K. HAUSSNER.

DIFFERENTIAL RECOIL GUN.

APPLICATION FILED JULY 28, 1909.

958,119. **Patented May 17, 1910.**

2 SHEETS—SHEET 1.

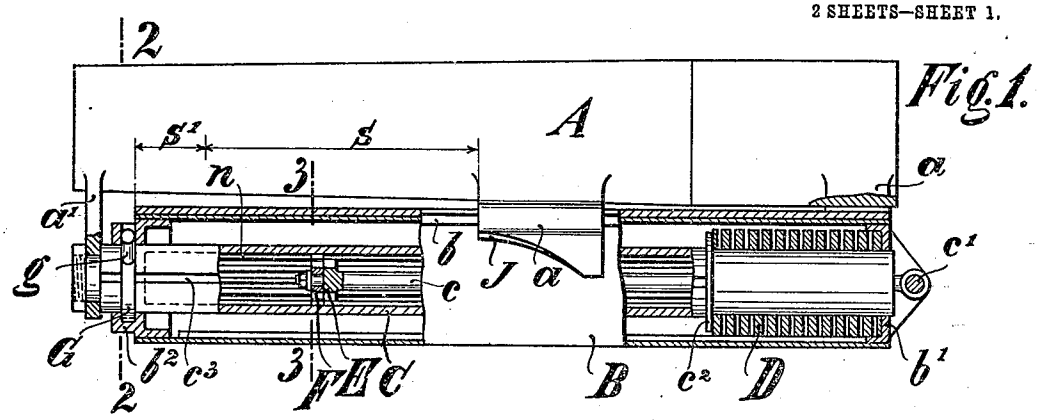


Fig. 1.

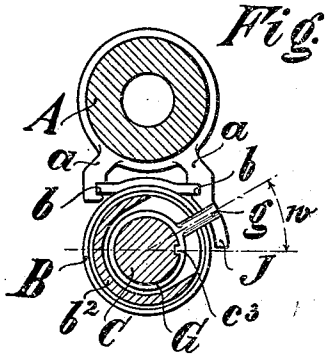


Fig. 2.

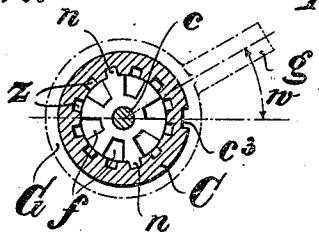


Fig. 3.

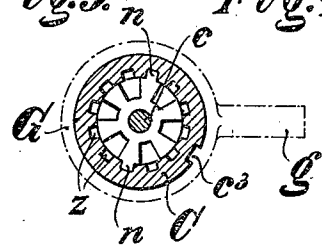


Fig. 4.

Fig. 5.

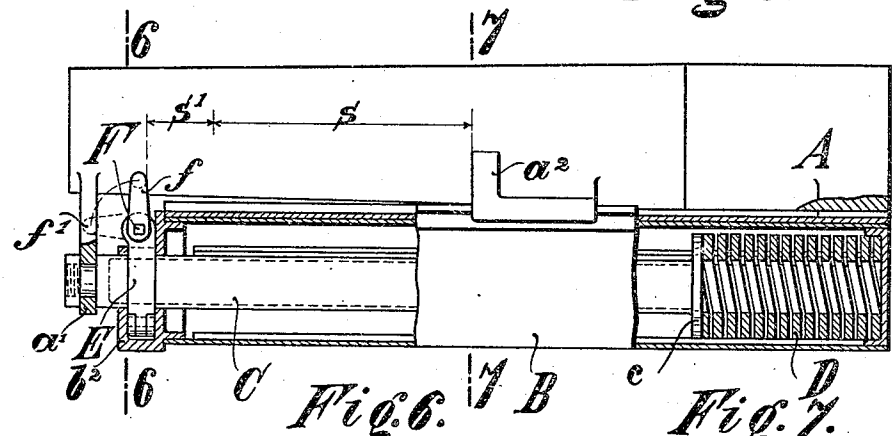
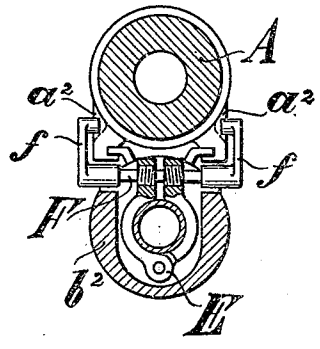
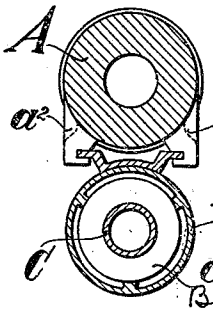


Fig. 6.

Fig. 7.





Witnesses
J. W. Wyckoff
E. B. Melton.

Inventor
Konrad Haussner,
By Knight Bros
Attorneys

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2 SHEETS—SHEET 2.

Fig. 8.

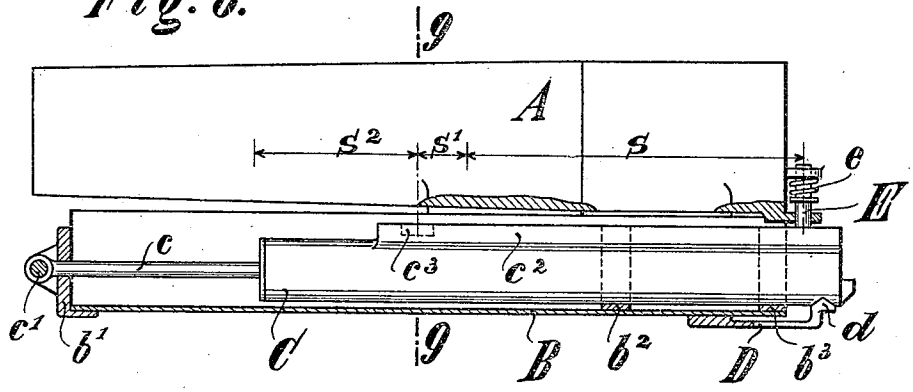


Fig. 10.

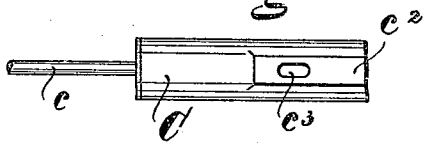


Fig. 9.

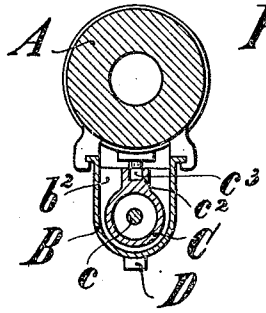


Fig. 11.

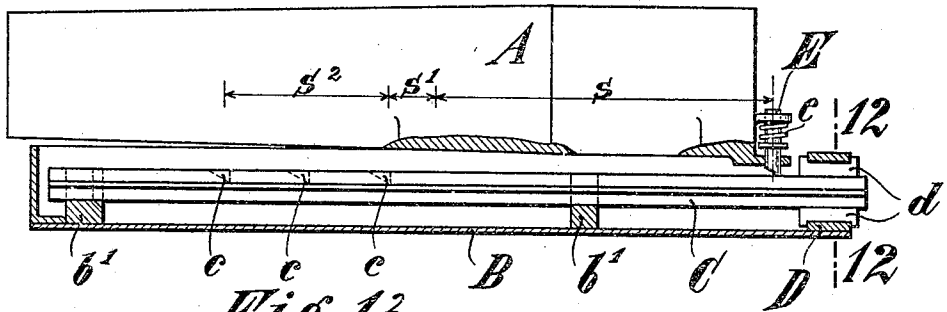


Fig. 13.

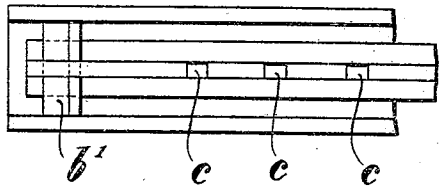
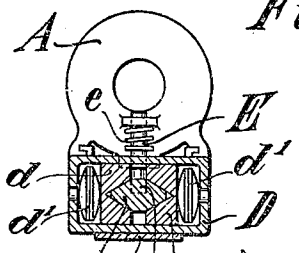


Fig. 12.



Witnesses
J. W. Hyslop,
C. B. Wrelton.

C B c d Inventor
Konrad Haussner,
By Knight Bros
Attorneys

UNITED STATES PATENT OFFICE.

KONRAD HAUSSNER, OF EISENACH, GERMANY.

DIFFERENTIAL-RECOIL GUN.

958,119. Specification of Letters Patent. Patented May 17, 1910.

Application filed July 28, 1909. Serial No. 510,098.

To all whom it may concern:

Be it known that I, KONRAD HAUSSNER, a subject of the Emperor of Germany, and a resident of 2 Amalienstrasse, Eisenach, Germany, have invented certain new and useful Improvements in Differential-Recoil Guns, of which the following is a specification.

As is commonly known differential recoil guns can be divided into two groups, one of which works only with accumulator, while the other, in addition to the accumulator, uses a brake for the absorption of the recoil. While the first group provides for the greatest ballistic yield of the gun, the ballistic yield in the second group is the smaller the more recoil-energy is absorbed by the brake.

The provision of a brake for the neutralizing of a considerable part of the recoil-energy has the advantage that the barrel reaches the loading and training position without detrimental shock even in case the automatic igniting device fails to cause explosion, that is when retarded ignition takes place, in which case an arresting device can cause the barrel to come entirely or nearly to a standstill. This is especially the case when a hydraulic brake is employed, since resistance of the brake, as commonly known, increases with the velocity of the barrel in such a manner that the distance of recoil remains the same for all velocities. When, however, only a small part of the energy is absorbed by the brake, the distance of recoil increases with the increased velocity of the gun barrel, and in case automatic ignition fails to produce explosion of the charge, the smaller the amount of energy absorbed by the brake in the normal operation of the gun, the greater will be the shock of the barrel in reaching the loading and aiming position.

The present invention solves the problem of relieving those differential recoil guns in which the hydraulic brake is adapted to neutralize but little energy in comparison with the accumulator, or which are provided with a friction brake, or which require no brake at all in the normal operation of the gun, from the shock of the barrel on reaching the loading and aiming position, occurring when the explosion caused by automatic ignition does not take place at the right time, that is, when the running-out velocity has been entirely or partly absorbed, before explosion of the charge takes place, or when, after the complete failure of automatic ignition, the gun is fired by hand without first being returned to the loading and aiming position. This object of the invention is attained in that as soon as automatic ignition fails to cause explosion of the charge at the right time, the barrel moving beyond the firing position, either automatically increases the resistance of the brake by means of suitable devices or actuates a brake, of suitable resistance, arranged exclusively on the mount or on the barrel.

In the accompanying drawings, Figures 1 to 4 show a differential recoil gun provided with a hydraulic brake; Fig. 1 being a side elevation with the cradle partly in longitudinal section; Fig. 2 a cross section on the line 2—2, Fig. 1; Fig. 3 a cross section on the line 3—3, Fig. 1, on an enlarged scale; and Fig. 4 a view similar to Fig. 3 showing the parts in different relative positions. Figs. 5 to 7 show a differential recoil gun with a friction brake; Fig. 5 being a side elevation with the cradle partly in longitudinal section; Fig. 6 a cross section on the line 6—6, Fig. 5; and Fig. 7 a cross section on the line 7—7, Fig. 5; Figs. 8 to 10 show an embodiment of the invention in which a brake that does not partake in the normal functioning of the gun, is mounted wholly on the barrel or its mount, and is only called into action under the abnormal conditions with which the invention deals; Fig. 8 showing a side elevation of the gun in loading and aiming position, and partly in section, together with the vertical longitudinal section of the cradle; Fig. 9 a cross section on the line 9—9, Fig. 8; and Fig. 10 a detail view thereof. Figs. 11 to 13 show a differential recoil gun in which the friction brake is connected with the cradle alone; Fig. 11 showing the gun barrel in loading and aiming position, and partly in section, with the cradle in vertical longitudinal section; Fig. 12 a cross section on the line 12—12, Fig. 11; and Fig. 13 a detail.

By means of the claws a, the barrel A slides on the guide rails b, b of the cradle B. The brake cylinder C has its front end rotatably but non-slidably connected to the projections a^1 of the gun barrel. The piston rod c is connected to the cradle by means of the bolt c^1. The accumulator spring D abuts with its rear end against the rear end

closure b^1 of the cradle and has its front end abutting against the collar c^2 on the brake cylinder.

The hydraulic brake consists of the brake cylinder C provided with grooves z and a piston composed of two piston disks. The piston disk E is integral with the piston rod c while the front piston disk F is rotatably mounted on the piston rod c and has two projections engaging in the grooves n, n in the brake cylinder. Both disks have similar sector-shaped cut-away portions f (Fig. 3).

The front end closure b^2 of the cradle (Figs. 1 and 2) is provided with a pocket in which is arranged an adjusting ring G provided with an adjusting lever g (Figs. 3 and 4). The ring is held from axial displacement by the closure b^2 and is provided with a projection which engages in an exterior longitudinal groove c^3 in the brake cylinder and causes the ring to turn with the brake cylinder. On the front claw of the barrel is provided a curved projecting surface J.

If the operation of the gun is normal, the automatic ignition takes place after the barrel has passed through the running-out path (s), and the barrel is returned to its original position (Fig. 1), tension being at the same time imparted to the spring. If, however, the explosion fails to take place at the right time, the barrel continues to move forwardly and when it has passed through the additional path s^1 the projecting surface J comes into contact with the adjusting lever g; the lever g is turned laterally until it has passed through the angle w (Fig. 2). The turning of the lever g causes the front piston disk F (Figs. 3 and 4) to turn, the same angle w and in this manner the sector-shaped passages f are covered in such a manner that the fluid can only pass through the grooves z. If the explosion of the charge caused by the retarded ignition does not take place until then or if the gun is then fired by hand, the resistance is such that the barrel has been deprived of its momentum when it reaches the loading and training position (Fig. 1). The increased braking effect commences directly after the running-out of the barrel through the path s^1 and the brake can therefore at the same time serve as arresting brake. When the barrel has returned to the loading and training position, the adjusting lever g is turned back by hand into its original position.

Referring to Figs. 5 to 7, the arrangement of the barrel A on the cradle B and the arrangement of the recuperator spring D in the cradle are the same as in the embodiment shown in Figs. 1 to 4. The hollow piston rod C is connected to the projection a^1 on the gun barrel and the front end of the recuperator spring D abuts against the collar c on the piston rod C. The front end closure b^2 of the cradle is provided with a pocket (Figs. 5 and 6) in which are mounted a pair of braking jaws E which are jointed together at one end. The free ends of the jaws can be moved toward or away from each other by means of a bolt F having right-hand and left-hand screw-threads. Each end of the bolt is provided with a lever f (Figs. 5 and 6). The gun barrel is provided with a pair of projections a^2 located one on each side of the front claw.

In the normal operation of the gun the barrel passes through a running-out path s and a recoil path s. If, however, the automatic ignition device fails to cause explosion to take place at the right time, the barrel moves farther forwardly and when it has passed through the additional path s^1 the projections a^2, a^2 hit the levers f, f and turn them forwardly until they have reached the positions f^1, f^1. This turning movement of the levers causes the two braking jaws to be brought closer together in such a manner that the friction between the jaws and the hollow piston rod C causes the barrel to come to a standstill. If now the retarded explosion takes place the friction and the accumulator consume the generated recoil-energy before the barrel has reached its initial position.

If the ignition entirely fails to take place the braking jaws may be released and the barrel may be drawn back into the initial position or the gun may be fired by hand whereby the barrel is forced rearwardly.

In lieu of the simple brake just described, a friction brake may be employed which permits of a predetermined automatic longitudinal movement of the braking jaws on wedge surfaces and which consequently is capable of ordinarily producing braking effect during the recoil and not during the running-out movement. Such brakes are known in recoil guns.

As was the case with the hydraulic brake the friction brake may be constructed in such a manner that the brake is automatically readjusted for normal firing when the barrel reaches the loading and training position.

In the embodiments so far described, the brakes always work with some braking resistance. In the constructions now to be described, it will be shown how the brake, which may be secured either on the cradle alone or on the barrel alone, is set in operation by the failure of the automatic ignition device to cause explosion at the right time. An embodiment of this type will now be described with reference to Figs. 8 to 10.

The accumulator which, for instance, may be arranged at both sides of the barrel, is not shown in the drawings. The fluid brake is connected with the cradle alone, by having the piston rod c rigidly connected to the

front end-closure b^1 of the cradle B through the medium of the bolt c^1, while the brake cylinder C rests in bearings b^2, b^3 on the cradle and is prevented from longitudinal displacement by the spring D which has its springy end d located in a recess in the brake cylinder.

On its upper side the brake cylinder is provided with a rail c^2 having a recess c^3. On the barrel is slidingly mounted a pin E which is forced by a spring e against the upper face of the rail c^2. If the operation of the gun is normal, the barrel moves forwardly and rearwardly through the path s. If, however, the automatic ignition device fails to cause explosion at the right time the barrel moves farther forwardly and when the barrel has passed through the path s^1 the pin E enters the recess c^3 and in that manner the barrel carries the brake cylinder along through the path s^2. On the path s^2 the arresting device, which might be the brake cylinder C *per se*, has brought the barrel to a standstill. Should firing now still take place, the brake cylinder C will be picked up by the recoiling gun barrel, through the medium of the projection E, so that the recoil will be braked and the gun barrel will reach its loading and aiming position without disturbed shock. The brake cylinder can then be moved forwardly into its normal position after withdrawal of the pin E.

Referring to Figs. 11 to 13 which show a differential recoil gun in which a friction brake is connected with the cradle alone, the prismatic brake-rod C rests and is guided in the bearings b^1 b^1. At the rear end of the cradle the braking jaws d, d are mounted in the bearing D. The braking jaws are forced against the brake-rod by the disk-springs d^1 d^1 and thereby prevent longitudinal movement of the brake-rod when the gun is not in use and when it operates normally. On the gun barrel is slidingly mounted a pin E which is forced by the spring e against the upper face of the brake rod, which face is provided with one or more holes c. If failure of explosion at the right time causes the barrel to exceed the normal running-out path s and move through the path s^1 the pin E can enter the recess c and carry the brake-rod along if the reversal of movement of the barrel does not take place at that time. If the reversal does not take place, the barrel continues to move forwardly through the path s^2 and is then brought to a stand-still by the arresting device. If now the ignition of the charge takes place, the pin E carries the brake rod along and thereby produces such a friction that, due to the simultaneous action of the accumulator and brake, the barrel gives off its recoil energy at the right time.

It is evident that the holes and the pin might be formed as shown in Fig. 8 so as to make it possible to use the brake rod at the same time as arresting brake. Also in this instance the brake rod must again be moved forwardly to its original position at the completion of the recoil.

Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. In combination with a differential recoil gun, means automatically called into action by the running-out movement of the gun barrel beyond a predetermined firing point, and imposing resistance to recoil.

2. In combination with a differential recoil gun, having means absorbing the work of recoil in the normal operation of the gun; means automatically called into action by the running-out movement beyond a predetermined point, adapted to absorb additional work of recoil.

3. In combination with a differential recoil gun having automatic firing means and a recuperator absorbing work of recoil; a recoil brake and means actuated by the movement of the gun barrel beyond a predetermined firing point, causing the recoil brake to add to the normal resistance to recoil and absorb additional work of recoil.

4. A safety attachment for differential recoil guns, comprising a recoil brake having its parts connected to parts of the gun which have relative movement during recoil and means whereby the gun controls the braking action of said brake by a running-out movement exceeding a predetermined limit.

5. In combination with a differential recoil gun, a safety attachment to relieve shock incident to abnormal length of running-out movement, comprising a recoil brake and means whereby one of the relatively moving members of said recoil brake is connected with a recoiling member of the gun, when the barrel exceeds a predetermined limit in its running-out movement.

6. In combination with a differential recoil gun, a safety device comprising a recoil brake the members of which are connected respectively to fixed and recoiling parts of the gun, means whereby the braking action may be increased, and means whereby the running-out barrel engages said brake increasing means when the barrel over-reaches a predetermined limit in its running-out movement.

7. In combination with a differential recoil gun having a recoil brake acting in the normal operation of the gun, means whereby the braking action of said brake may be increased and means whereby the gun barrel engages said brake increasing means when the barrel over-reaches a predetermined limit in its running-out movement.

8. In combination with a differential recoil gun having a recoil brake, means for varying the braking resistance comprising a swinging lever projecting into the path of a part which partakes of the running-out movement of the gun barrel.

9. In combination with a differential recoil gun, means retarding recoil when the barrel over-reaches a predetermined limit, comprising a recoil brake, having an adjustable braking member, a swinging lever controlling the movement of the adjustable braking member, and a member projecting from a running-out portion of the gun, having a curved surface through which it engages said swinging lever after the gun barrel passes a predetermined limit in its running-out movement.

The foregoing specification signed at Erfurt, Germany, this 17th day of July, 1909.

KONRAD HAUSSNER.

In presence of—

CARL GRUNWALD,

JOSEF OLBERTZ.