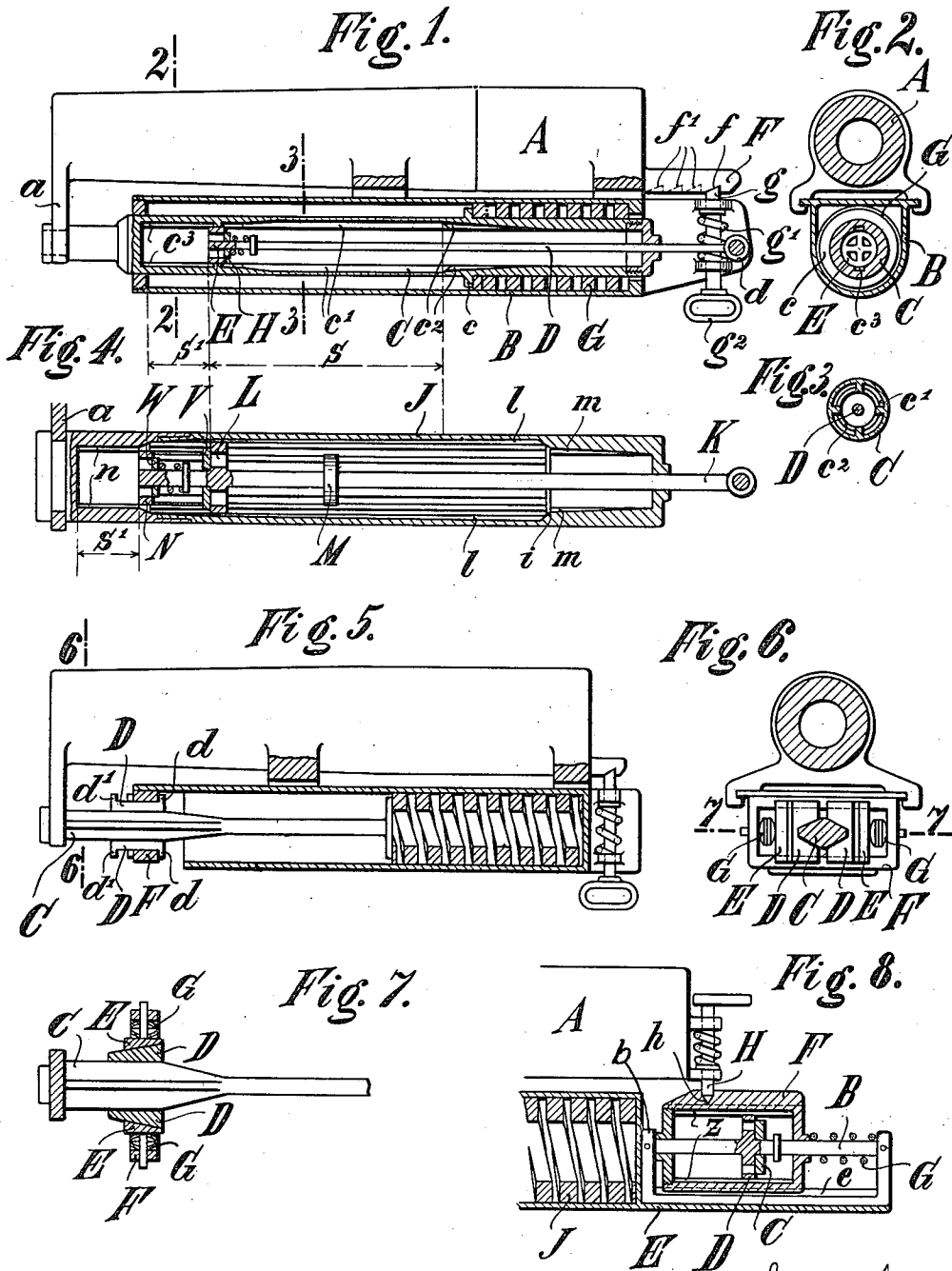


K. HAUSSNER.
GUN WITH DIFFERENTIAL RECOIL.
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Witnesses:
Janet W. Hunkoop,
Ernest B. Hunkoop

Inventor,
Konrad Haussner,
By Knight Bros
attorneys.

UNITED STATES PATENT OFFICE.

KONRAD HAUSSNER, OF EISENACH, GERMANY.

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Specification of Letters Patent.

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To all whom it may concern:

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

In guns with differential recoil as known up to the present time, whether they are provided with recoil brakes or not, the barrel seeks to return forward under the influence of the recuperator, after it is brought to a standstill at the completion of recoil. If, in recoiling, the barrel over-runs the position corresponding to the fixed location of the catching and releasing device for the next shot, it will be accelerated in a forward direction, by the recuperator until it reaches the loading and aiming position. As a result of this, an inelastic or unyielding catching device will receive a significant shock or an elastic or yielding catching device will receive a significant pressure, whereby the mount is moved forward and tipped. This is especially bad with wheeled mounts, when the trail pressure is slight, because in such cases, a destruction of the aim is very readily produced. In case a recoil brake is employed, the acceleration is somewhat reduced under certain circumstances, but the shock or pressure upon the catching device is only slightly weakened, because recoil brakes, in guns with differential recoil, are so adjusted that they have a greater section for the running-out movement of the barrel than for the recoil, as for example, by placing a counter-recoil valve upon the brake piston. But even when the section for recoil and running-out is the same, there is still an acceleration of the gun barrel in the forward direction, that produces a heavy shock or pressure upon the catching device. In order to avoid this difficulty, it has already been proposed to make the position of the catching and releasing device adjustable, that is to say, it is so devised that the barrel will be secured in any position at which it comes to rest after completion of recoil. In this manner the shock upon the catching device will be circumvented. But another difficulty is involved thereby, in that with the provision of automatic means for attaining a specific rate of counter-recoil for each elevation, there will nev-

ertheless be an irregular rate of running-out movement, because the barrel, in consequence of this locally adjustable catching device will be accelerated now for a long distance and now for a shorter distance, accordingly, as the barrel has produced a greater or smaller recoil.

The indicated difficulties in both types of catching device, are avoided by the present invention which consists in providing a running-out brake, which automatically comes into action, whenever the gun barrel, after completion of its recoil, seeks to accelerate its forward movement under the influence of the recuperator. The stroke of this running-out brake is so measured that it approximately equals the greatest difference between recoils, that is to say the difference between maximum and minimum recoils, and so that the barrel can be accelerated forward, only from a specified position relatively to the upper carriage.

Several embodiments of the invention or parts thereof are illustrated in the accompanying drawings in which,

Figure 1 is a longitudinal section through the upper carriage, in the plane of the axis of the brake cylinder, Figs. 2 and 3 are sections taken respectively on the lines 2—2 and 3—3 of Fig. 1, Fig. 4 is a vertical axial section through the upper carriage showing a modified construction of brake, Fig. 5 is a view corresponding to Fig. 1 illustrating the employment of a friction brake for the purposes of the invention, Fig. 6 is a vertical transverse section on the line 6—6, Fig. 5, Fig. 7 is a horizontal section on the line 7—7, Fig. 6, Fig. 8 is a detail view in vertical axial section showing a further modification of hydraulic brake.

In the embodiment shown in Figs. 1 to 3, the barrel A is shown in the loading and aiming position upon the upper carriage B. The fluid cylinder C is connected with the barrel by the barrel extension *a*, while the piston rod D of the piston E, is connected with the upper carriage through the eye *d*.

The barrel carries at its breech end, a laterally disposed extension F in the tooth *f* of which, the dog *g* engages, and is held by a helical spring *g*¹, against automatic release. By drawing the hand grip *g*², the engagement of the dog can be released; the barrel will then be moved forward, with an

accelerated movement, to deliver its shot, by the recuperator spring G which presses with its forward end against the abutment *c* of the fluid cylinder. Under the resultant fluid pressure, the valve H lies firmly against the perforated piston E, and the fluid is compelled to pass through the grooves *c*¹ of the brake cylinder. While at the beginning, the section of these grooves is very small, in order to weaken the counterforce of the spring, and to make the effect upon the mount, very slight at first, said grooves continually increase in section, so that the accelerating force of the spring during the remainder of the way will hardly be reduced. Before the distance *s* has been traversed by the barrel, firing takes place. Should firing not take place, the rear portion of the brake cylinder with its grooves *c*², serves to bring the gun barrel gradually to rest. If however, firing does take place, the brake cylinder again moves rearward, during which the valve H opens. If the barrel does not come to rest after traveling backward the distance *s*, the piston E moves further relatively to the forward part, but such movement is without any essential resistance, owing to the perforations provided in the piston.

During the entrance of the piston into the forward part of the cylinder, the rear inclined face of the projection F, impinges the dog *g* and presses it outward. Since only the ratchet tooth *f* is provided, the dog, after passing the tooth *f*, is held downward by the lower smooth face of the projection F. If the gun barrel now comes to rest, the spring seeks to hasten it forward. But since the valve lies against the piston, and the fluid finds but the very smallest section of passage through the grooves *c*³, the barrel can move forward only with extreme slowness, until the dog *g* snaps into the tooth *f*. In this manner shock upon the arresting device that would result from the accelerated mass, is avoided.

The description of the arrangement thus far, has assumed the provision of only one tooth *f* and therefore a locally unchangeable distance from the ignition point; but a locally changeable position of the arresting device can be secured by the addition of a plurality of teeth *f*¹ as shown in broken lines. Then when the gun barrel after completion of its recoil, comes to rest in any position, the dog *g* snaps into the corresponding tooth *f*¹. Upon withdrawing the dog for the next shot, the gun barrel can move only slowly at first and only when it begins to traverse the distance *s* does acceleration of movement take place. Thus by this arrangement, the same rate of running-out movement is always attained with a given elevation, and this is true whatever the length of recoil and whatever the distance the gun travels from

the loading and aiming position to the exploding position.

Other arrangements for regulating the running out and recoil speed can be substituted for the recoil brake described; it is necessary to exercise care only to select a sufficiently long length of stroke *s*¹.

Instead of a fluid cylinder according to Fig. 1, a brake cylinder J according to Fig. 4 may be employed, when the recoil is to be accompanied by the action of a brake. This cylinder consists of three parts, the intermediate part provided with grooves *l* running from rear forward, to which belongs the piston L formed in one piece with piston rod K and having perforations. Said rod K is further provided on its forward end with a valve V that opens during the running-out movement and closes the openings in the piston L during recoil. The rear cylinder part with its appurtenant massive piston M, formed in one piece with the piston rod has grooves *m* extending from front to rear and serves as a retaining brake in case firing during the running-out of the barrel, does not take place. The forward cylinder part with small section grooves *n*, with the forward perforated piston N, and the valve W which opens the piston perforations during recoil and closes them during running-out, constitutes the running-out brake with a length of stroke represented by *s*¹.

The brake cylinder is connected with the barrel extension *a*. The several pistons offer little or no resistance to the running-out of the barrel. Before the rear massive piston M enters the appurtenant cylinder, firing takes place and the barrel returns. If firing does not take place, such a braking is produced by the piston M in this part of the brake cylinder, that the gun would come to rest before the intermediate piston L could strike against shoulder *i*. During recoil of the barrel, the fluid must escape between the periphery of the intermediate piston L and the grooves *l*, whereby a desirably large or definite brake resistance is set up.

If the gun barrel moves rearward farther than the path *s* the forward piston N enters its appurtenant cylinder portion, without however setting up any material resistance to the movement, owing to the opening of the valve. When the barrel has been brought to rest by the effect of the recoil brake L and the recuperator spring and the spring seeks to accelerate the barrel forward, this is prevented by the running out brake piston N against which the appurtenant valve W closes and the fluid is forced through the restricted section of the grooves *n* alone. The barrel will thus be moved very slowly and brought to the arresting position almost free from shock.

Figs. 5 to 7 illustrate the use, for the pur-

poses of a running out brake, of a friction brake that is known in connection with barrel recoil guns. The drawing shows the barrel in the loading and aiming position. If the barrel is released, the brake rod C moves forward. Since, in consequence of its sectional form, (Fig. 6) it produces greater friction on the brake shoes D D than is produced by the slide pieces E E on the abutting straight faces of the brake shoes D D, the shoes seek to overcome the wedging angle and move with the brake rod C, during forward movement. This however will be prevented by the flanges d d which are supported by the brake bearings F. The pressure exerted by the brake bearing portions G G, produces friction upon the brake rod, which is somewhat smaller than the power of the recuperator spring, so that movement can take place. As the section of the brake rod reduces shortly after the commencement of the forward movement, no more resistance is offered during the full running out movement and the recuperator spring can accelerate the barrel. When, at the end of the recoil of the barrel, the brake rod enters its full section between the brake shoes D D, the latter are carried rearward with the rod until the flanges d^1 d^1 abut against the brake shoe bearings F and the further movement is prevented. The plate springs G G are thereby approximately untensioned so that the friction between the brake shoes and the brake rod is almost entirely removed. If the gun barrel, now in a position of rest, is again moved forward by the recuperator, the brake rod takes the brake shoes with it until flanges d d can impinge against the brake shoe bearings. In this manner, the plate springs G G are again put under tension in consequence of the rear wedge surfaces of the brake shoes, and the friction produced upon the brake rod is nearly equal to the power of the recuperator, so that the gun barrel will be brought to rest upon the catching and releasing device with very slight shock.

In Fig. 8, a hydraulic running out brake is illustrated in which no part stands in connection with the gun barrel during the entire running out and recoil movements. While the piston rod B of the perforated and valved (C) piston D is rigidly connected to the upper carriage E, the cylinder F has free longitudinal movement and is only prevented from rotating by the groove and spline e . The cylinder is held in its forward position by the spring G, while the gun barrel runs out and recoils. As soon as the barrel A is released by the withdrawal of the dog H from the depression h the barrel moves forward under the pressure of the recuperator spring J, with acceleration. After firing and in consequence of recoil, the dog again enters the recess h and carries the

brake cylinder backward. By the resulting fluid pressure upon the forward side of the piston, the valve C opens and the glycerin encounters but small resistance in passing. After the barrel has come completely to rest the recuperator spring J seeks to again move the barrel forward with an accelerated movement. But inasmuch as the valve closes the perforations of the piston against the fluid pressure on the rear side of the piston, the fluid can only pass through the small section of the groove z and in this manner, a sufficient braking pressure is produced to permit only a slow forward movement of the gun barrel and consequently but a very slight shock is exerted by the forward stuffing box against the piston rod bearing b .

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

1. The combination with a differential recoil gun, comprising means for holding the barrel in a recoiled loading position, of means for retarding its running-out movement up to its loading position when the gun barrel has recoiled beyond its loading position.

2. The combination with a differential recoil gun, comprising means for holding the barrel in a recoiled loading position, of automatically actuated means for retarding the running-out movement of the barrel up to its loading position when the gun barrel has recoiled beyond the loading position, and means permitting of acceleration from the loading position to the firing position.

3. The combination with a differential recoil gun, of an automatically actuated brake adapted to retard the running-out movement of the barrel from the end of its recoil to a fixed point, a device for holding the barrel at said fixed point, and means permitting of accelerated running-out movement of the barrel from said fixed point to the point at which firing takes place.

4. The combination with a differential recoil gun, comprising means for holding the barrel in a recoiled loading position, of a brake automatically entering into action at the end of recoil and preventing acceleration during that part of the running-out movement which lies in rear of the point at which the barrel is arrested, means permitting of acceleration of the barrel from the arresting point to the point of firing, and means for checking and arresting the barrel beyond the point of firing in the event firing does not take place.

5. The combination with a differential recoil gun, of means for arresting the barrel at different loading positions, and an automatically actuated brake adapted to retard the running-out movement of the barrel from the end of its recoil to its loading position whereby the point at which acceleration of

the running-out movement commences is rendered constant notwithstanding different lengths of recoil.

6. In a differential recoil gun, the combination with the gun barrel, and means for holding the barrel in a recoiled loading position, of a cylinder having means associated therewith for retarding the running-out movement of the gun barrel up to its loading position when the gun barrel has recoiled beyond its loading position, and a means also associated with the cylinder adapted to withhold the gun barrel from exceeding its prescribed running-out movement in the event of delayed ignition or miss firing.

7. In a differential recoil gun, the combination with the gun barrel and its carriage, and means for holding the barrel in a recoiled loading position, of a cylinder mounted on the gun barrel and having throttling channels therein, a piston rod within said cylinder and having one end secured to the carriage, and a piston on said rod cooperating with the throttling channels and adapted to retard the running-out movement of the gun barrel up to its loading position when the gun barrel has recoiled beyond the loading position; permitting of accelerated

running-out movement of the gun barrel to its firing position, and adapted to withhold the gun barrel from exceeding its prescribed running-out movement in the event of delayed ignition or miss firing.

8. The combination with the braking cylinder of a differential recoil gun, comprising means for holding the barrel in a recoiled loading position, of a piston located therein and adapted to retard the running-out movement of the barrel from the end of its recoil to its loading position.

9. The combination with the braking cylinder of a differential recoil gun, comprising means for holding the barrel in a recoiled loading position, of a piston located therein and adapted to retard the running-out movement of the barrel from the end of its recoil to a fixed point, and a second piston also located in said cylinder and adapted to arrest the running-out movement of the gun barrel in the event of miss firing or delayed ignition.

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

KONRAD HAUSSNER.

In presence of—

ALFRED KALLENBACH,
CARL GRUNWALD.