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FIREARM OF THE GAS RELOADING TYPE

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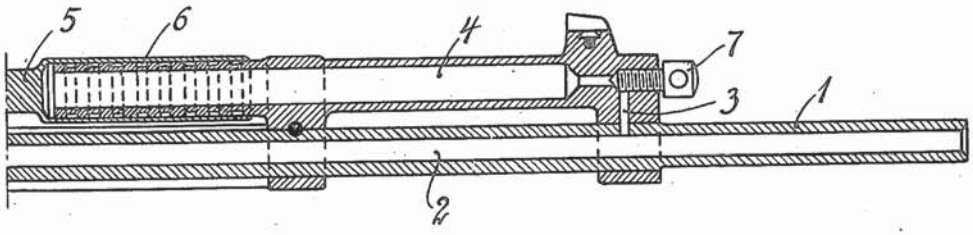

Inventor:-
Fridtjof Nielsen Bröndby
by L. L. Lunde & Co
Attys.

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FIREARM OF THE GAS RELOADING TYPE

Fridtjof Nielsen Bröndby, Oslo, Norway

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The present invention relates to automatic fire arms of the so-called gas reloading type, wherein a proportion of the powder gas developed by the firing is utilized as a driving power to open the breech and to move back the members taking part in the reloading. This is effected by the gas being caused to act upon a piston which is movable in a cylinder and is mechanically connected with the said movable breech members.

However, it is a well-known fact that the powder gas in its highly compressed state is an extraordinary "hard" gas. Therefore one has tried to mix it with atmospheric air in a cylinder of a large capacity in order thereby to have the breech opened by an elastic pressure action instead of a violent blow, but nevertheless the used gas mixture escapes from the cylinder with a substantial part of its energy, because the mixture has always a very high temperature and contains also considerable quantities of incompletely burnt gases and free carbon particles. Therefore great deposits of powder mud and soot took place in the channels, cylinder and on the piston, so that the device must be frequently cleaned to prevent stoppages. Further, the device becomes rapidly so hot that the firing time is limited.

According to the present invention a piston is used whose length is so proportioned in relation to the travel thereof that the piston can separate from the cylinder and thereby put the cylinder in connection with the atmosphere for so long a time after each shot that the gases of combustion may be thoroughly scavenged and before the next shot may be filled with air.

The cylinder volume is of such proportions so that the air content therefore is sufficient to effect, to the necessary degree, a supplemental combustion of the powder gas introduced into the cylinder. By this means not only the pressure and expansion of the powder gas are utilized but also its heat, and simultaneously with the known chock-free and elastic motion of the piston the formation of mud and soot is practically prevented.

It has been found that in this manner the device is sufficiently cooled after each shot by the cold atmospheric air in the cylinder, and said air assists simultaneously in obtaining a sufficiently elastic pressure action of the gas mixture. Further, a supplemental combustion is obtained of the mud-forming constitutents of the powder gas, particularly of the finely distributed free carbon and partly of the carbon monoxide, and such combustion takes place to such a degree that, as mentioned, soot and mud formation is prevented and moreover heat is developed that the same increases considerably the action of the gas mixture upon the piston, a substantially greater proportion of the energy contents of the gas is utilized for opening the breech.

When the gas beam is passed into the cylinder in axial direction at one end of the cylinder, an instantaneous mixing of the powder gases with the air present in the cylinder takes place and also a uniform supplemental combustion with a maximum efficiency. Further, a piston is used surrounding the gas cylinder and having such a length that it separates from the cylinder only when the breech mechanism, during the motion of the rearwardly traveling parts, has been released.

Thereby a safe operation of the device is obtained. Usually the piston surrounding the gas cylinder is approximately half the length of the travel of the rearwardly moving parts of the mechanism. However, this depends upon the properties of the breech mechanism.

For determining the diameter and length of the gas cylinder in a practical way, one may proceed as follows:

Upon having designed the breech mechanism of the arm and then found, for instance by measurement, the size and duration of the force necessary to open the breech, it is possible according to the chosen barrel bore, the projectile, the type of powder and the approximate powder charge to get the approximate temperature and pressure (from the well-known powder-curves) of the powder gases at the moment the gas passes from the barrel through the lateral channel into the gas cylinder. Then it is necessary first to provide for obtaining at least the pressure on the piston necessary to open the breech mechanism (the force necessary having been measured as mentioned above). The size of this pressure in combination with the working pressure of the powder gases gives the data for determining the gas cylinder diameter. Then its length, or more correctly its capacity, remains to be determined. This capacity should be sufficiently large to enable the air contained therein to supplement the combustion of the powder gas to such an extent that the formation of soot and mud is held to a minimum. A complete combustion of all its combustible constituents is not necessary. Only a partial combustion is required, but the necessary air therefore can always be determined.

Upon having determined the gas cylinder diameter the length thereof and the length of the surrounding piston, a model is made to make firing experiments. From such experiments it will appear, if the gas cylinder proportions have been correctly chosen or not. If no mud formation is observed and if in addition the reloading is effected automatically and safely, the sizes are correct.

By adjusting the screw serving to regulate the cross sectional area of the lateral channel it will be easy to find the limit, at which mud and soot formation will take place. If the channel is too open, the introduced gas quantity is too large and mud formation takes place, because the gas is subjected to an insufficient supplemental combustion, since there is insufficient air present in the cylinder in proportion to the gas quantity. Now the said passage is gradually throttled by the screw and shots are fired each time. If the mud formation ceases and the automatic reloading still takes place safely, one knows that the diameter and the length of the cylinder are of sufficient size. But if one of them is too small, the automatic reloading ceases before the passage has been throttled enough to cease mud formation. To avoid mud formation, namely, it would then be necessary to reduce the supplied gas quantity (in proportion to the air quantity present in the cylinder) so much that the force developed on the piston by such reduced gas quantity would be insufficient to open the breech mechanism. But if a safe operation without mud formation has been obtained, it is sure that a sufficient supplemental combustion is taking place so that a substantial proportion of the heat energy of the powder gas is utilized.

The invention is illustrated in the accompanying drawing showing a longitudinal section of the foremost barrel-half. The breech mechanism and the mechanism-members causing opening and closing after each shot to effect the automatic reloading are not shown, because such members are no part of this invention and may be constructed in many different manners.

1 is the barrel and 2 its usual bore, the foremost portion of which has an ordinary side-channel 3, through which the powder gas may pass into the gas cylinder 4 to yield driving power for moving back the reciprocating and automatical reloading-members, the foremost part of which is indicated at 5 with piston 6. The action is regulated by a screw 7.

In order now to utilize substantially the heat of the gas to force the piston rearwardly, the gas cylinder 4 is considerably extended rearwardly so as to obtain a large capacity, preferably at least the same capacity as the bore 2. Further, the piston 6 is made comparatively long; preferably equal to about one half of the stroke of the member 5 during the opening of the breech mechanism, so that the air within the cylinder heated by the powder gas obtains a sufficient time to be heated and to expand during the first half of this stroke. As soon as this half of the stroke is completed, the piston separates from the cylinder 4 to allow the cylinder to communicate with the air. Then the cylinder remains open during the second half of the rearward stroke and further until the members have again arrived at a position corresponding to the completion of half of the forward stroke so that the hot air has ample time to exhaust from cylinder 4 and cold air to enter it. The best action is obtained if the piston 6 surrounds the rearwardly extended gas cylinder, because thereby the weight of members will be small as compared with the cylinder capacity.

I claim:

1. An automatic fire arm of the gas reloading type having a breech mechanism comprising a barrel having a bore therein, a piston cylinder having a channel connecting said cylinder with said barrel bore in order to allow the combustion gases to enter into said cylinder, a piston cooperating with said cylinder and connected with the breech mechanism to operate the same, said piston engaging said cylinder during a part only of its travel thereby opening said cylinder to the atmosphere to thoroughly empty the combustion gases therefrom and permit the same to be filled with air, the volume of said cylinder being at least equal to a substantial portion of the volume of the barrel bore so that the air content therein is sufficient to cause a supplemental combustion of the combustion gases whereby not only the pressure and expansion of the combustion gases are utilized, but also the supplemental heat created and the formation of mud and soot is held to a minimum.

2. An automatic fire arm in accordance with claim 1 in which said channel connecting the barrel bore with said cylinder is constructed to direct the pencil of combustion gases in an axial direction into said cylinder at the end opposite to that which is open to the atmosphere.

3. An automatic fire arm in accordance with claim 1 in which the piston is of cup shape and surrounds said cylinder.

4. An automatic fire arm in accordance with claim 1 wherein the length of the piston is such that it separates from the cylinder during the motion of the rearwardly moving parts only after the breech mechanism has been released.

5. An automatic fire arm in accordance with claim 1 in which the piston has approximately half the length of the travel thereof.

6. An automatic fire arm in accordance with claim 1 wherein said channel connecting the barrel bore with the said cylinder is constructed to direct the pencil of combustion gases in an axial direction into said cylinder and in which the piston surrounds said cylinder.

7. An automatic fire arm in accordance with claim 1 wherein said channel connecting the barrel bore with the said cylinder is constructed to direct the pencil of combustion gases in an axial direction into said cylinder and in which the piston surrounds said cylinder and the length of said piston is approximately half the length through which said piston reciprocates.

8. An automatic fire arm in accordance with claim 1 wherein means are provided for controlling the cross sectional area of said channel.

9. An automatic fire arm in accordance with claim 1 wherein an adjustable screw is provided for controlling the cross sectional area of said channel whereby the ratio between the combustion gases of said cylinder and the air therein may be controlled so as to secure a correct supplemental combustion.

FRIDTJOF NIELSEN BRÖNDBY.