PUBLISHED

MAY 4, 1943.

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PROJECTILE FOR PERFORATING BORE HOLE CASINGS

Filed May 27, 1939

Serial No. 276,093

Fig. 1

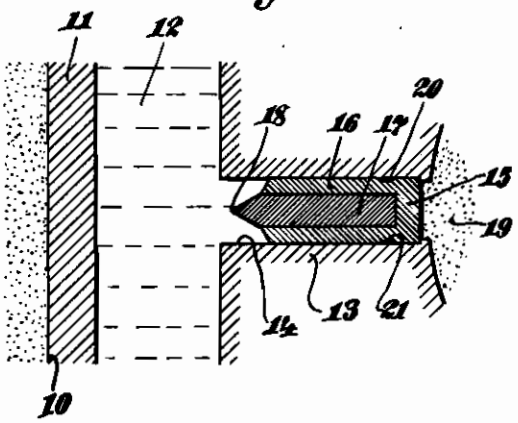

Fig. 2

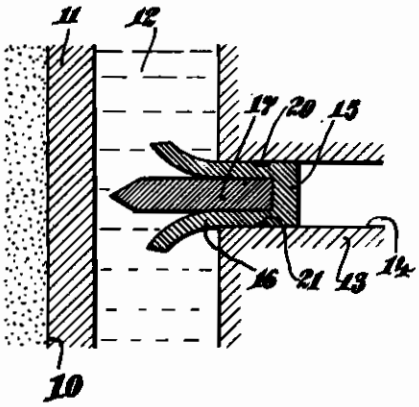

Fig. 3

Fig. 4

Fig. 5

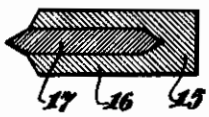

Fig. 6

Fig. 7

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Published May 4, 1943

Serial No. 276,093

ALIEN PROPERTY CUSTODIAN

PROJECTILE FOR PERFORATING BORE HOLE CASINGS

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Application filed May 27, 1939

The present invention relates to shooting devices, and more particularly to apparatus for perforating the metallic casings usually inserted within bore holes after drilling. More specifically the invention relates to a new and improved projectile construction for perforating metallic bore hole casings, although it is not limited to such use.

Heretofore perforating projectiles of this character have generally been formed with a conical forward portion and a cylindrical rear portion, and have been fabricated entirely out of hard steel. It has been found from long experience that these projectiles do not always make clean holes in the bore hole casing. In some cases the holes formed by the projectile have rough and projecting edges which are undesirable particularly inside the casing where they may interfere with the motion of instruments such as packers, pumps, etc., necessary for the production of the well.

It also happens that projectiles become jammed when penetrating the casing but before leaving entirely the barrel of the gun, causing the gun to be stuck in the well due to the smallness of the annular space between gun and casing.

Moreover, previous perforating projectiles can be discharged only from a gun having a barrel of the same diameter as the projectile itself so that it is necessary to provide as many different guns as there are projectiles of different size.

A primary object of the present invention, accordingly, is to provide a new and improved projectile construction for perforating a bore hole casing, which enables a greater impelling force to be developed in its discharge than has been possible heretofore, so that cleaner holes may be produced. This greater impelling force will also allow a greater depth of penetration through several concentric casings which may be cemented together.

Another object of the invention is to provide an improved projectile which can be loosened easily should it become accidentally wedged between the gun and the casing.

A still further object of the invention is to provide an improved projectile construction of the above character which enables holes of different diameter to be made in a bore hole casing by the same gun.

The objects of the invention are attained by providing a composite perforating projectile which comprises essentially an inner core of hard and relatively heavy metal such as, for example, hardened steel and an outer sheath preferably formed of a light and somewhat friable material such as, for example, an aluminum alloy. The projectile is so constructed that the soft outer sheath is torn away from the core as soon as it is discharged from the gun, and only the hard steel core pierces the metallic bore hole casing. It is also proposed to design the outer sheath so as to facilitate its removal from the hard core when discharged from the gun, as is described in greater detail below.

It will be readily seen that the improved projectile construction of this invention enables a much greater impelling force to be achieved for any given projectile diameter than has been heretofore possible, because the impelling gases produced by the combustion of the powder are directed against the rear surface of the outer sheath, which is considerably larger than the rear surface of the perforating core itself. Moreover, inasmuch as the total weight of the core and the sheath is less than the weight of a homogenous steel perforating bullet having the same caliber as the sheath, the initial speed developed by the perforating core itself is greater than the initial speed of a homogenous steel bullet of same dimensions. In addition, the principal section of the core is considerably less than that of the outer sheath, so that the friction and resistance to its advance, after being separated from the sheath, both in the fluid in the hole and in the casing itself, are much less.

Other features of the invention will appear from the following detailed description of several embodiments taken in connection with the accompanying drawings in which;

Figure 1 is a vertical section of a perforating projectile constructed in accordance with the invention, shown in firing position in a gun prior to discharge therefrom;

Figure 2 is also a view in vertical section of the projectile shown in Figure 1 just after discharge from the gun, illustrating the manner in which the outer sheath is torn away from the inner core;

Figure 3 is a view in perspective of one form of sheath which has been slitted in order to facilitate its removal from the core when the projectile is discharged from the gun;

Figures 4, 5, 6, and 7 illustrate further embodiments of projectiles constructed in accordance with the present invention.

Referring to Figure 1, a bore hole is shown at 10 which is provided with a metallic casing 11, and which contains the fluid 12. Within the bore hole 10 is a gun 13 of a well known type, for discharging projectiles for perforating the metallic casing 11. The gun 13, together with the associated equipment for raising it and lowering it within the bore hole and for igniting the powder, etc., are well known in the art, and need not be illustrated or described in detail here.

Located in firing position within the barrel 14 of the gun 13 is a projectile 15 constructed in accordance with the present invention. The pro-

jectile 15 comprises a cylindrical sheath 16 made of a light material within which is a perforating core 17. The material composing the outer sheath should have a strength sufficient to resist any shearing action at the firing moment. However, it should be soft enough to become separated from the perforating core 17 when ejected from the barrel. Light, non-malleable materials such as aluminum alloys or bakelite may be advantageously used.

The outer sheath 16 may be made in any desired form, although preferably it should not extend over the conical point 18 of the perforating core 17. It has been found that the removal of the sheath 16 by the resistance developed in its passage through the bore hole fluid is aided somewhat if its front edge is shaped so as to make a sharp angle with the surface of the forward portion of the perforating core 17, as shown in the drawings.

In order to prevent the fluid contained within the bore hole from entering into the powder chamber 19 of the gun 13 when the latter is lowered within the bore hole, paeking 28 may be inserted in a circular slot 21 formed about the periphery of the outer sheath 16. In some cases, the outer sheath 16, being of relatively soft material, if closely fitted within the bore 14 of the gun 13, will prevent seepage of water or mud into the powder chamber 19 from the bore hole 10 without the necessity for any packing.

When the powder in the powder chamber 19 is ignited in the conventional manner, the combustion gases directed against the rear face of the outer sheath 16 impart to the entire projectile construction an impelling force of considerable magnitude which, because of the comparative lightness of the entire assembly, gives to the projectile a considerable initial velocity. Upon leaving the bore 14 of the gun 13, the projectile 15 passes through the bore hole fluid 12, and a very high resistance to its movement is developed, which tears the outer sheath 16 away from the inner core 17. Experience indicates that the sheath is usually completely torn off before the core has passed through the fluid between the gun 13 and the metallic casing 11 within the bore hole 10. The projectile core 17 thereupon becomes separated from the outer sheath 16 and is projected against the metallic casing 11 within the bore hole 10. At the same time, the forward motion of the fluid and of the outer sheath around the projectile core exercises on the part of the casing opposite it an important pressure which puts this section of casing under strain. This action will result in a very clean hole as the metal constituting the casing has less tendency to splash.

In order to facilitate the removal of the outer sheath 16 from the inner core 17, the sheath 16 may be weakened mechanically as, for example, by forming a plurality of longitudinal slits 21' therein, as shown in Figure 3. The outer sheath 16 may be designed in a wide variety of forms in order to facilitate its removal from the inner core 17, which forms will be apparent to one skilled in the art, and it is to be understood that all such modifications are to be comprehended within the scope of the present invention.

If desired, the rear portion of the projectile core 17 may be threaded at 22, the outer sheath 16 being correspondingly threaded to hold the core 17 securely within it, as shown in Figure 4. In this case the rear face of the outer sheath 16 may be dispensed with.

It will be noted that the projectile construction of the present invention enables the core 17 to be made of any desired shape. For example, its rear portion may be made conical as shown in Figures 5 and 6, or spindle shaped as shown in Figure 7, or any other shape designed to facilitate its penetration through the steel casing 11 or to reduce resistance to its movement.

In addition, the core 17 may be made of any diameter up to the diameter of the sheath 16. Thus the diameter of the core 17 in the embodiment shown in Figure 5 is less than that of the core 17 shown in Figure 6. It will be apparent therefore, that the projectile construction of the invention enables perforating projectiles of different diameter to be discharged from the same gun.

Due to the power necessary to perforate the steel casing, the gun cannot be built smaller than a certain diameter, and it frequently happens that the space between the gun and the casing is therefore small. Under such conditions, there is the possibility that a bullet improperly fired may not have the sufficient impelling force to entirely leave the barrel and penetrate the casing. In using a projectile which has an outer sheath of relatively soft material, it is possible to easily release the gun by a traction on the cable supporting it, without danger of breaking the cable. The effort required to loosen the projectile from the barrel will be relatively small, the outer sheath being easily removable from the steel core.

From the foregoing it will be apparent that the projectile construction of the present invention enables metallic bore hole casings to be perforated more readily and efficiently than has been heretofore possible. By providing a composite projectile it is possible to achieve a much greater impelling force than could be obtained with a solid projectile. Hence the holes perforated in the casing are cleaner, and the depth of penetration is increased. Moreover, by the use of an outer sheath of the same diameter as the diameter of the gun barrel used in its discharge, it is possible to use one gun for discharging projectiles of a wide variety of sizes up to the diameter of the gun barrel itself.

In the above description, aluminum alloys and Bakelite have been suggested as materials from which the sheath 16 might be made. It is to be understood that these materials are given merely by way of example, and the invention is not to be limited in any way thereby. Many other materials will suggest themselves to those skilled in the art, which will have the requisite strength to resist any shearing action at the firing moment, and yet which will be soft enough to become detached from the perforating core when the projectile is ejected from the gun, and it is intended that all such materials be included within the scope of the invention.

The specific embodiments described above have been given merely by way of example and the invention is not intended to be in any way limited thereby but is susceptible of numerous changes in form and detail within the scope of the appended claims.

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