Electrical Trigger Device

The invention relates to an electrical trigger device for smalls arms,

- having a trigger which can be adjusted against a trigger slack,
- a trigger spring which preferably is adjustable and acts on the trigger,
- and an electrical switching element which is activated after the forward motion is traveled.

US 7 131 336 B2, US 5 083 392 A and FR 2 788 124 A are already known as similar devices.

Particular significance is assigned to the trigger device of a small arm, in particular with regard to the firing precision. For example, in the case of a flare gun a simple triggering of the shot with a trigger pull ranging between 25 and 50 N is sufficient; after application of this force on the actual trigger the shot is discharged, without consideration for discontinuities in the trigger travel or its length. In the case of a military rifle the trigger force should not exceed 45 N, wherein the marksman should be able to feel it exactly when the shot is imminent. In the case of a target gun, precision rifle or hunting weapon the trigger pull to be overcome should not exceed 15 N (in the case of small arms 25 N), wherein the trigger pull should ideally be adjustable.

In any event the forward motion of the trigger that is traveled until the shot bursts should be identical or at least adjustable in the case of production weapons of the same model.

In the case of mechanical triggers that have been predominantly used up to now the force which is to be overcome in pulling is dependent on many factors, in particular the mechanical structure of the trigger device and the tolerances inevitable in production. In the case of a self-loading weapon the vibration must also

be taken into consideration which follows a shot; the trigger catch must hold absolutely reliably, even if the weapon itself carries out considerable movements in the case of the engagement of the catch, said movements being caused by the previous shot. These movements are in particular in the case of modern weapons, which are predominantly made of plastic, rather considerable.

In the case of the newly emerging weapons with electrical ignition on the other hand the release of the trigger ultimately consists only in the production of a contact; the difficult mechanical problems, such as the interruption after a preceding shot by a self loader, can namely be solved electrically or electronically, to be precise both safely and simply. However, the force progression in the actuation of a mechanical double pull trigger should be imitated as precisely as possible, so that the marksman, who is trained with mechanical weapons, is ultimately no longer able when pulling the trigger to notice whether he is holding an Olympic rapid fire pistol with the most complicated mechanical trigger device or a cheap small caliber pistol with electrical actuation from an airplane survival kit in his hand.

While in the case of non-self loading, mechanically discharging target guns up to now the minimum force to be overcome has been about 0.4 N (free pistol, very finely adjusted Stecher), in the case of weapons to be discharged electrically weapons without greater expenditure it can amount to only about 0.04 N. In both cases the vibration is however sufficient to trigger the shot when putting the weapon down. On the other hand, precautions are to be taken, which are often only inadequate due to the lack of space. For this reason up to now the conventional electrical trigger is as a rule only a simple release, which bears only a little resemblance to a trigger with a pressure point, and which even in the case of a high quality service weapon, say a sharpshooter's rifle, should not fall below about 10 N for safety reasons. There

is a problem here, which prevents the person skilled in the art from setting his trigger too soft.

All difficulties coincide in the case of a sports rifle, which is carried along and used in the biathlon, because there a hard trigger slack must be present, which is not triggered even by a hand shaking from exertion, but on the other hand facilitates a precise, rapid triggering, because the shots must be fired in very short time, since the time which is required for shooting is added to the running time and the shortest time takes away the victory.

In the case of pulling over a specified trigger travel the double pull trigger travels a forward motion in the surmounting of a specified, adjustable force, which increases with the travel. Within this forward motion the trigger always travels, when it is released, back to its unactivated starting point, without the shot firing. After traveling of the forward motion, if one continues pulling, the trigger force increases as abruptly as possible over a lowest possible trigger travel, after which the shot bursts. In the case of shooting one pulls, if one wishes to shoot, beyond the forward motion uniformly, until one comes to an abruptly increasing region, the so-called "trigger slack". There one can if necessary wait until a good opportunity for the shot arises, and then increase the tension in the shooting finger, as a rule the right or the left index finger, until the shot bursts.

In this connection two factors are important: The trigger should, if the shot has not yet been discharged and the tension in the trigger finger is reduced, return to its position prior to the trigger slack or even to its starting point; in particular the trigger should after surmounting the trigger slack not travel any further unloaded path and if at all possible not continue moving.

In the case of the mechanical trigger one speaks of the "trigger stop", which usually, due to tolerances, is adjustable and in the case of which it can definitely happen that it blocks the trigger in the case of improper setting in such a way that one can no longer shoot at all. The purpose of the trigger stop is to prevent a falling of the finger and with it an unintended movement in the hand. This is also important if through electrical discharge the shot has long since been fired, before the falling finger can cause a movement of the weapon, because the practiced marksman assesses the point of contact of his shot also from the feeling in the trigger finger while pulling.

The invention is based on the object of finding an easy, reliable electrical trigger with a "trigger stop" in which case preferably the forward motion and/or trigger slack can be adjusted in which case the trigger stops immediately, but reliably after discharge of the shot and in the process the weapon is the least influenced. In the process preferably tolerances which are inevitable in serial production, should have the least possible influence on the trigger slack and the trigger stop, even if said trigger slack and trigger stop are not pre-adjustable.

To put it crudely, the invention should find the driest possible, extremely reliable and secure double pull trigger which does not require increased production expenditure.

This problem is solved by the fact that the initially named, electrical trigger device the switching element is actuated by a spring element which forms a limitedly pliable end stop of the contact arm in the case of reaching the trigger slack (Claim 1). The spring element sets a force against the trigger in the trigger slack which – depending on the structure of the leaf spring – can progressively increase, so that the trigger in the case of the release of the trigger slack neither falls nor will be

stopped by an impact, but rather is slowed down by an increasing resistance force. The electrical switching element can be controlled by the movement of the spring element or by the increase of the tension in the spring element.

In accordance with Claim 2 the trigger is constructed rotatable around a lateral axis and exhibits a trigger tongue and an adjusting arm, through this a safe and easy trigger is realized.

In a preferred embodiment of the invention all the parts of the trigger are located, with reference to the lateral axis, in a balanced or nearly balanced state (Claim 3).

By balancing the trigger, thus for example by a counterweight to the trigger tongue on the opposite side of the transverse shaft, a self balanced trigger is achieved, which as opposed to acceleration forces such as say collisions or vibrations is completely inert. Through this measure the trigger is completely decoupled from other devices, so that it, even if the trigger spring is rather weak, can never be moved by acceleration forces. In the case of reaching the trigger slack when the trigger bumps against the spring element, the spring element is deflected by the trigger and for its part actuates the trigger contact. Since the mass of the spring element, compared to the force which is required for its deflection, is very small, the required acceleration forces for its deflection are high; to be precise, higher than they occur in the case of the falling down of a weapon from a considerable height.

The contact itself is completely decoupled from the trigger and can, for this reason, be designed practically without movable lines or the like, so that it outlasts the entire service life of the weapon

and consequently, with regard to reliability, cannot lead to problems.

In the case of the balancing of the trigger the fact must be taken into consideration that the trigger spring fraught with a mass acts on the trigger and attempts to move it to the rest position. This trigger spring must thus be taken into consideration in the balancing of the trigger. In the most unfavorable case, namely, the acceleration forces influence the spring force, which acts on the trigger. In the process one must take into consideration the fact that under circumstances yet other mass forces also act on the trigger spring.

In order to counteract this problem in accordance with one embodiment of the invention the trigger spring is formed by a torsion bar which forms the lateral axis or runs along said lateral axis (Claim 4). In the process the lateral axis can form for example a tube, which is pivoted on both sides and in the middle of which the torsion bar extends. The torsion bar is, whether it is tensioned or not, with regard to the lateral axis always balanced and hence in no way impedes the balancing of the trigger. Thus the trigger can be completely balanced and if necessary provided with adjusting screws or boreholes for more precise balancing, for example like the balance spring of a clock mechanism, so that conversely in spite of the double pull trigger extremely low trigger weights are possible, since the trigger never changes its position in the case of an impact, collision, when falling down or the like, but rather at the most when it is released, on the basis of the trigger spring returns to its original location if it previously was already deflected.

A further embodiment of the invention consists in that at least one free end of the torsion bar is supported in a case of the trigger device, and that this free end can be adjusted by twisting (Claim 5). After this the pre-stress of the torsion bar, which is formed in the

actual design of a metal bar, can be adjusted in accordance with the wishes of the marksman. The positioning of the trigger takes place in the process, as already stated, through a tube, in whose middle the metal bar extends.

Another development especially suitable for small arms lies in the fact that the trigger spring acts on a rod which is connected in hinged manner to the trigger and for its part upon reaching of the trigger slack acts on the switching element (Claim 6). Due to the compact structure in the region before and above the trigger of a small arm the electrical switching element here is relocated to the rear, where it is located in the direct proximity of the other electronic devices and of the power source. In the case of the electrical switching element the leaf spring upon which the trigger acts is not in the immediate area, but rather above a rod.

Now it would be possible to cushion the rod and the trigger separately and to provide only a stop between them, in order to decouple the mass forces of trigger and rod in the case of the action of outside forces, or to connect the rod to the trigger tongue so that the mass forces of the rod load the trigger against the trigger force. However, here a contrary solution is selected, which is particularly suitable for service pistols and consists in the fact that the rod is connected to the adjusting arm of the trigger and is pushed to the rear by the trigger spring. Since the trigger and rod are connected to each other on the adjusting arm, they are also coupled to each other in the case of the action of outside forces in such a way that the mass force of the rod could pull the trigger. The trigger spring however counteracts such a triggering force. In the case of the action of a mass force the weapon will as a rule not be held in the hand. The weight and thus the mass of the rod can be kept rather low, and ultimately the trigger slack in the case of a service pistol is usually around 20 N or more. For this reason this especially

simple solution can be selected without one having to take a loss of security into account.

An especially simple design consists in the fact that a projecting part is constructed on the rod, which upon reaching the trigger slack presses against the spring element (Claim 7). This projecting part can preferably point down like the bit of a key, so that when the trigger is pulled, the "bit" moves to the front against the spring element, but the entire rod only has the space requirements of a sheet metal strip.

There can even be a second projecting part constructed on the rod in front of the first one, said second projecting part being somewhat parallel to the first one and striking in the rest position of the trigger against the other side of the spring element (Claim 8). This second stop can be used in the electrical switching element or in a separate switching element, in order to produce somewhat the function of an interrupter. The two switching elements or the two states of one switching element hence act on a flip-flop switch so that it is only possible to effectively pull a second time when the trigger has actuated the other switching element that does not discharge the shot. In the process the distance of the two projecting parts or "bits" set the forward motion of the trigger. The tolerances which such adjacent formations of one and the same punched or stamped part have are extraordinarily slight even in the case of careless serial production.

The electrical switching element which is actuated by the spring element is preferably a switching element actuated by the deflection of the spring element (Claim 9), for example a reed switch, although a contact-less switching element could be given preference, which for example is actuated by the free end of the spring element.

According to a further embodiment the switching element exhibits a strain gauge which is seated on the spring element (Claim 10) and whose strain measures in one or both directions. Such strain gauges can be constructed especially small and light. The switch assigned to the strain gauge or gauges detects a threshold value of the voltage or of the current, which correspondingly change the deformation of the leaf spring (and of the strain gauge or gauges) and discharges the shot in the case of the exceeding of this threshold value. In the case of the previously described service pistol the (weak) bending of the spring element in the one direction triggers the interrupt signal, in the other direction fires the round.

In the process the strain gauge can have an electrical adjusting element, for example a potentiometer, for the adjustment of the trigger slack weight (Claim 11). Thus the trigger slack is not defined by the design of the spring element leaf spring, but rather can additionally be set by the threshold value of the voltage discharging the shot. The expensive mechanical structure, subject to malfunction, is as a result even further simplified.

Claim 12 relates to a weapon with an inventive trigger device.

In total the invention creates a trigger device with, as far as the trigger weight (the force to be expended for actuating the trigger) is concerned, a nearly freely selectable course and a likewise adjustable trigger slack. The trigger slack can be set from just barely perceptible all the way to hard, without different trigger travels being necessary. Only a pre-stressed spring element, a hard spring element or a spring element with progressive spring constancy must be selected.

Slight deflections are already sufficient to achieve a steep increase in force.

Thus an extraordinarily "dry" trigger results, in which case after the forward motion over a random distance a trigger slack follows, which proceeds practically without further – for the marksman – perceptible trigger travel until the firing of the shot. After the shot the trigger neither falls nor is it stopped by a stop, but rather the trigger pull increases further without a trigger travel being perceptible.

Non-restrictive exemplary embodiments can be seen from the drawing, in which only the mechanism of the inventive trigger device is depicted without a case holding it. In the process the figures show the following:

- Figure 1 shows a trigger with a torsion spring,
- Figure 2 shows a pistol trigger, in rest position, and
- Figure 3 shows the pistol trigger, in the case of the firing of the shot.

Identical parts have the same reference number in all of the figures.

In the case of the exemplary embodiment shown in Figure 1 the trigger 1 exhibits a trigger tongue 3, which is extended upward by an adjusting arm 5 which exhibits at its topmost, front corner a nose 11. The trigger 1 is as a whole a plane formation with a center of gravity through which an axis perpendicular to the plane 35 of the trigger 1 proceeds, said axis being represented here by a torsion spring 15. Such a trigger 1 is e.g. suitable for a sharpshooter's rifle.

With regard to this axis 35 the trigger 1 is balanced, that means when it is suspended in a rotating position around the axis 35, then

it is balanced in any pivoting position. An outer acceleration force can therefore not influence the position of the trigger 1.

A tubular holding fixture (not shown) serving as trigger bar extends around the geometric axis 35, said holding fixture being fastened on the trigger and somewhat pivoted in the trigger housing. Within this tubular holding fixture the torsion spring 15 runs, upon which the trigger is seated, said torsion spring being clamped to the outer ends and which can be adjusted on one or both sides at the outer clamp(s) in the direction of the arrow 17. In another embodiment the torsion spring 15 itself can serve as a trigger bar.

In a rest position, in which the trigger 1 is not actuated, the rear side of the adjusting arm 5 (the right side in the drawing) rests against a stop (not shown). When the finger is placed into the trigger tongue 3 and exercises a force on said tongue, then the trigger 1 moves away from the stop against the somewhat linear increasing force of the torsion spring 15, which forms the trigger spring, until the nose 11 on the adjusting arm 5 buts against a spring element constructed here as a leaf spring 7.

The spring element can however also be a bending element with a freely designed cross-section. A torsion piece can also serve as a spring element, on which an actuating element acting as a lever arm is provided, upon which the adjusting arm 5 acts.

The leaf spring 7 extends here somewhat vertically before the nose 11 and is clamped with one end into a spring clamp 13. The other end is freely moveable against the spring force of the leaf spring 7. The mass of the leaf spring 7 is low measured by its spring resistance. The spring clamp 13 can be adjusted if necessary by twisting, in order

to adapt the location of the trigger slack and with it the trigger travel to the marksmen.

On the front side of the leaf spring 7 there is a strain gauge 9 which is connected to a test circuit or ignition circuit not shown here by wires or other electrical conductors (not shown). For improvement of the signal, several strain gauges are arranged in other embodiments (not shown), if necessary also on both sides of the leaf spring 7. The test circuit is provided with a method of temperature compensation in order to compensate for temperature dependent signal change.

If the trigger 1 is actuated, then it first travels a forward motion which is loaded by the torsion spring 15 until it strikes with the nose 11 against the leaf spring 7. Here the trigger force increases (the force required for actuating the trigger 1) intermittently, wherein the leaf spring 7 is bent a little. This bending changes the resistance in the strain gauge 9 until a threshold value is reached, in which case the ignition signal is triggered. The threshold value can be adjusted for example by a potentiometer, to be precise from a barely perceptible trigger slack in the trigger 1 up to a considerable trigger slack, which can reach some N. In the process the expended trigger force is dependent on the setting of the torsion spring 15, whose resistance, because the trigger is balanced, can be very low. For a sharpshooter's rifle the force to be applied on the trigger tongue 3 at the end of the forward motion is for example 7.5 N, the force to be released is about 13 N, and the force continues increasing after the release, so that no falling of the trigger is perceptible. The setting can be changed as desired, so that the respective sharpshooter, marksman or hunter can adapt the weapon to his own usage.

In Figures 2 and 3 a trigger device is shown which e.g. is suitable for a self-loading pistol. Like the previous trigger device this one also exhibits a trigger 1 which consists of a trigger tongue 3 and adjusting arm 5. The trigger 1 can be swiveled around the axis 35, which is fastened on both sides in the grip of the pistol (not shown). A trigger spring 25, which supports itself on the weapon (not shown), acts on the front end section of the adjusting arm 5, which is arranged similar to the nose 11 of the first exemplary embodiment of Figure 1. In Figure 3 the trigger spring 25 is only represented as an arrow of force.

On the contact arm 5 the front end of a rod 21 is connected for example by means of a pivot pin 23. The rod 21 extends to the rear.

On the rear end the rod 21 exhibits a rear hook 27 and a front hook 29, which both extend downward and are spaced – in horizontal direction – from each other with low tolerance. Above this distance there is a cross-piece 37 which prevents the rod 21 from getting loose and flying upward. The front hook 29 ha on its rear side a contact point 33 and the rear hook 27 has a contact point 31 on its front side. When the trigger 1 is released or completely pulled, then one of the two contact points 33, 31 comes into contact with the leaf spring 7 and exerts a force on it.

From below this leaf spring 7, upon which one (or more) strain gauges 9 are seated, protrudes into the gap between the hooks 29, 27 (or between the two contact points 33, 31). The leaf spring 7 is fastened in a part 19 of the weapon.

In Figure 2 the trigger device is shown in rest position, on the other hand in Figure 3 it is shown in the case of complete pulling of the trigger. By pressing on the trigger tongue 3 the adjusting arm 5 has moved forward, and to be precise against the force of the trigger spring 25. As a result the rod 21 was moved forward, wherein the front hook 29 (contact point 33) is disengaged and the rear hook 27 (contact point 31) is engaged with the leaf spring 7.

In the case of the pressing of the hook 27 against the leaf spring 7 in the contact point 31 the leaf spring 7 is loaded and elastically bent forward, until the strain gauge has reached a state representative for the trigger slack and the electronics are influenced in such a way that a shot is fired.

If the trigger is released the trigger device again takes on the state of Figure 2, the front hook 29 (contact point 33) is then rests against the spring 7 from the front and the gauge strip 9 can cause the electronics of the weapon to be again ready for the next shot.

The entire trigger device can be used for single shot rifles, repeating arms, self-loading weapons and even fully automatic weapons; the interruption in the case of self-loading weapons takes place electrically, wherein the readiness to fire is again produced when the flow of current in the strain gauge 9 ha dropped from a value above the threshold value which was reached in the case of the shot to the value below the threshold value, or if an upper and a lower threshold value has been exceeded.

In the case of the above described trigger devices the trigger 1 can remain practically unmoved in its trigger slack position even in the case of a sequence of shots, only the trigger finger increases and lowers the trigger force, so that first and foremost the force which

acts on the trigger, and not its location is essential for the interruption. Thus for example in Olympic rapid fire a low, but perhaps deciding time savings in comparison with mechanical triggers can be achieved, in which case the trigger must always move back after each shot by a certain, quite appreciable distance, before it can be actuated again.

The trigger device is suitable for a mechanical and an electrical ammunition ignition. In the case of mechanical ignition the switch acts on a control element which releases a firing pin piece, if necessary also acting on the release of a safety element, for example a firing pin safety. In the case of electrical ammunition ignition the ammunition is ignited directly – without striking mechanism– via a current impulse.

Claims

1. An electrical trigger device for smalls arms,
   - having a trigger (1) which can be adjusted against a trigger slack,
   - a trigger spring (15) which preferably is adjustable and acts on the trigger (1),
   - and an electrical switching element (9), characterized in that the switching element (9) is activated by a spring element (7), in particular a leaf spring, said leaf spring forming an end stop for the trigger (1).

2. The trigger device according to Claim 1, characterized in that the trigger (1) exhibits a trigger tongue (3) and an adjusting arm (5) and is constructed rotatable around a lateral axis (35).

3. The trigger device according to Claim 1 or 2, characterized in that all parts of the trigger (1), with reference to the lateral axis (15, 35), are in largely balanced state.

4. The trigger device according to Claim 1, 2 or 3, characterized in that the trigger spring is formed by a torsion bar (15) which runs coaxially to the lateral axis (35).

5. The trigger device according to Claim 3, characterized in that at least one free end of the torsion bar (15) is supported in a case of the trigger device, and that this free end can be adjusted by twisting (Arrow 17).

6. The trigger device according to any one of Claims 1 through 5, characterized in that a rod (21) is provided which is connected in hinged manner to the adjusting arm (1) and for its part upon reaching of the trigger slack acts on the switching element (9).

7. The trigger device according to Claim 6, characterized in that a projecting part (27) is constructed on the rod (21), which upon reaching the trigger slack presses against one side of the spring element (7).

8. The trigger device according to Claim 7, characterized in that a second projecting part (29) is constructed on the rod (21) in front of the first one, said second projecting part being somewhat parallel to the first one and pressing in the rest position of the trigger (1) against the other side of the spring element (7).

9. The trigger device according to any one of Claims 1 through 8, characterized in that the electrical switching element is a switching element (9) actuated by the deflection of the spring element (7).

10. The trigger device according to Claim 9, characterized in that the switching element exhibits a strain gauge (9) which is seated on the spring element (7) and detects its deformation.

11. The trigger device according to Claim 10, characterized in that the strain gauge (9) has an electrical adjusting element allocated to it, in particular a potentiometer, for the adjustment of the trigger slack resistance.

12. A weapon with a trigger device according to any one of Claims 1 through 11.

AMENDED CLAIMS
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Patent Claims

1. An electrical trigger device for smalls arms,
   - having a trigger (1) which can be adjusted against a trigger slack,
   - a trigger spring (15) which preferably is adjustable and acts on the trigger (1),
   - and an electrical switching element which can be activated after the forward motion is traveled, wherein
   - the switching element is activated by an interchangeable spring element (7), in particular a leaf spring, said leaf spring forming an end stop for the trigger (1) and
   - the switching element exhibits a strain gauge (9) which is seated on the spring element (7) and detects its deformation.

2. The trigger device according to Claim 1, characterized in that the trigger (1) exhibits a trigger tongue (3) and an adjusting arm (5) and is constructed rotatable around a lateral axis (35).

3. The trigger device according to Claim 1 or 2, characterized in that all parts of the trigger (1), with reference to the lateral axis (15, 35), are in largely balanced state.

4. The trigger device according to Claim 1, 2 or 3, characterized in that the trigger spring is formed by a torsion bar (15) which runs coaxially to the lateral axis (35).

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5. The trigger device according to Claim 4, characterized in that at least one free end of the torsion bar (15) is supported in a case of the trigger device, and that this free end can be adjusted by twisting (Arrow 17).

6. The trigger device according to any one of Claims 1 through 5, characterized in that a rod (21) is provided which is connected in hinged manner to the adjusting arm (1) and for its part upon reaching of the trigger slack acts on the switching element (9).

7. The trigger device according to Claim 6, characterized in that a hook (27) is constructed on the rod (21), which upon reaching the trigger slack presses against one side of the spring element (7).

8. The trigger device according to Claim 7, characterized in that a hook (29) is constructed on the rod (21) in front of the first one, said second hook being somewhat parallel to the first one and pressing in the rest position of the trigger (1) against the other side of the spring element (7).

9. The trigger device according to Claim 1, characterized in that the strain gauge (9) has an electrical adjusting element allocated to it, in particular a potentiometer, for the adjustment of the trigger slack resistance.

10. A weapon with a trigger device according to any one of Claims 1 through 9.

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