No. 623,707. Patented Apr. 25, 1899.

G. DITTMAR.

ARMOR PIERCING SHELL.

(Application filed Aug. 23, 1898.)

(No Model.)

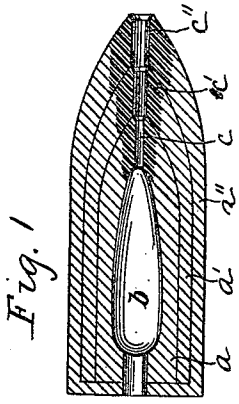

Fig. 1

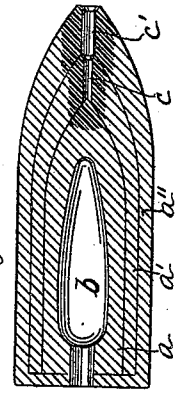

Fig. 2

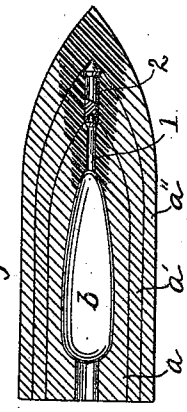

Fig. 3

Fig. 4a

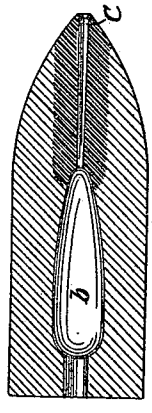

Fig. 4

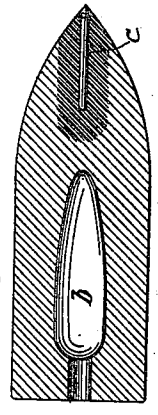

Fig. 5

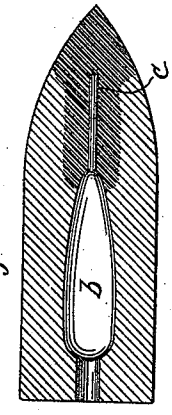

Fig. 6

Fig. 1a

WITNESSES

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ARMOR-PIERCING SHELL.

SPECIFICATION forming part of Letters Patent No. 623,707, dated April 25, 1899.

Application filed August 23, 1898. Serial No. 689,281. (No model.)

To all whom it may concern:

Be it known that I, GUSTAV DITTMAR, a citizen of the United States, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Armor-Piercing Projectiles; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to armor-piercing projectiles, and more especially to shells, having for its object to insure a better effect and a more regular breakage. With this object in view I harden the projectiles inside—that is to say, I create an approximately cylindrical body of great resistance and hardness in the interior and I leave the outer metal surrounding said body in a soft state, so as to form, on the one hand, a protecting-jacket for the inner hard body and, on the other hand, a jacket adapted to yield readily when upon the impact on the armor-plate the latter tends to retain the metal of the shot. Thus the outer soft metal will shrink up or strip off, and only the hardened inner body will penetrate and make a much smaller hole, and therefore find much less resistance than an ordinary projectile. In some instances I harden the metal of the projectile inside and the point simultaneously outside in the usual manner. In order to facilitate the stated yielding of the outer soft-metal body and in order to break up the latter more easily and more regularly, I divide the outer metal into zones or I separate the same more or less from the inner hard body in casting the projectile.

An ordinary so-called "armor-piercing" shell in striking an armor-plate generally has its point and the whole front part broken or crushed, so that the tremendous pressure under the impact of the projectile acts on a surface being almost alike the full cross-section of the shell, and consequently the plate is able to resist. If the pressure under the impact of the projectile could be restricted to a smaller area, as it is intended to be brought about by a well-resisting point, it is clear that the pressure would act under far more favorable circumstances to break the plate. This I obtain by the form of my shells, of which the inner part is hardened and tempered along a central line of the projectile, leaving the outer part preferably soft; but also the outside of the inclosed inner part may be tempered in the well-known manner. The central hardened part of the shells acts like a mandrel of comparatively small area, which transfers the impact of the shell upon a comparatively small surface of the armor-plate, which therefore must yield, and thus the effect of breaking the armor-plate is more readily obtained.

In addition to the above statement it may be said that the wedging action of the shells of to-day is materially changed into the punching—*i. e.*, shearing—action, which requires much less power, as is well known to mechanics, and as by my shell the area upon which the impact of the projectile is acting is perhaps less than half of the area than heretofore it is clear that a much smaller charge of powder will be sufficient to drive a shot through the plates.

The outer soft metal of my shells is able to yield, and therefore will not be wedged into the armor-plate, as is the case with the hard crust of ordinary shells. The outer soft metal in yielding will allow the inner hardened part to throw the weight or impact of the shell against a much smaller bulk of metal of the armor-plate than heretofore, and said bulk has to yield in the direction of travel of the shot, in which the metal is unsupported, similar to metal being punched out of a sheet.

An ordinary shot having passed through an armor-plate without injury to itself shows that it has become thicker and shorter by the action of upsetting. My shell, on the contrary, will be elongated or stretched after passing through an armor-plate, and the hole consequently will be of smaller diameter.

In order to obtain with certainty the punching action, the following conditions must be fulfilled: First, the inner part of the shell must be hardened and should extend, preferably in the form of an approximately cylindrical mandrel, from the extreme front toward the rear; second, the outer part of the metal surrounding said mandrel and protecting it against breaking must be soft in order to resist on the impact by upsetting or by detachment when the soft metal is divided off from the hard mandrel by a division into

zones or otherwise; third, the outer soft metal must be connected with the inner hardened body in such a way that its whole weight will be thrown upon the contact-point of the shot with the armor-plate on impact, and the soft metal should not detach itself from the inner hardened body in the moment of impact by reason of its momentum; fourth, the outer envelop of non-hardened metal must be comparatively thick and strong in order to protect the inner hardened working part against breaking and to guide it as a die is guided in an ordinary punching apparatus.

The above conditions are fulfilled in the hereinafter-described forms of shots, which are represented in the accompanying drawings, forming part of this specification.

In the drawings, Figure 1 is a longitudinal section through a shell obtained by casting or otherwise providing separate zones of metal one over the other, each having a perforation along the central line; and Fig. 1ª shows, separately, the steel plugs which are inserted into the central openings, so as to form the points of the different zones. Fig. 2 shows a shell in longitudinal section cast in zones, having only part of the same perforated. Fig. 3 is a section through a shell made up in zones, which are made separately to be fitted together when cold. Fig. 4 is a longitudinal section through an ordinary shell having a central opening, and Fig. 4ª is an elevation of a plug to be inserted therein. Fig. 5 shows in longitudinal section a modification of this shell, the central opening running only partly from the point to the rear. Fig. 6 is a longitudinal section of a modification, the central bore extending from the rear only partly toward the point.

In making a shell, as shown in Fig. 1, I cast at first the inner part *a* with the inner chamber *b* for the charge and with a central opening *c* in front, so that this body when ready appears without a point. The latter is formed by a steel plug 1, Fig. 1ª, which can be inserted in the opening *c*, snugly fitting the same. When the inner body *a* is ready, I preferably cast a second body *a'* over it and provide in the same a bore or central opening *c'* of such diameter that after casting the plug 1 can be inserted therethrough into the inner body *a*. Hereupon I cast the outer zone *a''* over it and provide the same with an opening *c''* in front, which is of such diameter that the plug 2, Fig. 1ª, can be inserted from the outside. This plug 2, as shown in Fig. 1ª, has in the rear a conical cavity, which snugly fits over the head of plug 1. The plug 3 is provided with a similar cavity to cover the head of plug 2, and when the shell is cast and the walls of the openings *c c' c''* are properly hardened and tempered the plugs 1, 2, and 3, having also been properly hardened, will be inserted from the outside and the shell is ready. It is evident that the number of zones, of which *a a' a''* are indicated as examples only, may be increased at will, and the breakage of these zones will be so regular, one by one, that the different points of the heads of the plugs 1, 2, and 3 and the hardened parts of the bores surrounding the plugs come successively into action. The shell is somewhat weakened by this division into zones, but to no disadvantage. The mass of the shell is the same, the impact and the pressure are the same; but they are concentrated upon a smaller area, and, moreover, the advantage is obtained that the charge will break the walls more easily, and consequently the chamber *b* may be made smaller, thus allowing me to increase the metal bulk and weight of the projectile.

The modified form, Fig. 2, is obtained in substantially the same manner as form Fig. 1, except that the opening *c* is omitted, and therefore the body *a* has a solid point. The bodies *a' a''* have the openings *c c'* and plugs 1 and 2, as above described.

Fig. 3 shows a modification in zones *a a' a''*, the latter being provided with a solid point, and zones *a a'* having the openings *c c'*, as in Fig. 1, to be filled with plugs 1 and 2, Fig. 1ª. This form of shell cannot be obtained by casting the zones one over the other. The parts are separately cast or forged and are separately tempered with care and then fitted together cold. The forms Figs. 1 and 2 are preferably cast over each other, but may be fitted together in a cold state by forming the part *a''* without a bottom, as in Fig. 3.

The inner hardened part of the projectile produces in the armor-plate a small hole, the edge of which retains the outer soft metal, forming a protecting-jacket of the hardened inner core, and the yielding of said protecting-jacket can be facilitated by dividing the metal, as represented, in zones or by making a division of the outer surrounding soft metal from the inner hardened core.

In order to cheapen the manufacture of the projectiles, I can omit the provision of separate metal zones and have only the central hardened part along an opening.

Fig. 4 shows an ordinary solid shell having a longitudinal opening *c* extending from the chamber *b* to the point of the projectile. The walls of this opening *c* are hardened in any suitable manner. Fig. 4ª shows a special plug to be inserted into the opening *c*. While hardening the walls of the opening *c*, I can at the same time submerge the point of the projectile into a tank to chill the outside in the usual manner, thus producing on the outer surface of the point a hard crust and in the longitudinal center the hardened part, as above described.

The form shown in Fig. 5 is modified, inasmuch as the opening *c* does not extend fully from the point to the chamber *b*, and the form Fig. 6 varies in the same way from the form Fig. 4, having the opening *c* extending from the chamber only partly toward the point of the projectile, which in this instance remains solid. The forms Figs. 4 and 5 may also be

cast in zones, as above described, having only a single plug, as shown in Fig. 4ª, and in the form Fig. 6 a special plug without a head may be inserted from inside the chamber *b*, or it may remain open or be filled with a charge of an explosive element.

It is evident that this invention may be applied to any kind of projectiles, solid or hollow, cast, forged, rolled, or otherwise manufactured, the gist of the invention being the longitudinal hardened inner part along a central line of the projectile in addition to the outer soft part surrounding the inner hardened part like a protecting-jacket, which may form a single piece of metal with the inner hardened part or may be divided off therefrom in regular layers or zones or otherwise.

The plugs 1, 2, and 3, which form the points of the different zones, may be secured in the bores *c c' c''* in any suitable manner. The outer plug may be provided, for instance, with screw-thread to be screwed into the outer opening, so that all the plugs, being in close contact, are secured in place and form the hardened points of the different zones. In casting the metal in zones, one over the other, I may provide ribs and grooves to insure a better union.

I do not claim the different special forms of shells, which have been described as examples only; but

What I claim is—

1. A projectile having integral concentric and longitudinal zones of different degrees of resistance contained within the body of the projectile, the hardened zone being within and extending to the point of the projectile.

2. A projectile composed of a hardened resisting inner portion extending longitudinally from the point toward the rear, and an integral and relatively soft yielding outer portion inclosing said hardened portion and forming a jacket to prevent the breakage of said inner portion under the action of impact.

3. A projectile having an axial longitudinal zone of great resistance, extending to the point of the projectile, a charge-chamber in rear thereof, and an outer zone of less resistance.

4. A projectile having a longitudinal bore in the front portion thereof the walls of which bore are hardened.

5. A projectile having a longitudinal bore in the front portion thereof with hardened walls and a hardened plug fitted therein.

6. A projectile having a longitudinal bore in the front portion thereof with hardened walls and a hardened plug fitted therein, said projectile being built up of separate concentric zones, substantially as described.

7. A projectile having an axial longitudinal bore provided with hardened walls and the point of the projectile hardened in excess of the remaining portion thereof.

In testimony whereof I affix my signature in presence of two witnesses.

GUSTAV DITTMAR.

Witnesses:

ROBERT VOSS,

JAS. A. RICHMOND.