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PRESSURE CONTROL DEVICE
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ABSTRACT OF THE DISCLOSURE

A device for influencing the pressure of propellant charge gases within a barrel wherein an auxiliary pressure chamber is arranged outside of the barrel projectile guiding bore for allowing expansion of the propellant gases passing through an interconnecting aperture. The auxiliary chamber may be charged in volume and additionally have an adjustable aperture for allowing escape of the gases from the auxiliary chamber to the atmosphere to compensate for variations in propellant charge temperature. An indicator may be coupled to the adjustment for correlation with selected propellant charged temperatures.


Background of the invention

The starting velocity of a shell or projectile which is fired out of a barrel depends, as known, on the pressure which develops during the burning of the propellant charge powder. This pressure, in turn, depends on the prevailing temperature of the propellant charge powder which is the reason why shells or projectiles of one and the same type with different firing temperatures of the propellant, but otherwise under completely identical conditions have a different starting velocity resulting in very considerable differences as regards firing accuracy, penetrating force and flight distance of the shell or projectile in addition to strongly varying loads of the gun barrel.

In order to avoid these disadvantages one seeks to achieve, over the range of all firing temperatures of the propellant charge powder that possibly occur in practice, a constant starting velocity of the shell or projectile. A known measure to influence the starting velocity of a projectile in this sense resides in the use of partial charges of differently rapidly burning propellant charge powders. With recoilless guns there has been used with much success for propellant powder charges of predetermined size also a change in the inertia mass corresponding to the temperature differences. Both prior art measures have, however, the considerable disadvantage that they require a supply maintenance and experimentation of additional charge or inertia elements which represents a considerable inconvenience and burden for a field-type deployment or for combat action of the troops.

Summary of the invention

According to the present invention there is proposed a mechanism for influencing the pressure of propellant charges for projectiles to be fired from a barrel which can be manipulated in simple manner similar to a range finder adjustable to a desired distance. The mechanism according to the present invention is characterized in that the pressure space for the propellant charge is connected for the purpose of discharge or release of a variable quantity of propellant charge gases through one or several apertures, bores or the like arranged in the wall of the gun barrel with an additional pressure space closed off against the outside or also connected with the atmosphere by further apertures, bores or the like or also directly with the atmosphere.

By means of the device of the present invention, one can readily control and always accurately adjust, by simple discharge or outflow of a corresponding quantity of the gases developing during burning of the propellant charge powder out of the pressure space for the propellant charge, the pressure of the propellant gases within the pressure space corresponding to the prevailing firing temperature of the propellant charge powder to such a value that the projectile always has the same starting velocity. If, for example, one intends to let the excess quantity of propellant gas flow out or escape directly into the atmosphere, then only the apertures, bores or the like connected with the pressure space have to be covered with adjustable outflow cross section and the prevailing free outflow cross section has to be adjusted correspondingly, which can take place, for example, in such a manner that a threaded ring is arranged on the gun barrel which, depending on the adjustment in the one or the other direction, frees or opens up a greater or smaller number of correspondingly arranged apertures of the gun barrel.

In the interest of as little as possible an impairment of the rigidity of the gun barrel and also in the interest of as little as possible an endangering of the operating personnel by the high pressure of the outflowing or released propellant gases, it may, however, also be advisable not to let the excess quantity of propellant charge escape into the atmosphere or at least to let the same flow out into the atmosphere only indirectly by way of an auxiliary pressure space connected with the main pressure space. In that case, use may be made of various measures. For example, the pressure space may be connected with an auxiliary pressure space which is closed, completely tight with respect to the outside atmosphere and of constant volume, though of sufficient volume for all possible applications, in that the excess propellant gas quantity is then let off or released by way of bores of adjustable flow cross section. In lieu thereof, however, the volume of the auxiliary pressure space may be made adjustable and the flow cross section of the apertures, bores or the like can then, instead, be kept constant. Finally it is also possible to render adjustable both the volume of the auxiliary pressure space as well as also the flow cross section of the bores.

An excessively high load of the auxiliary pressure space by the propellant gas quantity let out of the pressure space can be avoided in that at least a part of this excess propellant gas quantity is permitted to flow out of the auxiliary pressure space into the atmosphere. In that connection the present invention proposes to construct the bores or the like provided in the walls of the auxiliary pressure space with adjustable flow cross section and according to a further feature of the present invention to couple the change of the flow cross section with the change in volume of the auxiliary pressure space whereby not only an excessively high load is avoided but above all also a constant loading is achieved.

In all cases the arrangement will appropriately be made in such a manner that the predetermined, non-adjustable volume of the pressure space corresponds to the desired starting velocity of the projectile at the lowest possible
temperature of the propellant charge powder so that with a fixed temperature always a portion of the propellant charge gases has to flow out in order to achieve the required starting velocity of the projectile or shell. This measure is necessary if an influencing of the pressure of the propellant charge gases is to be possible in the sense of a constant starting velocity of the projectile or shell both at higher as well as at lower temperatures than the normal temperature.

Accordingly, it is an object of the present invention to provide a pressure control mechanism adapted to control the pressure of the propellant for shells and projectiles in such a manner as to avoid by extremely simple and inexpensive means the shortcomings and drawbacks encountered with the prior art constructions.

It is another object of the present invention to provide a pressure control means for the propellant gases of shells and projectiles which is not only simple in construction but also operationally reliable as well as easy to handle and adjust.

A further object of the present invention resides in the provision of a control mechanism capable of maintaining constant the starting velocity of a projectile to be fired from a barrel regardless of prevailing temperature while simultaneously preventing any considerable changes in the loads and stresses to which the gun is subjected, particularly as regards the gun barrel.

Another object of the present invention resides in the provision of a pressure control device for guns which requires no experimentation, testing or cumbersome storing facilities to assure at all times the same starting velocity for the shells or projectiles thereof.

Still another object of the present invention resides in the provision of a pressure control and adjusting device for guns adapted to maintain essentially constant the starting velocity of the projectile to be fired, which is simple in its adjustment as well as safe for the operating personnel.

Brief description of the drawing

These and other objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, several embodiments in accordance with the present invention, and wherein

FIGURE 1a is an axial longitudinal cross sectional view of a first embodiment of an adjusting mechanism in accordance with the present invention in which the influence of the pressure of the propellant gas takes place by means of an auxiliary pressure space surrounding the gun barrel in a ring-shaped manner;

FIGURE 16 is a cross sectional view taken along line A—A of FIGURE 1a; and

FIGURE 2 is a transverse cross sectional view through FIGURE 1c illustrated embodiment of a pressure control mechanism in accordance with the present invention having an auxiliary pressure space mounted over the gun barrel.

Detailed description of the drawing

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate like parts, and more particularly to FIGURE 1, reference numeral 1 designates the gun barrel which is provided with radial bores 2; the bores 2 are arranged at the place of the highest starting pressure of the propellant powder gases developing during the burning of the propellant charge (not shown) and connect the inside of the pressure space 3 formed by the barrel 1, the flange 5 provided on the barrel 1 as well as the annular housing 4 by means of the annular seal 9. Under certain circumstances it may also be appropriate to provide an annular seal between the barrel 1 and the annular housing 4.

Upon a corresponding rotation of the annular housing 4 on the barrel 1 the auxiliary pressure space 3 decreases, whereby simultaneously the charge density is increased. Inversely the charge density decreases with an increase of the auxiliary pressure space 3 by an opposite rotation of the annular housing 4. The starting velocity of the projectile or shell may be influenced by means of this change in the charge density in the sense that it always has the same magnitude within the entire range of the normally occurring temperatures of the propellant charge powder, for example, from —20° C. up to +40° C. The volume of the auxiliary pressure space 3 corresponding to the respective temperature of the propellant charge powder can be adjusted by means of the temperature scale arranged at the rear end of the annular housing 4 (FIGURE 16) in a most simple manner and to the correct magnitude whereby the indicator mark 10 secured at the flange 5 indicates always the condition under which the firing takes place.

In those cases in which a change of volume of the auxiliary pressure space 3 does not by itself suffice to influence the effect of the propellant charge in the desired sense, the radial bores or apertures 11 may be provided— as shown in dash and dot line in the lower half of FIGURE 1a—in the walls of the annular housing 4. As may be readily seen from FIGURE 1a, the flange 5 upon rotation of the annular housing 4, that is, with a change of the volume of the auxiliary pressure space 3, frees or opens up a more or less large total cross section of the apertures 11 so that a more or less large portion of the propellant charge gases can escape into the atmosphere. It is recommended in practice to construct the apertures 11 with an approximately square or rectangular cross section and to stagger or offset the same in the circumferential direction with respect to one another in such a manner that the end of one aperture coincides accurately in the axial direction with the beginning of the aperture. In this manner a linear relationship is established between the change in the auxiliary pressure space 3 and the change of the free cross section of the discharge apertures 11, whereby the pressure of the propellant charge gases can be changed continuously, that is, without pressure gaps. A disturbance of the predetermined relationship between powder temperature and charge density does not occur by reason of the arrangement of the discharge apertures 11 since the pressure decrease takes place linearly with partial discharge of the propellant gases.

The embodiment illustrated in FIGURE 2 of the mechanism according to the present invention is advantageous especially in those cases in which a considerable decrease of the charge density is not possible without endangering thereby the regular combustion process of the propellant powder. With this mechanism the auxiliary pressure space 3 is constituted by the threaded stud or connection 14 arranged on the barrel 1 at the place of the highest starting pressure, in this embodiment, for example, welded thereon—and by the cover 15 provided with discharge apertures 8 and threaded on the stud or connecting piece 14. The auxiliary pressure space 3 is in communication with the pressure space 7 on the inside of the gun barrel 1 by way of a bore 2 having a constant cross section. The volume of the auxiliary pressure space 3 participating in determining the charge density is changed only slightly by rotating the cover 15 on the threaded stud or connection piece 14 whereby the end surface of the cover 15 and the oppositely disposed end surface of the thread stud 14 form together an annular
nozzle insofar as the cover 15 is not screwed-in up to the mutual abutment of the two end surfaces. This annular nozzle has its smallest cross section along the inner edge 16 of the threaded stud or connecting piece 14 whereby the respective size of the cross section is determined, in addition to being determined by the inner diameter of the threaded stud 14, also by the respective distance between the oppositely disposed end surfaces of the cover 15 and of the threaded stud 14. The distance between these end surfaces and therewith also the nozzle cross section can be changed within the given limits at will and continuously by rotating the cover 15. These limits are in practice a cross section of zero, that is, a closed nozzle for firing at the lowest powder temperature to be considered, and the nozzle cross section of such size that upon firing of the powder at the highest temperature to be taken into consideration, exactly so much of the propellant gas can escape that in both cases the same starting velocity of the projectile or shell is realized. In order to be able to adjust accurately the annular nozzle cross section in a single manner, a temperature scale is again provided at the cover 15 which indicates in connection with an indicator mark (not shown) and provided, for example, at the threaded stud 14 the prevailing conditions under which the firing takes place.

The annular nozzle constituted by the threaded stud 14 and the cover 15 is not subject to corrosion by the hot propellant gases close the hot is conducted away over a relatively large surface. At the outer circumference of the nozzle cross section, which increases in width with increasing diameter, the propellant gases are conducted into the atmosphere by way of apertures, bores or the like 9, arranged in a larger number in the cover 15, whereby the deflection effected by the shape of the cover 15 illustrated in the drawing of the propellant gases escaping or outflowing in the direction of the arrows 13 neutralizes the momentum produced by these propellant gases.

While we have shown and described several embodiments in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to a person skilled in the art and we therefore do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

We claim:

1. A device for influencing the pressure of propellant charge gases for projectiles to be fired out of a barrel comprising:

   a barrel having a projectile guiding bore with an axis,
   first means forming a pressure space for the propellant charge gases, and
   means including aperture means in communication with said pressure space for releasing an adjustable amount of the propellant charge gases to compensate for the temperature variations in the propellant charge, and
   further means which is adjustable to control the barrel for adjusting the flow cross section of said aperture means, including indicator means for directly indicating the temperature of the propellant charge corresponding to a respective adjustment.

   4. A projectile firing device adjustable to produce a fixed predetermined projectile starting velocity and effective propellant pressure over a wide range of firing temperatures without changing the type and characteristics of the shells to be fired, comprising:

   a barrel having a projectile guiding bore with an axis;

   first means forming a pressure space for the propellant charge gases, and

   means including aperture means in communication with said pressure space for releasing an adjustable amount of the propellant charge gases to compensate for the temperature variations in the propellant charge, and

   further means which is adjustable to control the barrel for adjusting the flow cross section of said aperture means, including indicator means for directly indicating the temperature of the propellant charge corresponding to a respective adjustment.

   5. A device for influencing the pressure of propellant charge gases for projectiles to be fired out of a barrel comprising:

   a barrel having a projectile guiding bore with an axis,
   first means forming a pressure space for the propellant charge gases, and
   means including aperture means in communication with said pressure space for releasing an adjustable amount of the propellant charge gases to compensate for the temperature variations in the propellant charge, and

   further means which is adjustable to control the barrel for adjusting the flow cross section of said aperture means, including indicator means for directly indicating the temperature of the propellant charge corresponding to a respective adjustment.

   6. The device of claim 5, wherein said barrel means consists essentially of the exterior of said barrel, an annular flange concentric with said barrel and integral with said barrel, and the exterior periphery of said annular flange; said first control means being constituted by a threaded connection between said annular flange and said annular housing; said second control means being constituted by a plurality of bores through said annular housing spaced in the axial direction to be sequentially opened and closed by said annular flange during threaded adjustment of said annular housing in one axial direction and the other axial direction, respectively.

   7. The device of claim 5, wherein said annular flange having an axis of symmetry transverse to said axis and integral with said barrel, and an annular housing concentrically disposed on said annular flange and telescopically engageable with said barrel and said annular housing; said first control means being constituted by a threaded connection between said annular flange and said annular housing adjustable in the direction of said axis of symmetry; said second control means being constituted by a radially extending, with respect to said axis of symmetry, annular surface on said annular flange and a cooperating opposed generally parallel annular surface on said annular housing mounted for movement toward and away from each other during threaded adjustment of said annular housing in one axial direction and the other axial direction, respectively, discharge apertures fluid connecting the annular spaces between said annular surfaces with the atmosphere, and an annular deflection lip means generally at right angles to the discharge of said discharge apertures for deflecting and distributing the discharge propellant gas.
8. The device of claim 5, wherein said wall means consist essentially of the exterior of said barrel, an annular flange integral with said barrel, and an annular housing telescopically sealingly engaging the exterior periphery of said annular flange; said first and second control means each include a common single adjustment thread on said annular housing.

9. The device of claim 5, wherein said wall means consist essentially of the exterior of said barrel, an annular flange integral with said barrel, and an annular housing telescopically sealingly engaging the exterior periphery of said annular flange; said first and second control means each include a common single adjustment thread between said annular housing and said annular flange.

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