Nov. 9, 1965 K. WENGENROTH ETAL 3,216,323

PROPELLANT CHARGE WITH REARWARDLY ATTACHED TAMPING BODY FOR NONRECOILING WEAPONS

Filed July 29, 1963

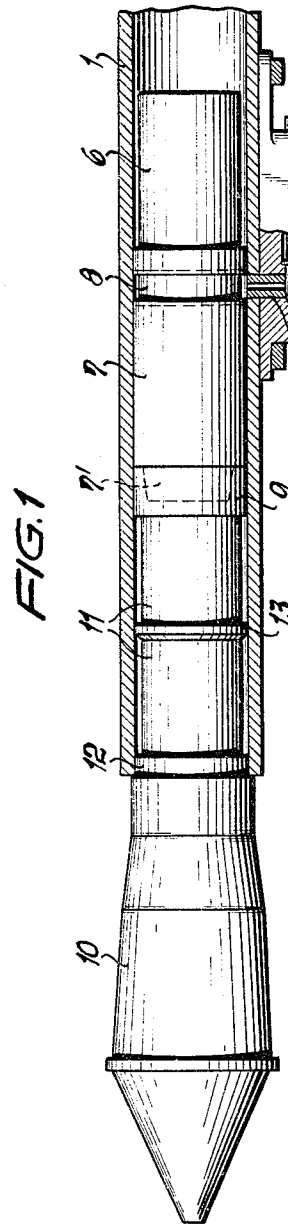

FIG. 1

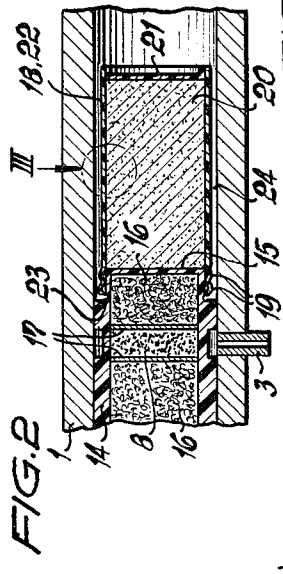

FIG. 2

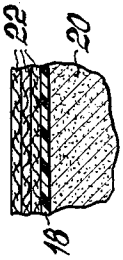

FIG. 3

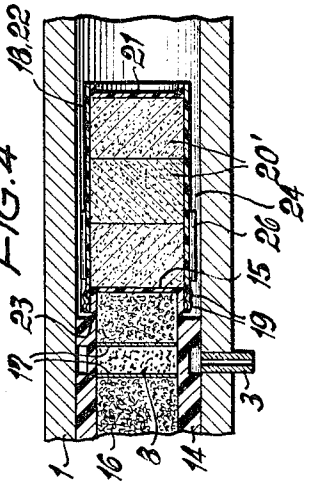

FIG. 4

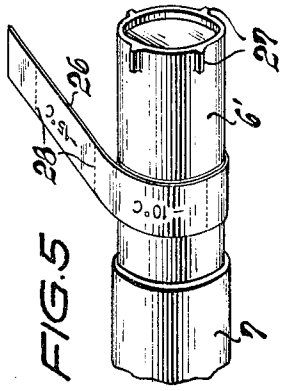

FIG. 5

INVENTORS
Karl WENGENROTH
Wilhelm PERNISS

By Walter Becker

United States Patent Office 3,216,323 Patented Nov. 9, 1965

3,216,323

PROPELLANT CHARGE WITH REARWARDLY ATTACHED TAMPING BODY FOR NONRECOILING WEAPONS

Karl Wengenroth, Munich, and Wilhelm Perniss, Nurnberg, Germany, assignors to Diehl, Nurnberg, Germany

Filed July 29, 1963, Ser. No. 298,385
Claims priority, application Germany, Aug. 1, 1962, W 32,717; Aug. 11, 1962, D 39,605; Dec. 20, 1962, D 40,556
11 Claims. (Cl. 89—1.7)

The present invention relates to improvements in nonrecoiling weapons and relates more specifically to an improved arrangement of a tamping body behind the propellant charge in such a weapon.

Armor piercing, mostly over-calibrated explosive missiles, may be fired by using firearms which, to avoid recoiling effects upon the weapon, utilize a tube having an opening at its rear end. A tamping body, filling the tube diameter tightly, is provided behind the propellant charge for improving the force of the propellant charge on the missile.

In a known construction, this tamping body consists of stapled paper layers which will blow out of the rear of the tube, supposedly, as relatively harmless debris, when the projectile is fired. The useful effect of such a tamping body, however, is very low. Furthermore, these paper layers will gather together in lumps, so that, when using such tamping in an effective amount, the area behind the rifleman will not be entirely free from danger.

The object of this invention is to provide the propellant charge of a nonrecoiling weapon with a tamping body which will be effective but which will not be of danger within the area behind the rifleman.

The tamping body according to the invention, furthermore, improves the weapon, in such a way, that the initial velocity (V_0) of projectiles fired from the weapon is kept substantially constant, thus improving the accuracy of the weapon.

A further object of the invention is to increase the efficiency of the weapon by preventing the development of undue high gas pressure which would cause an unwanted increase of the recoil of the weapon tube.

A further object of the invention is to compensate for the influence of temperature upon the propellant load and thus upon the initial velocity of the projectile.

The tamping body according to the invention includes in particular the following characteristics:

(a) The tamping body according to the invention preferably consists of dust or powder, in particular of metal dust or metal powder, pressed to the form of a body with or without a cementing agent. One or more of such pressed bodies may be used to make up a tamping body. The characteristic of this tamping body is to be chosen so, that the internal cohesive or adhesive structure thereof will be disrupted through the shock of the firing, so that it will be destroyed completely as to form and become dust or powder again, and in this form leave the weapon tube, propelled by the gases of the propellant charge. Dust or powder of pure or substantially pure iron of suitable grain size is preferred.

(b) The tamping body, consisting of one or more pressed bodies, can be cased in an air-tight and dampproofed enevelope, for example, a case formed out of light inflammable or light meltable material, particularly of plastic (polyethylene), to guarantee good transportation facilities and long life storage conditions.

(c) The weight of the tamping body is chosen as large as possible compared to the weight of the projectile. It should preferably be of 20 to 25 percentage of the weight of the projectile. The tamping body, with its diameter, however, does not fill the inner diameter of the barrel

completely but consists of one or more channels, arranged in longitudinal direction of the weapon tube, through which channel or channels a part of the propellant gas may escape rearwardly upon firing, before the tamping body has left the tube. The channel or channels are preferably constructed so that the diameter of the tamping body is of a smaller diameter than that inner diameter of the tube.

(d) Furthermore, the tamping body can be provided with a packing, such as a wraping, consisting of a self-sealing textile tape, in order to provide that the aforementioned channel means for the propellant gas, provided between the weapon tube and the tamping body, is, after the firing of the weapon maintained as long as possible, at least until the pressure of the gas has passed its maximum value and has come down to a lower value.

(e) The casing of the tamping body can be combined for instance, by welding with a casing containing the propellant charge which is preferably of plastic (polyethylene) material. This connection, however, should be only so strong, that, upon firing of the weapon, the said channel means is available before the pressure in the tube reaches its maximum value. For this purpose one or both of the casings is provided with a weakened spot.

(f) The tamping body can furthermore be provided with an arrangement to lower, or to compensate for the influence of temperature upon the propellant charge and thus upon the initial or muzzle velocity V_0 of the projectile. This arrangement should, with increasing temperature enlarge the cross-section of the channel means and decrease it as the temperature decreases. Such an arrangement could either be designed to be adjustable manually or to be controlled automatically by the influence of the temperature. In a simple construction, the tamping body is provided with an adhesive tape which is wound around it and which may be added to or subtracted from according to the ascertained temperature before placing the tamping device into the weapon tube.

Further characteristics of the invention will become apparent from the following description and examples taken together with the accompanying drawings wherein:

FIGURE 1 is a side view partly in section of a hand firearm ready to fire provided with an armor piercing projectile or missile, a propellant charge, and a tamping body according to the invention;

FIGURE 2 is a fragmentary view like FIGURE 1, but showing the propellant charge and the tamping body in section;

FIGURE 3 is an enlarged fragmentary view of the region inside circle "*a*" of FIGURE 2 showing the arranging of a bandage or wrapping around the casing of the tamping body;

FIGURE 4 is a section view of a modification of the tamping body; and

FIGURE 5 is a perspective view of the FIGURE 4 modification.

The nonrecoiling weapon, illustrated in FIG. 1, consists in particular of a relatively thin walled tube **1**, open on both ends, and provided with a firing device **2** mounted in the bottom intermediate the ends. The inside of the tube **1** communicates with the firing device **2** via a detonating or ignition canal or passage **3**. The fusing cartridge **5** is exploded by operating the firing trigger **4**, thereby causing an ignition flash which blows into the inside of tube **1** via the ignition canal **3**. The necessary sighting device provided on the tube **1** is not shown in the drawing.

FIG. 1 also illustrates the position of tamping body **6** and propellant charge body **7** within the weapon tube **1**. The front end **7'** of the propellant charge body **7** projects

into a recess in the rear end 9 of the projectile. The projectile 10, has a reduced rear end 11 which is received in the tube 1, and which reduced rear end is provided with guiding ring means 12 and 13.

When loading the weapon, the projectile 10, propellant charge body 7, and tamping body 6, are stacked together, and are then inserted into the weapon tube from the front end. A so-called igniting or primer charge 8, provided within the propellant load body, is, it will be noted, positioned above the ignition canal 3.

FIG. 2 shows the construction of the propellant load with its combined tamping body according to the invention. A cylindrical case 14 with a wall-thickness of about 1.5 millimeters is made of plastic (polyethylene) and may be closed at its front end. The wall-thickness of the said plastic case is reduced to about 0.5 millimeter within the range of the igniting charge 8 and at its rear end 15. Case 14 fits snugly into tube 1.

The rear end part 15 of the propellant load case 14 is filled with a part of the propellant charge 16, which for instance, may consist of a nitrocellulose powder of a suitable composition and grain size. The igniting charge 8 is contained between two paper board disks 17. The igniting charge 8 may be, for example, a black powder which will ignite the main propellant charge 16 after the charge 8 has been ignited by the ignition flash entering tube 1 via canal 3 and piercing casing 14. The front part of the propellant charge case 14 is also filled with nitrocellulose powder so that propellant charge 16 is in two parts with the igniting charge 8 therebetween.

A cylindrical case 18 is provided on the tamping body 6 and is fitted to the reduced diameter rear end 15 of the propellant charge case 14. Case 18 is, for example, polyethylene material with a thickness of 0.15 millimeter, and may be welded to the said rear end 15 of case 14 along two ring-shaped annular regions 19, for instance by means of ring-shaped electrically heated means. The actually tamping body 20 is positioned inside case 18. The right, or rear end, of case 18 is sealed from the air, by a bottom plate 21 which is welded to the case 18. Furthermore, there are a few layers of self-sealing textile tape 22 wound around the case 18, as shown in FIG. 3.

According to the invention, the tamping body may consist of iron dust, pressed with or without a cementing agent, to a cylindrical block 20 (FIG. 2) or to shorter blocks 20' (FIG. 4). The essential thing is that the structure of the tamping body, on the one hand, is sufficiently firm and solid that, it will keep its form under normal conditions, while, on the other hand, it will loosen up and return to powdered or granular condition under the firing thrust of the weapon. Thus, the tamping body when leaving the rearwardly directed tube opening, will be carried as dust the shortest distance by the gases leaving the rear of the tube.

The tamping body may be produced for instance in the manner described in the following:

Pure, substantially pure, iron with a medium size of grain, of a diameter, for example, of 0.06 millimeter, which may be produced by an electrolytic method, is pressed under high pressure into a cylindrical block of more or less length or into ring-shaped bodies. Adding a lubricant to the iron dust helps to obtain uniform density in the pressed bodies, and also to protect the pressing devices. The lubricant may, for instance, consist of 1 to 2 percentage of oil in the iron dust. Pressing can be accomplished by a pressure of about 1 to 2 tons/cm.^{2} and will result in bodies having a specific gravity ranging between 4 and 5 grams/cm.^{3}. A body, pressed in this manner, is stable to handle but will disintegrate into dust again under the impact of the firing thrust of the weapon. The bodies when stored, and protected by the case 8 against the humidity of the air, will keep their characteristics for a long period of time.

Instead of using iron dust, other dusts may also be used, for instance, copper or lead dust, but these may be injurious to health and iron dust is, therefore, preferred.

It is a further important object of the invention not to fill the tube diameter completely with the tamping body, but to leave an annular clearance 24 of a suitable size between the inside of tube 1 and the outside of the tamping body. This clearance or channel means should be maintained for a certain period of time after the firing of the weapon. As mentioned before, a part of the propellant charge gases will blow out of the tube to the rear through this said annular clearance in this manner, by passing the tamping body. This clearance for instance measures 2.3 millimeters for a weapon having a caliber of 43.6 millimeters.

This annular clearance is available immediately after the ignition of the propellant charge. It is a further important object of the invention to provide, for this purpose, a breaking region at the connection of the propellant charge case 14 to the case 18 of the tamping body as, for example, at point 23, which represents a weakened region in case 14. This weakened region will rupture upon firing of the weapon and body with its case, and the rear end 15 of the propellant charge case 14, will be moved towards the right by the firing operation, so that the propellant charge gases can blow rearwardly through the annular clareance 24 immediately after the tearing off of the case 14 at the spot 23.

As it is beforementioned, the tamping body according to the invention should not only reduce the danger in the area behind the weapon during firing operation, but should also improve the operating properties of the weapon.

Using a pressed member in the tamping body with a specific gravity of 4 to 5 grams/cm.^{3} will allow the use of a relative large tamping mass, through which the efficiency of the ammunition will be increased remarkable. However, the disadvantage arises that, with the enlarging of the mass of the tamping body, the muzzle velocity V_0 of the projectile and the maximum value of the pressure developed in tube 1 are also increased. If the weapon is not to become too heavy, the pressure in the tube must exceed the range of 800 to 900 atmospheres. To achieve a low pressure of the gas within the tube, it is necessary to enlarge the combustion chamber to a relative large size. By using a larger tamping mass, the combustion chamber can be supplied with a small amount of propellant charge. This has, on the other hand, the disadvantage of considerable variation in the muzzle velocity V_0 of the projectile. This shows that the characteristics of the weapon may not be improved simply by enlarging the tamping mass.

It is another important object of the present invention, to provide a channel in the longitudinal direction between the inside of the tube and the tamping body through which said channel a part of the propellant charge gas may blow off to the rear of the tube. Calculation and experimentation have proved that such a blow off channel executes an important influence upon the maximum pressure developed in the tube, and also upon the projectile V_0, so that, by providing a suitable dimensioned channel, the maximum pressure developed in the tube may be decreased to a remarkably low value without decreasing thereby the projectile V_0.

With such a said blow off channel, it will thus be possible to use a tamping mass of a very large volume, whereby a specified maximum of pressure will not be exceeded. It is also possible to enlarge the propellant charge by means of the determined combustion chamber. Through this measure, the variation of the initial velocity V_0 of the projectile will be decreased considerably without detraction from the efficiency, especially because the tamping body remains in the tube for a longer period of time, and through important differences in the manner the propellant charge acts in the combustion chamber.

It is, however, essential that the blow off channel be

maintained from the beginning of the pressure rise in the tube up to the point of time at which the maximum of pressure is passed during the firing operation. It will also be obtained in this way, that the occurring projectile V_0, is close to the value calculated therefor. The proposed bandage or wrapping, surrounding the tamping body must be selected, thus, so that these requirements are met.

Calculations and experiments have proved that the reducing of the cross section area of the tamping may vary over a relatively large range, within about 4 and 40 percent of the tube area. An optimum value is about 6 to 7 percent of the cross sectional area of the tube.

In order to be able to operate the weapon within the range of temperature from —20° to +40° centigrade, it is necessary to provide the weapon with a correction device combined with the sighting device, as because the influence of the temperature upon the propellant charge and, thus upon the V_0 of the projectile must be compensated. According to a further object of the invention, this influence of the temperature is compensated in a relatively simple manner, simply by alternating the cross sectional area of the blow off channel.

A simple example is illustrated in the FIGS. 4 and 5 for effecting such a compensation. The annular clearance **25** provided between the tamping body **20'** and the weapon tube **1** is of maximum value for the V_0 of the projectile at +40 centigrade. The tamping body has on its front part a bandage or wrapping **26**, wound around it, and consisting of a self-sealing textile tape, which reduces the cross sectional area of the annular clearance such that, if the whole of the bandage **26** remains wound upon the tamping body, the resulting clearance will give a certain V_0 of, the projective, for a given propellant charge temperature of —20° centigrade. Before loading, i.e., before placing the projectile into the tube, the rifleman rewinds the textile tape **26** to a determined mark and tears off the remainder according to the ascertained temperature. The tape may be provided not for this purpose, with markings of temperature and can be perforated as at **28** within certain separations so as to be easily torn off.

The case of the tamping body is also provided with ribs or the like **27** (FIG. 5) for centrally supporting the tamping body within the tube **1**.

The invention is not restricted to the examples illustrated. According to the illustrated examples, the blow off channel consists of an annular clearance between the tube and the tamping body. It is also possible to provide one or several channels arranged around or within the tamping body, for instance, whereby the tamping body or its bandage **22** can be fitted closely within tube **1**.

Some other solutions are possible for constructing the predescribed rated breaking point or spot within departing the scope of the present invention.

Also automatic acting devices, such as bimetal elements, may be provided in place of the predescribed packing or bandage **26**, which, will enlarge upon an increase in temperature and reduce upon a reduction in temperature and thereby control the cross sectional area of the blow off channel automatically. All of the elements in the tube, apart from the projectile consist of inflammable or meltable material, in particular of plastic or the like, convertible by the firing of the weapon into dust or fine granules.

What we claim is:

1. In a weapon having a barrel open at both ends and adapted to receive a projectile in the front end and an explosive propelling charge in a frangible casing in the barrel behind said projectile; a tamping body in the barrel behind the propelling charge and adapted to be expelled from the rear end of the barrel upon exploding of said charge, the adjacent ends of said casing and tamping body having connecting means of less diameter than said barrel connecting said tamping body to said casing, said tamping body comprising body means of finely comminuted material compacted into solid members of a predetermined fixed configuration which can be handled without breaking but which will be ruptured so as to return to substantially the original particle size under the shock of explosion of said charge so as to leave the barrel in the original particle size, the maximum cross-sectional area of said tamping body and said connecting means being smaller than the cross sectional area of the barrel to provide an escape channel means for gas past the tamping body at the time of exploding said charge.

2. In a weapon having a barrel open at both ends and adapted to receive a projectile in the front end and an explosive propelling charge in a frangible casing in the barrel behind said projectile; a tamping body in the barrel behind the propelling charge and adapted to be expelled from the rear end of the barrel upon exploding of said charge, the adjacent ends of said casing and tamping body having connecting means of less diameter than said barrel connecting said tamping body to said casing, said tamping body comprising body means of finely comminuted material compacted into solid members of a predetermined fixed configuration which can be handled without breaking but which will be ruptured so as to return to substantially the original particle size under the shock of explosion of said charge so as to leave the barrel in the original particle size, the maximum cross-sectional area of said tamping body and said connecting means being smaller than the cross sectional area of the barrel to provide an escape channel means for gas past the tamping body at the time of exploding said charge, said comminuted material comprising iron dust or powder and said solid members having a specific weight of about 4 to 5 grams/cm.^{3}.

3. In a weapon having a barrel open at both ends and adapted to receive a projectile in the front end and an explosive propelling charge in a frangible casing in the barrel behind said projectile; a tamping body in the barrel behind the propelling charge and adapted to be expelled from the rear end of the barrel upon exploding of said charge, the adjacent ends of said casing and tamping body having connecting means of less diameter than said barrel connecting said tamping body to said casing, said tamping body comprising body means of finely comminuted material compacted into solid members of a predetermined fixed configuration which can be handled without breaking but which will be ruptured so as to return to substantially the original particle size under the shock of explosion of said charge so as to leave the barrel in the original particle size, the maximum cross-sectional area of said tamping body and said connecting means being smaller than the cross sectional area of the barrel to provide an escape channel means for gas past the tamping body at the time of exploding said charge, said comminuted material comprising iron dust or iron powder having an average particle diameter about 0.06 millimeter, about 1 to 2% of weight by oil included in said material, and the specific weight of said solid members being about 4 to 5 grams/cm.^{3}.

4. In a weapon having a barrel open at both ends and adapted to receive a projectile in the front end and an explosive propelling charge in a frangible casing in the barrel behind said projectile; a tamping body in the barrel behind the propelling charge and adapted to be expelled from the rear end of the barrel upon exploding of said charge, the adjacent ends of said casing and tamping body having connecting means of less diameter than said barrel connecting said tamping body to said casing, said tamping body comprising body means of finely comminuted material compacted into solid members of a predetermined fixed configuration which can be handled without breaking but which will be ruptured so as to return to substantially the original particle size under the shock of explosion of said charge so as to leave the barrel in the original particle size, the maximum cross-sec-

tional area of said tamping body and said connecting means being smaller than the cross sectional area of the barrel to provide an escape channel means for gas past the tamping body at the time of exploding said charge, said tamping body including an air and liquid impervious enclosure or casing enclosing said solid members.

5. In a weapon having a barrel open at both ends and adapted to receive a projectile in the front end and an explosive propelling charge in a frangible casing in the barrel behind said projectile; a tamping body in the barrel behind the propelling charge and adapted to be expelled from the rear end of the barrel upon exploding of said charge, the adjacent ends of said casing and tamping body having connecting means of less diameter than said barrel connecting said tamping body to said casing, said tamping body comprising body means of finely comminuted material compacted into solid members of a predetermined fixed configuration which can be handled without breaking but which will be ruptured so as to return to substantially the original particle size under the shock of explosion of said charge so as to leave the barrel in the original particle size, the maximum cross-sectional area of said tamping body and said connecting means being smaller than the cross sectional area of the barrel to provide an escape channel means for gas past the tamping body at the time of exploding said charge, the said cross sectional area of said tamping being of a size as to leave from 4 to 40% of the cross sectional area of the barrel unobstructed to form the said escape channel means.

6. The arrangement according to claim 5 in which the maximum diameter of the tamping body is smaller than the inner diameter of the barrel whereby said channel means comprises an annular channel surrounding said tamping body.

7. In a weapon having a barrel open at both ends and adapted to receive a projectile in the front end and an explosive propelling charge in a frangible casing in the barrel behind said projectile; a tamping body in the barrel behind the propelling charge and adapted to be expelled from the rear end of the barrel upon exploding of said charge, the adjacent ends of said casing and tamping body having connecting means of less diameter than said barrel connecting said tamping body to said casing, said tamping body comprising body means of finely comminuted material compacted into solid members of a predetermined fixed configuration which can be handled without breaking but which will be ruptured so as to return to substantially the original particle size under the shock of explosion of said charge so as to leave the barrel in the original particle size, the maximum cross-sectional area of said tamping body and said connecting means being smaller than the cross sectional area of the barrel to provide an escape channel means for gas past the tamping body at the time of exploding said charge, said tamping body including an air and liquid impervious enclosure or casing enclosing said solid members, and wrapping means wrapped about said casing for controlling the diameter thereof and thereby controlling the size of the annular clearance between the tamping body and the barrel forming said escape channel means.

8. In a weapon having a barrel open at both ends and adapted to receive a projectile in the front end and an explosive propelling charge in the barrel behind said projectile; a tamping body in the barrel behind the propelling charge and adapted to be expelled from the rear end of the barrel upon exploding of said charge, said tamping body comprising body means of finely comminuted material compacted into solid members of a predetermined fixed configuration which can be handled without breaking but which will be ruptured so as to return to substantially the original particle size under the shock of explosion of said charge so as to leave the barrel in the original particle size, the maximum cross-sectional area

of said tamping body being smaller than the cross sectional area of the barrel to provide an escape channel means for gas past the tamping body at the time of exploding said charge, said tamping body including an air and liquid impervious enclosure or casing enclosing said solid members, a frangible casing surrounding said propelling charge and the casing surrounding the propelling charge having an end portion of lesser diameter connected to an end portion of the casing surrounding the tamping body to form a single unit, and a weakened zone provided in the combined casings in the region of the interconnection thereof which will rupture under the force of said propelling charge when the latter is exploded.

9. The arrangement according to claim 8 which includes means for changing the effective cross sectional area of said escape channel means to compensate for the influence of temperature upon the propelling charge.

10. The arrangement according to claim 9 in which said means for changing the cross sectional area of said escape channel means comprises an adhesive tape element wound about the tamping body and provided with temperature designations for indicating the amount of tape to be associated with the tamping body under any ascertained temperature conditions.

11. In a weapon having a barrel open at both ends and adapted to receive a projectile in the front end and an explosive propelling charge in a frangible casing in the barrel behind said projectile; a tamping body in the barrel behind the propelling charge and adapted to be expelled from the rear end of the barrel upon exploding of said charge, said tamping body comprising body means of finely comminuted material compacted into solid members of a predetermined fixed configuration which can be handled without breaking but which will be ruptured so as to return to substantially the original particle size under the shock of explosion of said charge so as to leave the barrel in the original particle size, the maximum cross-sectional area of said tamping body being smaller than the cross sectional area of the barrel to provide an escape channel means for gas past the tamping body at the time of exploding said charge, said tamping body including an air and liquid impervious enclosure or casing enclosing said solid members, the adjacent ends of said frangible casing and the tamping body casing having connecting means of less diameter than said barrel connecting said tamping body to said frangible casing, said casing including rib means projecting from the outer surfaces thereof operable for engaging the inside of said barrel to hold said tamping body in a central position therein.

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BENJAMIN A. BORCHELT, *Primary Examiner.*

SAMUEL W. ENGLE, *Examiner.*