

Training projectile for an automatic rapid-fire weapon

The invention relates to a medium-bore training projectile for an automatic rapid-fire weapon and also a system based on such a training projectile and a weapon barrel.

For training purposes, it is necessary to have at one's disposal training and manoeuvre ammunition, the features of which correspond to live ammunition, at least where rapid-fire weapons are concerned, so that all functions can run smoothly. It must not be necessary in this regard to make any essential modifications to the weapon. At the same time, the training projectile and any necessary conversion kit for the weapon must be configured in such a way that live ammunition cannot inadvertently be fired whilst shooting with manoeuvre ammunition.

DE-A-14 53 827 proposes to equip the training cartridge with a bore hole, which is closed off above the propellant charge arranged in the rear area and if necessary in the area near the projectile tip by a destructible cap. If the cover(s) is (are) correctly dimensioned, the projectile, when fired, is followed by an initial shock dust, which is sufficient to guarantee a recoil of the barrel when the weapon bolt is reversed. The covers are subsequently destroyed by the propellant charge and leave the barrel before the projectile, the speed of which is reduced due to the presence of the continuous bore hole.

This type of training projectile however does not guarantee to prevent live ammunition being inadvertently fired.

DE-A-37 33 216 discloses a weapon barrel for automatic weapons for the purposes of firing training ammunition, particularly blank cartridges, whereby a limiting bush is secured near a cartridge bearing and the weapon bolt inside the barrel and a nozzle insert is secured as a gas choke near the muzzle in the front part of the barrel. This limiting bush must be configured so as to prevent a live cartridge being fully pushed into the barrel, which ensures that the weapon will remain fully operable in this case. Training ammunition, which is simply modified to be thinner near the projectile tip can be inserted so far into the limiting bush that the cartridge is completely accommodated by the barrel.

When firing blank cartridges, this barrel, which is preferably a de-commissioned barrel that has been modified for use with live ammunition, is replaced by a barrel suitable for firing live ammunition. The use of a nozzle insert, which if necessary has an adjustable tuyere area, creates a gas pressure in the barrel that is both necessary and adequate for automatic weapon function when a training cartridge is fired. This gas pressure guarantees both the locking function and ejection of the cartridge. The blank cartridge does not leave the barrel, the bang, smoke and possibly the flash from the muzzle are simply simulated when the blank cartridge is loaded.

This system can be applied to small-bore training ammunition. It does however require structural modifications to the barrel and the training ammunition.

Moreover, it is very extremely difficult to achieve the gas pressure required for medium-bore rapid-fire weapons with this system. With conventional 40mm training cartridges, gas pressures able to release the weapon bolt, which weighs approx. 7 kg, must be provided.

DE-A1-4134505 discloses a small-bore cartridge for simulated firing using a laser beam, which has a bush with longitudinal bore hole, whereby the external form of the bush corresponds to that of a standard cartridge case containing a projectile. Release of a weapon bolt is also not possible with this cartridge.

The task of the invention is to provide a training projectile, particularly for large-bore rapid-fire weapons, which allows large gas pressures to be created in the barrel that can release even heavy weapon bolts. A further purpose of a system based on this type of training projectile and its application as a weapon barrel is to create an automatic rapid wire weapon, which has a reliable function, is simply constructed, consists of few components and which is therefore cost-effective to produce.

In terms of a training projectile, the task is solved by the characteristics in Claim 1 and in terms of a system based on a training projectile and a barrel, by the characteristics of the independent Patent Claim.

Accordingly, the training projectile has a continuous central channel, which contains a propellant charge in the rear area of the projectile and which is sealed off at the rear by a detonator charge for the propellant charge. The channel is open at the projectile tip.

Training projectile and barrel both have devices to prevent the insertion of a live projectile. The open channel of the training projectile is preferably used for this purpose: when the training projectile is fully inserted into the barrel, the mandrel of an insert projects into the barrel in the open end of the channel, whereby this insert limits the vacant space before the nose of the projectile. The insert can also be equipped with overflow channels.

The mandrel ensures that a live projectile cannot be inserted instead of a training projectile, since this is sealed at its tip to prevent it from completely leaving the barrel. The rapid-fire weapon would be operable in such a case.

After the detonator charge has ignited the propellant charge, e.g. using a strike pin, the propellant gas disperses vehemently towards the open end of the central channel in the training projectile, whereby a high gas pressure is rapidly created in the relatively small space between propellant charge and mandrel tip. This pressure rapidly propels the projectile backwards towards the weapon bolt which is then released.

The diameter of the insert mandrel is preferably smaller than the diameter clearance of the central channel in the projectile, which creates a gap between channel and mandrel through which the propellant gas starts to escape shortly after the propellant charge is ignited and through which the overflow channel in the insert acting as a gas choke runs towards the muzzle of the barrel. Given correct dimensions of the mandrel, central channel and gas choke, the same effects as those achieved with a

live projectile can be simulated, e.g. flash, bang and smoke.

The training projectile can essentially be constructed from four components, namely a projectile base, a central barrel inserted into the projectile base that runs longitudinal to the projectile into which the propellant charge is loaded, an ignitor cap inserted into the projectile base for igniting the propellant charge and a single-piece projectile body, which surrounds the central barrel from projectile barrel upwards, this does however leave the central barrel open at the projectile tip. The projectile body is preferably produced from injection-moulded plastic. The projectile base is usually a metal component and should preferably be aluminium or steel; the central pipe should preferably be steel, in order to be able to withstand the gas pressures occurring when the propellant charge is ignited.

It is also possible, to cover the nose end of the propellant charge with a destructible cap or rupture disk and/or provide a further nozzle or nozzle arrangement in the central channel, whereby the development of the gas pressure created in the barrel can be further optimised after the propellant charge has been ignited.

A training projectile as proposed by the invention does not cause a direct pressure build up behind the training projectile with simulated firing. Instead, the gases created by the propellant charge are fed into the projectile over the projectile tip, so that the gas pressure created between the projectile tip and the insert in the barrel propels the training projectile to release the weapon bolt.

The drawings help to explain the invention in more detail. These drawings show:

Figure 1: a cut view of a training projectile for a 40 mm rapid-fire weapon as proposed by the invention

Figures 2 to 6: sequential drawings showing simulated firing of a training projectile, from loading the projectile through to ejection and

Figure 7: a partially cut view of a slightly modified training projectile

As shown by Figure 1, training projectile 1 has a projectile base 2 from aluminium, a central steel barrel 4 screwed into a central thread 3 of the projectile base and a projectile body 5 forming a cup shape from the projectile base upwards, this projectile body being a single-piece injection-moulded plastic component and extending to the front end of the steel barrel 4. The rear half of the steel barrel 4 is filled with propellant charge 6, which, with the aid of a striking pin, can be ignited by an ignitor cap 7 inserted into the projectile base in the rear of the projectile. The steel barrel has at its tip a free opening 8, the edge of which lies directly adjacent to the aforementioned projectile body 5.

As shown by Figure 1, central steel barrel 4 can be split at its centre by a dividing wall 9, in which a nozzle 10 is provided, which connects the space around propellant

charge 6 with the empty space in the steel barrel up to opening 8.

In Figure 2, 21 shows a barrel of an automatic rapid-fire weapon, for which no further drawings exist. An insert 22 is pushed into this barrel from the front end outwards, whereby this insert consists of a barrel 23 and a piston 24. Barrel 23 lies flush with the inside of barrel 21 and is fitted at the end facing piston 24 with a limit stop 25, which lies adjacent to the front edge of barrel 21. Barrel 23 is held by a spigot nut 26 with a central opening 27, which is screwed into an outer thread of barrel 21.

Piston 24 has a central mandrel 28, the outer diameter of which is smaller than the clear diameter of steel barrel 4. The length of the mandrel is equivalent to a maximum of the distance between opening 8 of the steel barrel 4 and the dividing wall 9 in barrel 4.

Several further overflow channels 29 are provided around central mandrel 28 in piston 24.

Figures 2 to 7 show the functional sequence of the automatic rapid-fire weapon when used with the training projectile.

Figure 2 shows the point in time at which training projectile 1 is loaded by the bolt in barrel 21: this process causes central mandrel 28 of insert 22 to project into central steel barrel 4.

In Figure 3, training projectile 1 has completely left the lock and is located in barrel 21; at this moment in

time, ignitor cap 7 is ignited by a strike pin of the lock. The propellant charge 6 is ignited at virtually the same time.

The propellant gases (31) generated as the charge is combusted, which are schematically illustrated in Figure 4, disperse towards the projectile nose, whereby the gas is choked through the gap between central mandrel 28 and the width clearance of central barrel 4. The gases flow into the space that forms a vacant space 30 between the front end of a propellant charge and the tip of the mandrel; this creates a high gas pressure, which, as indicated in Figure 4 by the arrow, moves the projectile back towards the lock.

The propellant gases, the volume of which has increased in vacant space 30 between the projectile nose and piston 24, escape from free opening 8 of the steel barrel and through the gap between mandrel 28 and steel barrel 4, so that the pressure of these propellant gases, as indicated in Figure 5, now acts on the full face of the projectile and accelerates this backwards into the projectile. The propellant gases then flow through overflow channels 29 and escape into the outside air from central opening 27 of spigot nut 26.

At the point in time indicated in Figure 6, the training projectile slides completely from central mandrel 28 and is transferred back into the bolt, from which point it is subsequently ejected.

By optimising the dimensions of mandrel diameter 28, diameter clearance of steel barrel 4, number and diameter of overflow channels 29 and the distance between piston

24 and insert 22 and where necessary arranging and dimensioning nozzle 10 in dividing wall 9, the pressure build-up in barrel 21 can be optimised to force the training projectile back into the bolt. The gas pressure created initially in a small high pressure space between propellant charge and mandrel tip and the subsequent creation of another pressure area between the piston and the entire cross-sectional area of the projectile, the high forces required for the bolt of the automatic weapon to function are achieved. It is also possible, through the stated dimensioning and also of course collecting the propellant charge at the muzzle of barrel 21 for simulated firing, to imitate the effects occurring with live ammunition, e.g. flashes, bangs and smoke.

Figure 7 shows a modified training projectile. For equivalent elements as illustrated by the design example in Figure 1, equivalent reference symbols are used. With this projectile, propellant charge 6 positioned on the rear side is covered by a destructible cap or rupture disk 71; the dividing wall with nozzle is omitted. The diameter of the training shot reduces in the nose area, so that a limit stop 72 is created, which then lies adjacent to a corresponding limit stop 73 of the barrel 21 indicated schematically here. In this nose area of the projectile, the diameter of the barrel is smaller than in the rear area of the projectile. Live ammunition, the diameter of which is the same in both the nose and the rear area, cannot be inserted into this barrel.

The firing functions are the same as described above; the mandrel, which in the above design is inserted into channel 8, is not required with this design. However, it is possible to use both mandrel and limit stop jointly.

It is also possible, to provide a proprietary training barrel rather than modifying a barrel intended for live ammunition by adding an insert. If flashes, smokes and bangs are not simulated, the aforementioned overflow channels in the gas choke can also be omitted, so that all the gas pressure is used to drive back the projectile and release the weapon bolt.



Claims

1. Medium-bore training projectile for medium-bore automatic rapid-fire weapon, characterised in that training projectile (1) has a continuous central channel (4), which in the rear area of the projectile (1) accommodates a propellant charge (6), which is closed at the rear by an detonator charge (7) for propellant charge (6), open at the projectile tip and that the projectile (1) has devices (4, 72), which allows projectile (1) and not a live projectile to be inserted into a barrel (21) designed for training purposes.
2. Training projectile in accordance with Claim 1, characterised by the following features:
 - a projectile base (2),
 - a central barrel (4) Inserted into the base (2), in the longitudinal direction of projectile (1), which accommodates a propellant charge (6) at least in the rear area,
 - an ignitor cap (7) inserted into the projectile base for igniting propellant charge (6) and
 - a single-piece projectile body (5), which surrounds central barrel (4) from projectile base (2) upwards and which leaves an opening (8) at the tip of projectile (1)
3. Training projectile in accordance with Claim 2, characterised in that the projectile body (5) is an injection-moulded plastic component.



4. Training projectile in accordance with Claims 2 or 3, characterised in that projectile base (2) is a metallic component from either aluminium or steel.
5. Training projectile in accordance with one of the Claims 2 to 4, characterised in that central barrel (4) is from steel.
6. Training projectile in accordance with one of the above claims, characterised in that central barrel (4) has a gas choke or gas nozzle (10) between propellant charge (6) and open end (8).
7. Training projectile in accordance with one of the above claims, characterised in that propellant charge (6) is covered by a destructible cap (71).
8. Training projectile in accordance with one of the above claims, characterised in that training projectile (1) has a smaller diameter in its nose area than in its rear area, whereby the two stages created by a limit stop (72) are separated from each other.
9. System based on a training projectile, which can be fired from an automatic rapid-fire weapon, and a barrel, which is geometrically designed such that live ammunition cannot be inserted into the barrel and constructed such that after the training projectile is ignited, pressure is created in the barrel, which guarantees the automatic function of the weapon as if firing live ammunition, characterised in that the training projectile (1) has a continuous central



channel (4), which accommodates a propellant charge (6) in the rear area of the training projectile (1), that training projectile (1) and barrel (21) have corresponding devices (4, 28, 72, 73), which are designed such that only a training projectile (1) can be inserted into the barrel (21) and that when a training projectile (1) is inserted, before the nose of which a vacant space (30) is created, into which the gases created by propellant charge (6) escaping from the open end (8) of channel (4) flow and that the pressure created in vacant space (30) pushes training projectile (1) backwards towards a weapon bolt and out of barrel (21), whereby the bolt is re-tensioned.

10. Training projectile in accordance with Claim 9, characterised in that vacant space (30) is limited by an insert (22) in barrel (21), which essentially fills the entire cross-sectional area of barrel (21) and a piston (24) facing training projectile (1), which is fitted with a central mandrel (28), which projects into central channel (4) of training projectile (1) inserted into the weapon.
11. Training projectile in accordance with Claim 10, characterised in that a gas choke (29) is provided in piston (24).
12. System in accordance with Claim 10 or 11, characterised in that the diameter of central mandrel (28) of insert (22) is smaller than the diameter clearance of central channel (4) of training projectile (1).



13. System in accordance with Claim 10 or 12, characterised in that piston (24) is arranged at one end of a tube (23) to be inserted flush into the weapon barrel (21), where by tube (23) has a flange-type limit stop (25) facing outwards at the end opposite piston (24) and that to secure and hold insert (22) in position in the weapon barrel, a spigot nut (26) with a central opening (27) is provided.
14. System in accordance with one of the Claims 9 to 13, characterised in that the training projectile has a corresponding limit stop (72) in its nose area and the weapon barrel has a corresponding limit stop (73).