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BY A. P. C.

A. A. A. DARCHE

GUNS AND FIREARMS

Filed May 13, 1939

Serial No.
273,401

3 Sheets-Sheet 1

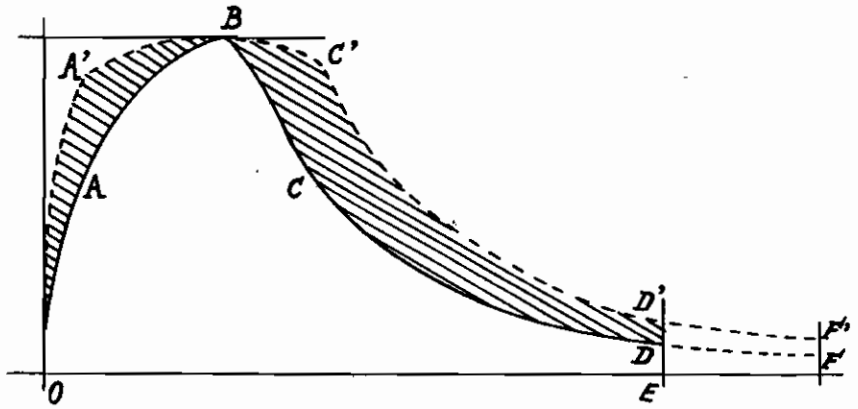

Fig. 1

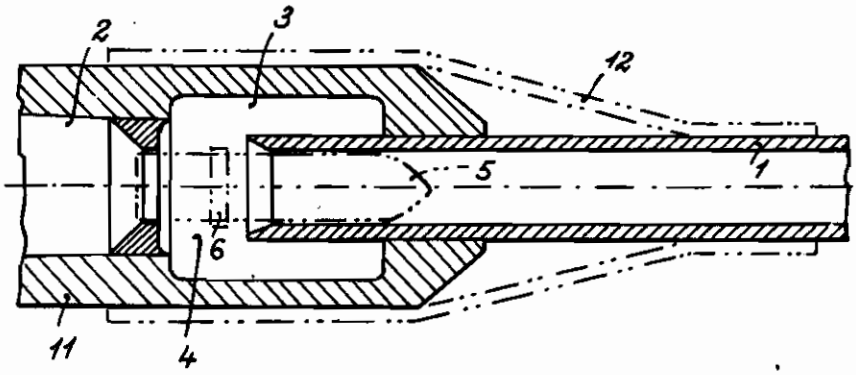

Fig. 2

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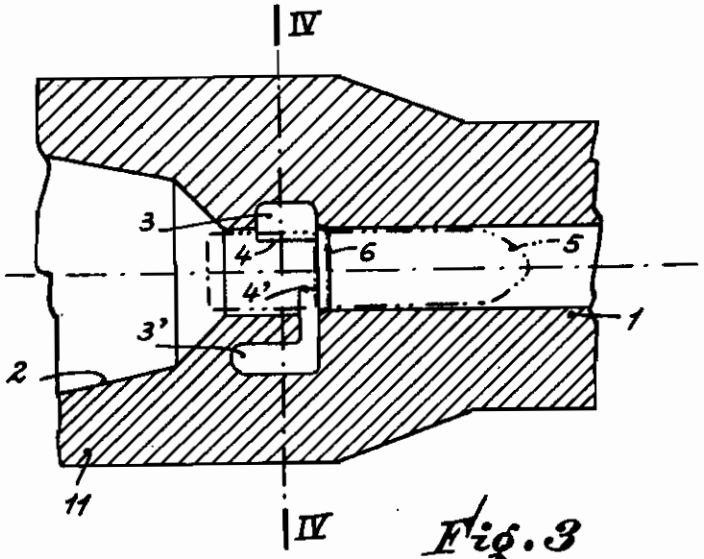

Fig. 3

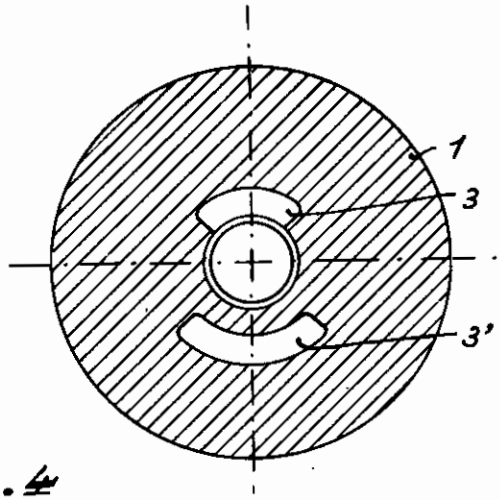

Fig. 4

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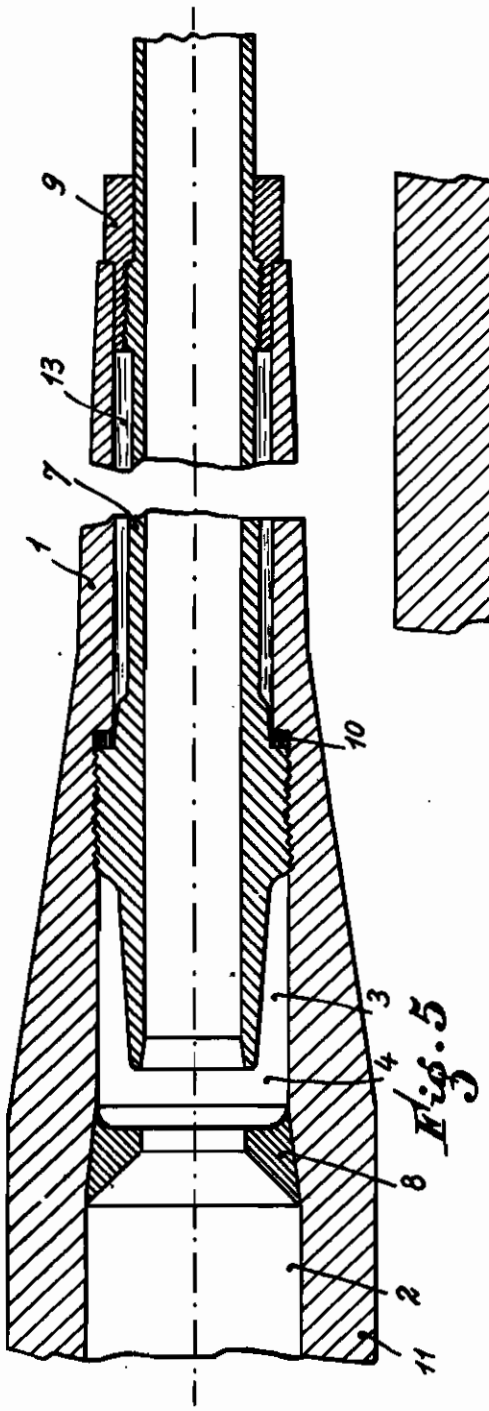

Fig. 5

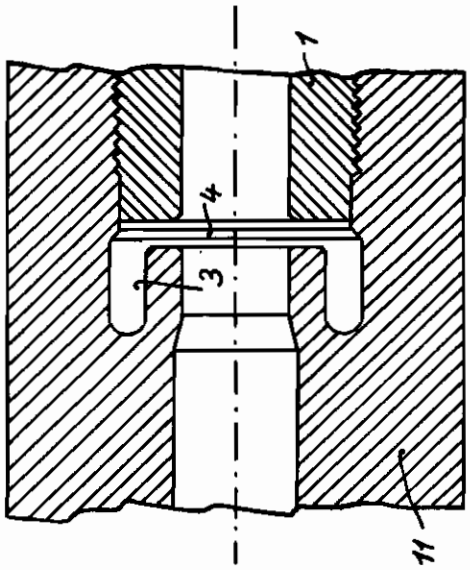

Fig. 6

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ALIEN PROPERTY CUSTODIAN

GUNS AND FIREARMS

Albert Alexandre Augustin Darche, Bondy, France; vested in the Alien Property Custodian

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The invention has for its object improvements in guns and firearms, in order to increase, for a given pressure and calibre, the useful energy at the muzzle and, consequently, the muzzle velocity of the projectile.

Reference is made to the fact that:

1. For firing, with the same maximum pressure, a projectile of given calibre and weight, it is possible, by increasing the charge of powder and decreasing the quickness of the powder, to increase the muzzle velocity of the projectile up to a certain limit (maximum powder effect).

Then, the increase of the charge, conjugated with the decrease of the quickness, not only does not procure any gain, but leads to a decrease of the muzzle velocity.

2. Keeping the same quickness as for the maximum powder effect, it is also possible to increase the charge if the density of charging is simultaneously decreased. This therefore leads to a double increase of volume of the powder chamber.

The powder acts as if it were less quick, pressure is set up more slowly and the result is the same as in case (1), that is to say that the increase of the charge does not further increase the muzzle velocity.

3. The maximum pressure will moreover only be maintained so long as "undulatory pressures" do not occur. The same will have a greater tendency to occur as:

a—The increase of the size of the powder chamber, on the one hand, and

b—The decrease of the charging density, on the other hand, juxtapose their effects and tend to cause irregularity of ignition and of combustion.

In short, with the classical arrangements, for the same length of tube, and beyond the maximum powder effect, it would appear that it is only possible to increase the muzzle velocity of the projectile by increasing the maximum pressure (thicker and heavier tube; quicker wear; projectile with less capacity for the explosive).

The applicant has, on the contrary, been led to discover that, while retaining the charging density, if an auxiliary volume can be placed in communication with the main volume:

a—At a predetermined instant,

b—With controlled progressiveness, and

c—An essential condition, without the possibility of "undulatory pressures" occurring, it is possible to act on the development of the pressures so as to obtain the results which would be produced by a powder—if it existed—of automatically variable quickness during combustion.

It is thus possible to cause, for the same maximum pressure and the same charging density:

1. the pressure to approach quickly its maximum value,

2. combustion to be prolonged, in this case at substantially constant pressure, during a part of the travel of the projectile,

3. the pressure then to be maintained, up to the muzzle, at a high mean value.

Consequently, the energy transmitted to the projectile is considerably increased.

The invention consists in the combined use of one or a plurality of auxiliary volumes, and of arrangements which enable the indispensable conditions mentioned to be fulfilled.

In the accompanying drawings which are given solely by way of example:

Fig. 1 shows, for the same maximum pressure, the comparative mechanical diagrams of a usual gun and of a gun according to the invention;

Fig. 2 shows diagrammatically a first embodiment of the invention;

Figs. 3 and 4 show a second embodiment, in longitudinal section in Fig. 3, and in Fig. 4 in transverse section along IV—IV of Fig. 3.

Figs. 5 and 6 show two other embodiments.

Let it be assumed, Fig. 1, by way of example, that OABCDEO is the (pressure-volume) mechanical diagram of an ordinary gun.

For the same charging density and the same powder, the charge of which is increased, a diagram will be obtained, according to the invention, that tends to become similar to the one shown at OA'BC'D'EO.

Comparison with the usual diagram shows that the pressure increases first of all much quicker according to OA'.

Then the gradual intervention of the auxiliary volume inclines the diagram along A'B.

Without necessarily occurring at the same point B, the maximum pressure remains the same in the two diagrams.

Owing to the initial increase of the charge and simultaneously of the gas emitting area of the powder, the evolution of energy, which is much greater than for the usual gun, then maintains the pressure of the diagram OA'BC' practically constant from B to C'.

Said diagram then includes the downwardly inclined arm C'D' and closes along D'EO.

The increase of useful area, which is shown by the hatched surface of Fig. 1, involves an increase of the muzzle velocity and of the momentum of the projectile.

As can be seen, by extending the diagrams, respectively along DF and D'F', an elongation of the tube produces, according to the invention, a greater increase of momentum than can be obtained in the case of the ordinary gun.

Various combinations are obviously possible.

In particular, for the same charging density and the same maximum pressure, it is possible to obtain an increase of the muzzle velocity while retaining the same charge, but using a quicker powder.

For the same muzzle velocity, it is possible to effect a reduction of the maximum pressure.

It is further possible to combine increases, either of the charge, or of the quickness, or of both simultaneously, with the maintenance or the reduction of the maximum pressure.

A number of diagrammatical examples are shown in the accompanying drawing.

In the example of Fig. 2, the gun tube has been shown at 1 and the powder chamber at 2. An additional auxiliary volume 3 forms, for the gases evolved by the combustion of the charge, an "expansion chamber" which enables the maximum pressure to be kept at the same value, or at a lower value, while enabling an increase to be effected in the charge or in the quickness of the powder, or in both simultaneously.

Said expansion chamber 3 forms, about the rear part of the tube 1, an annular volume which is concentric, or if necessary eccentric with respect to the tube 1.

Between the powder chamber 2 and the rear part of the tube 1 a space has been provided. The volume thus limited communicates, through its rear base, with the powder chamber 2 and through its lateral wall 4 with the expansion chamber 3.

Said volume is first of all occupied by the projectile 5. But as soon as same has sufficiently moved in the tube 1, communication is set up between the powder chamber 2 and the expansion chamber 3.

According to the distance the projectile 5 has to move forward in the tube before it uncovers the lateral communication 4; according to the passage cross-section given said communication 4; and finally according to the volume of the expansion chamber 3, it is possible to control and regulate the law of the development of the pressure during the combustion of the powder.

For a given value of the maximum pressure B, it is therefore possible to increase the charge and the useful area of the diagram.

During the period of rise of pressure, and then subsequently, the volume which can be occupied by the gases evolved by the combustion no longer depends essentially on the volume produced by the movement of the projectile 5.

It is known that in the usual guns and particularly during the preliminary period, called "forcing" period of the projectile, intense leaks occur towards the front. These cause metal to be carried away which is deposited further on and obstructs the grooves (metal fouling).

Owing to its presence, the expansion chamber 3 causes in this case, on the path of the leaks and behind the band 6 of the shell, a sudden expansion which considerably reduces the final magnitude of said leaks and consequently their erosion effect.

The delay caused in placing the expansion chamber 3 in communication with the volume 2 occupied by the gases of the powder, accelerates the beginning of the rise of pressure and the forcing of the projectile.

As has been shown in Fig. 1 (hatched surface OA' BAO), a first increase is also obtained of the useful surface of the diagram.

Instead of using, as in the case of Fig. 2, a single auxiliary volume, a plurality of same could be used, the shapes, sizes and positions of which could be varied, said volumes being successively or simultaneously placed in communication, by the movement of the projectile, with the volume occupied by the gases evolved by the combustion of the charge.

It is known that the sudden expansion of the gases of the powder may produce, in their mass, undulatory movements which cause violent dynamic overloads on coming into contact with the walls.

With an arrangement like that of Fig. 2, or with any arrangement based on the same principle, the initial cylindrical gaseous stream is subjected laterally to a sudden expansion by means of curved waves which are not adapted to the production of undulatory pressures.

As stated, it is indispensable to fulfil this condition, otherwise the gun would be quickly dislocated.

In the example of Fig. 3, the case has been considered diagrammatically of two expansion chambers 3 and 3' which become successively operative. In this example, the large passage cross-section 4 provided for filling the chamber 3 enables same to act extremely quickly. On the other hand, according to the same example, a much more gradual effect is provided for the second chamber 3' having a reduced passage cross-section 4'.

In the example of Fig. 3, the case has been diagrammatically considered of the application of the invention to an existing gun, in order to use, while retaining the same pressure and the same charge, a projectile of reduced calibre, the muzzle velocity of which will be very much increased.

An auxiliary tube 7 of reduced calibre is fitted inside the primary tube 1 of given calibre.

The expansion chamber 3 which, in the example shown, is assumed to be annular and concentric with the rear end 7' of the tube 7, is closed towards the rear by a separate plate 8 on which the charge of powder bears.

An additional connection of the auxiliary tube 7 is effected, towards the front of the primary tube 1, by the intermediate part 9.

By the use of shims, such as the one shown at 10 in Fig. 5, provision may be made for shifting the auxiliary tube 7 longitudinally with respect to the primary tube 1 and for varying the effect of the expansion chamber 3 by modifying its volume and the area of the passage cross-section 4, this latter modification being generally predominant.

By replacing the auxiliary tube 7, it is possible to change the calibre.

In the example of Fig. 6, a single concentric annular expansion chamber 3 is also used, but same is no longer arranged, as in the case of Fig. 2, round the rear end of the tube 1, but is lodged in the breech 11 itself.

The annular communication passage 4 is thus located towards the front of the expansion chamber 3.

The tube 1, which is screwed in the breech 11, can be shifted longitudinally.

The study of the comparative diagrams of Fig.

1 shows that, according to the invention, it is advantageous to provide a considerable elongation of the tube whereby, on the other hand, the pressure at the muzzle is reduced.

In order to obtain said elongation, without running the risk of longitudinal bending that might make firing impossible, use is made of the considerable transverse difference of dimensions which can be obtained between the outer wall of the expansion chamber 3 and the tube, so as to provide same with one or a plurality of additional connections.

A kind of "reinforced beam" is thus formed.

The principle of reinforcing the tube by means of external beams having a large moment of inertia has been shown diagrammatically in chain dotted lines 12 in Fig. 2. One or a plurality of trunconic tubular parts may be used, having their large base turned towards the rear.

Said beams may be continued so as to form a hoop round the breech. Since rigidity is more desirable than strength in such beams of girders, alloys of the light metals may be used (duralumin for example).

In Fig. 5, it is the primary tube 1 of the gun itself which forms the reinforcing element of the inner auxiliary tube 7.

For cooling the tube, a substance which is solid at ordinary temperatures, but having a low melting point, may be interposed between the tubes 1 and 7, in the intermediate space 13 (Fig. 5). The heat passing through the tube 7 will first of all be used for supplying, then for maintaining the latent heat of fusion of said substance, so long as the internal wall of the outer tube 1 is not at a temperature which is at least equal to the temperature of fusion of said substance. Then the latent heat will continue to be transmitted from the tube 7 to the tube 1 through the liquid obtained. In this manner, the temperature of the inner tube 7 will be very substantially lowered.

Of course, all the necessary arrangements will be provided for ensuring the liquid-tightness of the space which is intended to form a liquid chamber for the molten substance.

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