpose fully described hereinafter. (See Figs. 8 and 9.)

To the rear member F of the recoil device is connected a segment K, toothed on its rear face and arranged to mesh with a pinion k , fixed upon a pinion-shaft k' , journaled in the trail and provided outside the same with a crank k^2 and with a square-toothed ratchet-wheel k^3 , engaged by a suitable locking device—such, for example, as the pawl L.

The operation of the apparatus is as follows: The pawl L being turned back out of engagement, the pinion k may be rotated by the crank k^2 , whereby the recoil device and its attached parts may be moved about its pivotal connection to the trail, swinging from its folded position (indicated in dotted lines in Fig. 1) to a position near the ground, as indicated in full lines in said figure. The mechanism may be held at any desired position by turning the pawl L into engagement with the ratchet-wheel k^3 , which, it is to be noted, locks the apparatus against movement either upward or downward. During transit the mechanism is intended to be in the position shown in dotted lines in Fig. 1. To plant the gun in position for firing, the pawl L is released and the crank turned, so as to lower the recoil mechanism, whereby the spade is released from the tripping device I and allowed to swing by its weight into such a position that the notches in the lugs h will be opposite the ears g' on the spade-holder. As soon as the point of the spade strikes the ground the further downward movement of the spade will be checked for an instant, while the spade-holder will continue to move downward, owing to its slotted connection with the spade, whereby the ears g' will enter the notches in the lugs h , thus locking the spade at a fixed angle with relation to the spade-holder. At this time the pivot-pin h' comes into contact with the upper end of the slot, whereupon the spade is compelled to partake in the continued downward movement of the spade-holder, and by the application of sufficient power to the crank k^2 the spade is forced into the ground. This initial planting of the spade prior to the firing of the gun is a distinguishing feature of my invention. Upon the firing of the gun the forward member F' of the recoil device is held by the spade, except to the slight extent to which the spade drifts rearward in the ground, depending, of course, upon the condition of the ground at the place of anchorage. The rear member F of the recoil mech-

anism moves backward with the gun-carriage, pulling with it the piston-rod f^4 and piston f^5 , thereby compressing the spring f^8 , this movement of the rear member being resisted by the spring and delayed by the fluid in the cylinder, which is forced to flow through the passages f^{12} and bore or opening f^{11} in the piston, this flow being restricted for the reason that the throttling-rod nearly fills the said bore, which restricted flow results in a yielding pressure being exerted upon the piston in opposition to its movement to the rear.

Owing to the fact that the throttling-rod is smaller in diameter near its front end than at its rear end, the area for the escape of the fluid around the throttling-rod is greater at the beginning of the rearward movement than near the end of said movement, and as the energy of recoil is greater at the beginning than near the end of the recoil a substantially uniform pressure of the fluid at the rear of the piston is obtained.

It is to be noted that although the valve f^{15} rests against its seat on the bushing f^{14} it cannot stop the flow of fluid to the front of the piston, because the pressure will open the valve against the action of its spring. After the piston has traveled a short distance to the rear it is out of contact with said valve, which can only follow the movement of the piston for a short distance.

When the energy of recoil has been completely absorbed and the carriage is brought to rest, the spring f^8 forces the piston forward again, the fluid then passing from in front of the piston to the rear of the same, through the annular space between the throttling-rod and the walls of the bore or opening f^{11} , and through the passages f^{12} . As the forward movement of the piston, and with it the gun and carriage, continues a certain momentum is gained, and it is the function of the valve f^{15} to prevent the shock which would otherwise result from the sudden arrest of the forward movement of the carriage. This obtains from the fact that when the piston has arrived near the end of its forward movement the valve will become seated on the bushing f^{14} , and thus still further restrict the flow of fluid, which can only pass from the front of the piston to its rear by way of the restricted space between the valve and the throttling-rod, the valve being provided with a central opening slightly larger than the throttling-rod in order that this action may occur.

The spring f behind the valve allows the valve to retain its seat and yet travel forward under the action of the piston.

The action of the spade is as follows: When the force of the recoil is transmitted to the spade, the latter, owing to the angle which it makes with the line of recoil, tends to lift the earth at the rear of it and also tends to compress the said earth. Owing to this compression

and lifting of the earth, the reaction of the said earth produces a downward resultant on the spade, while so much of the earth as is crowded up into contact with the under surface of the spade-holder produces an upward resultant tending to lift the spade from the ground; but since in my device the spade-holder is arranged to produce but a slight obstruction to the upward movement of the earth the upward resultant developed is small compared to the downward resultant produced by the spade, and the algebraic sum of the two resultants is a force downward which is sufficient to hold the spade firmly in the ground notwithstanding the drift of the spade through the ground.

By making the upper portion of the spade with a slight convexity, as hereinbefore described, the earth as it is driven up by the lower part of the spade tends to crack or separate at the center of the upper portion of the spade, and thereby passes off to the right and left of the spade-holder, rising clear of the said spade and falling over the top of the spade at each side of the spade-holder. Furthermore, the convex upper portion of the spade tends to compress the earth in radial directions to the rear of the spade, and thereby increases the area of resistance of the ground.

To the lower end of the trail is attached a runner N, arranged to cut into the ground, whereby the tendency of the trail to move laterally, due to inequalities of the ground, is avoided.

Referring now to Figs. 9 to 12 of the drawings, the embodiment of my invention therein shown differs from the construction previously described in three particulars: first, in having the forward member of the recoil device extended rearward to form a track upon which slides the lower end of the trail; second, in having a toggle device for raising and lowering the recoil mechanism, and, third, in having a spring-controlled latch device for holding the spade in its operative position. In this construction the recoil-cylinder f^{18} is attached by bolts f^{19} to two I-beams F^2 , whose inward-extending top flanges F^1 enter grooves in the sides of the rear member, as shown in Fig. 10, whereby the said rear member is guided by the front member. The rear member is provided with two downward-extending lugs f^{20} , which project between the two I-beams, while between the said lugs is inserted the lower end of the trail, which is bifurcated, as shown at f^{22} , the end of the piston-rod being formed with an eye f^{23} , inserted in the forked end of the trail, the said piston-rod, the trail, and the two lugs on the rear member being pivotally connected by a pivot-pin f^{24} . The rear ends of the I-beams are connected by a lunette f^{25} , which allows the carriage to be connected to a limber in the same manner as is the trail of an ordinary gun-carriage. The mechanism for raising and lowering the

recoil mechanism in this construction comprises a pair of toggle-arms K^1 K^2 , the lower one being pivoted at its lower end to the rear member F^3 , while the upper end of the toggle-arms is pivoted to the trail. The two toggle-arms are pivoted at their meeting ends, and the lower toggle-arm is provided with a stop device consisting of an extension-piece L^1 , which comes into contact with the front face of the upper toggle-arm and prevents the toggle-arms from passing a central position. The drawing Fig. 9 shows the toggle at its extreme rear position. The upper end of the lower toggle-arm is provided with an ear f^{27} , to which is connected one end of a chain K^3 , which passes over a chain-wheel L^6 , mounted on a shaft L^7 , operated by a crank L^8 , the shaft being also provided with a square-toothed ratchet-wheel L^9 , engaged by a pawl L^1 . The other end of the chain K^3 is connected to an ear on the rear member of the recoil device, as shown in Fig. 9. The spade is held at the desired angle relative to the spade-holder G' by a latch M , pivoted to the top of the spade and arranged to engage a notch in the top of the spade-holder, as shown in Fig. 9, the said latch M being acted upon by a spring m . In this construction a tripping device I' is supplied on the under side of the carriage, as in the construction hereinbefore described in connection with Figs. 1 to 8, said tripping device being arranged to trip the latch M and then swing the spade into its folded position. The operation of this mechanism will be obvious from the description hereinbefore given of the operation of the mechanism shown in Figs. 1 to 8.

In the practical construction and use of modern high-power mobile guns, such as field and siege guns, one of the most essential actions to be considered is the jumping of the gun, because of the effect such jump has upon the flight of the projectile which causes said jump and because, furthermore, of the effect said jump has in disturbing the location of the carriage for subsequent shots.

By my invention I avoid all jumping of the gun, while at the same time avoiding any unnecessary weight upon the forward bearing of the carriage or any reduction in the height of the gun above the ground or any increase in the length of the trail such as would interfere with the rapid maneuvering of the gun, this being accomplished by reason of the fact that a part of the recoil of the gun is converted into a downward resultant, which is applied to the carriage to counteract the upward resultant which would otherwise tend to make the gun jump.

My invention, broadly considered, is distinguished from prior attempts in that the spade is so constructed and attached that the force applied to it causes a downward resultant in the spade capable of application to the carriage to hold it from jumping.

In my construction the spade is located at an angle to the line of recoil of the carriage substantially equal to a right angle minus the angle of friction of the material, whereby I insure the slipping of the material along the face of the spade and avoid its slipping on itself along any other line, while at the same time enabling it to offer the maximum resistance to being pulled through the ground by the recoil of the gun.

It is evident that if the material has a tendency to slide along the face of the spade it will be forced upward, and if this upward tendency is not obstructed a downward resultant is produced on the spade; but if this tendency of the earth to move upward is obstructed—as, for example, by horizontal surfaces located near the top of the spade—then instead of a downward resultant an upward resultant is obtained, because the material will compress between the spade and such horizontal surface and a new line of slip will be formed in the material itself, forming an incline plane sloping in an opposite direction to the spade, up which the spade, its attached parts, and the material held therein will be drawn by the recoil of the carriage, reacting downward upon the ground in an opposite manner to that resulting with my device and not only failing in the attainment of the object sought, but where the spade is rigidly connected to the carriage actually increasing the jump of the gun.

Other important features of my invention are, first, that the spade may be located intermediate the two wheels and substantially underneath the axle, whereby the direction of the gun may be changed readily by moving the trail without altering the position of the spade relative to the carriage and without withdrawing the same from the ground.

Second. The attachment of the spade to the carriage is such as to form a guiding device whereby the carriage recoils and returns in the same line and at the end of the return is prevented from running ahead unduly, while also the said attachment obviates lateral movement of the front end of the carriage when operating on ground having an inclination lateral with relation to the recoil of the carriage.

Third. By the construction employed by me the spade may be positively forced into the ground initially—that is to say, prior to firing—and also may be positively withdrawn from the ground—a matter of great importance in the use of such guns, as will be obvious to those skilled in the art.

Fourth. The location of the recoil device is such as to utilize the entire weight of the gun and carriage in overcoming the momentum of recoil, thereby producing a minimum distance of recoil. At the same time the recoil device is in the position of least exposure, while if destroyed or rendered inoperative it

may be disconnected readily and the carriage still remain efficient for moderate speed of firing.

Fifth. Owing to the fact that the means for raising and lowering the spade are connected to the rear member of the recoil device, said means partake of the movement of the carriage, and thereby form a truss with the said rear member and the trail, thus enabling it to support the carriage in case of accident to the wheels.

Sixth. The spade may be inserted into the ground more or less, according to the nature of the ground and as may be required to hold the gun and, furthermore, may be locked in any position to which it is adjusted.

Seventh. The runner on the end of the trail prevents lateral displacement of the same, and thus causes the trail to move backward and forward in a straight line parallel to the direction of recoil, thus assisting in insuring the return of the gun to its prior position.

Eighth. Owing to the fact that the spade in my preferred form of construction is located just slightly in front of the center of gravity of the gun and carriage and is connected with the carriage by means which may serve as a compressive member, the spade is capable of sustaining that part of the weight of the gun and carriage ordinarily borne by the wheels. Hence if these or either of them be shot away this device will sustain the carriage and permit the continued operation of the gun. To assist in this, it may be advisable under some circumstances to supply wings or legs to increase the width of the base of support, preferably by supplying the spade with such wings so located as not to obstruct the upward movement of the earth, for which reason said wings are most advantageously located at the front of the spade, as indicated in dotted lines in Figs. 2 and 8.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with a gun-carriage, a gun mounted thereon, and a spade engaging the ground forward of the rear bearing-point of the carriage and making a permanent angle with the direction of recoil of the carriage not greater than a right angle minus the angle of friction between the ground and the holding-face of the spade, the spade being constructed to permit an unobstructed flow of the earth up its holding-face, whereby a downward resultant is produced during the recoil of the gun, of a recoil device connected to the spade and connected to the carriage forward of the rear bearing-point of the same.

2. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a spade located in front of the rear bearing of the carriage and arranged, when in the operative position, to permit the unobstructed upward

movement of the material pressing against the spade and to maintain a fixed angle relative to the line of recoil of the carriage, and a recoil device intermediate said spade and the carriage.

3. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a recoil device pivotally connected to the carriage at a point intermediate the axle and the rear bearing of the carriage, and a spade carried by the said recoil device.

4. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a recoil device pivotally connected to the carriage at a point intermediate the axle and the rear bearing of the carriage, and a spade attached to said recoil device and, when in the ground, making a fixed angle with said recoil device.

5. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a recoil device pivotally connected to the carriage at a point intermediate the axle and the rear bearing of the carriage, and a spade pivoted to said recoil device.

6. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a spade, and a recoil device connected to the carriage intermediate the axle and the rear bearing of the carriage, said recoil device being connected to the spade and arranged to form a compressive member intermediate its point of connection to the carriage and the spade, when the carriage has returned to its original position.

7. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a spade located in front of the rear bearing of the carriage, and a recoil device intermediate the spade and the carriage and arranged, when in its normal position to act as a compressive member against a forward movement of the carriage.

8. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a spade located in front of the rear bearing of the carriage, and a recoil device intermediate the spade and the carriage, and arranged, when in its normal position, to act as a rigid compressive member against a forward movement of the carriage.

9. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a spade located in front of the rear bearing of the carriage, and a recoil device intermediate the spade and the carriage and arranged, when in its normal position, to act as a rigid compressive member against a forward movement of the carriage and as a tensile member against a rearward movement of the carriage.

10. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a spade located in front of the rear bearing of the carriage and a recoil device intermediate the spade and the carriage and arranged, when in its normal position, to act as a compressive

member against a forward movement of the carriage and as a yielding tensile member against a rearward movement of the carriage.

11. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a spade located in front of the rear bearing of the carriage and a recoil device intermediate the spade and the carriage and arranged, when in its normal position, to act as a compressive member against a forward movement of the carriage and as an elastic tensile member against a rearward movement of the carriage.

12. The combination, with a mobile gun-carriage and a gun mounted thereon, of a spade arranged to enter the ground at a point not back of the center of gravity of the gun and carriage and having such an angle to the line of recoil and such an unobstructed space above it that it will produce a downward resultant, and a connection between said spade and carriage independent of the wheels and arranged to maintain fixed vertical distances between the carriage, spade and the ground, and a recoil device intermediate said spade and carriage.

13. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a spade arranged to enter the ground forward of the rear bearing of the carriage, and a longitudinally-movable, vertically-rigid connection between said spade and carriage.

14. The combination, with a mobile gun-carriage, and a gun mounted thereon, of a spade arranged to enter the ground forward of the rear bearing of the carriage, and a longitudinally-movable, laterally and vertically rigid connection between said spade and carriage.

15. The combination, with a gun-carriage, a gun mounted thereon, and a spade arranged to enter the ground, of means for connecting said spade to the carriage, the spade being movably connected to said means, a locking device arranged to hold the spade in fixed relation to said means, and automatic mechanism carried by the carriage and arranged to release said locking device and move the spade with relation to said connecting means.

16. The combination, with a gun-carriage, a gun mounted thereon, and a spade, of means for connecting said spade to the carriage, said means being movably attached to said carriage, the spade being movably connected to said connecting means, a locking device arranged to hold said spade in fixed relation to said connecting means, mechanism carried by the carriage and arranged to release said locking device, and mechanism for raising the connecting means and spade.

17. The combination, with a gun-carriage, a gun mounted thereon, and a spade, of means for connecting said spade to the carriage, said means being movably attached to said carriage, the spade being movably connected to said connecting means, a locking device arranged to hold the spade in fixed relation to said connecting means, mechanism carried by the carriage and arranged to release said locking device, and mechanism for forcing said connecting means and spade downward whereby the spade is positively driven into the ground.

18. The combination, with a gun-carriage, a gun mounted thereon, and a spade, of means for connecting said spade to the carriage, said means being movably attached to said carriage, the spade being movably connected to said connecting means, a locking device arranged to hold said spade in fixed relation to said connecting means, mechanism carried by the carriage and arranged to release said locking device, mechanism for raising the connecting means and spade, and locking mechanism for holding said connecting means at any point to which it may be raised.

19. The combination, with a spade arranged to be forced downward by the recoil of the gun, of separated wings located forward of the rear face of the spade and arranged to limit the downward movement of said spade.

In testimony whereof I affix my signature in presence of two witnesses.

WILLARD S. ISHAM.

Witnesses:

M. C. MASSIE,

ALBANUS S. T. JOHNSON.