May 31, 1932. R. A. HADFIELD ET AL 1,861,054

ARMOR PIERCING PROJECTILE

Filed Jan. 19, 1931

Fig. 1.

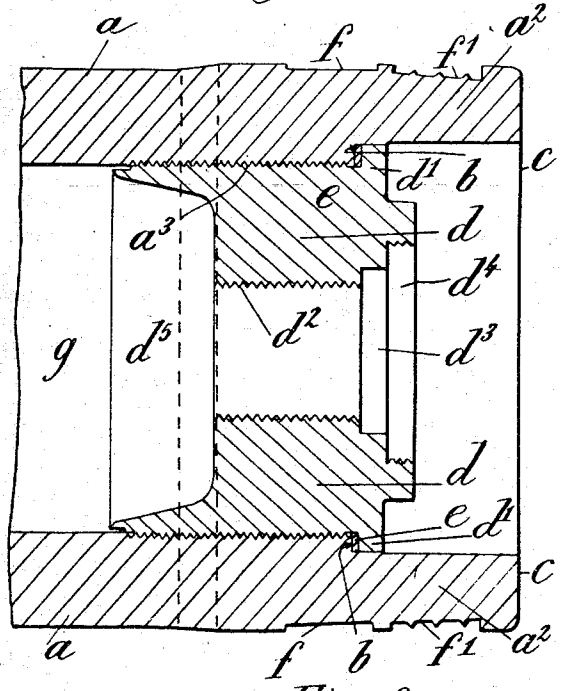


Fig. 2.

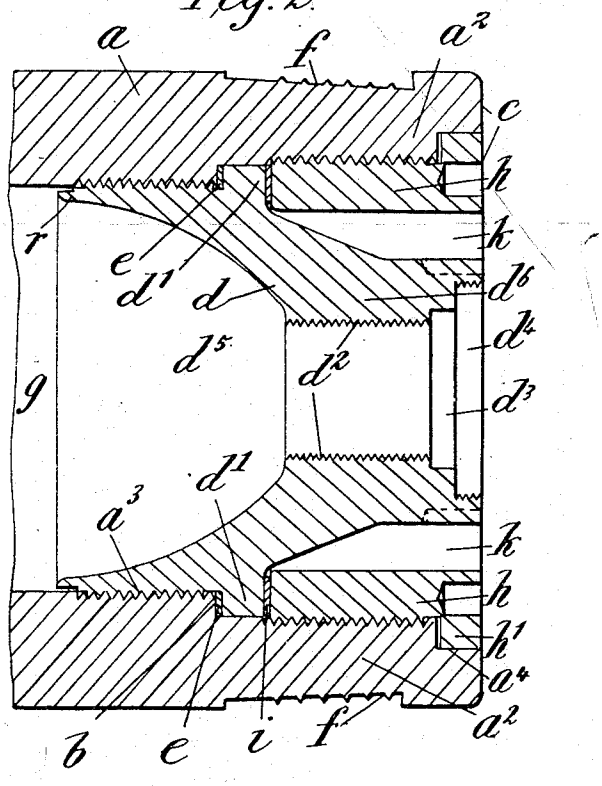


Fig. 3.

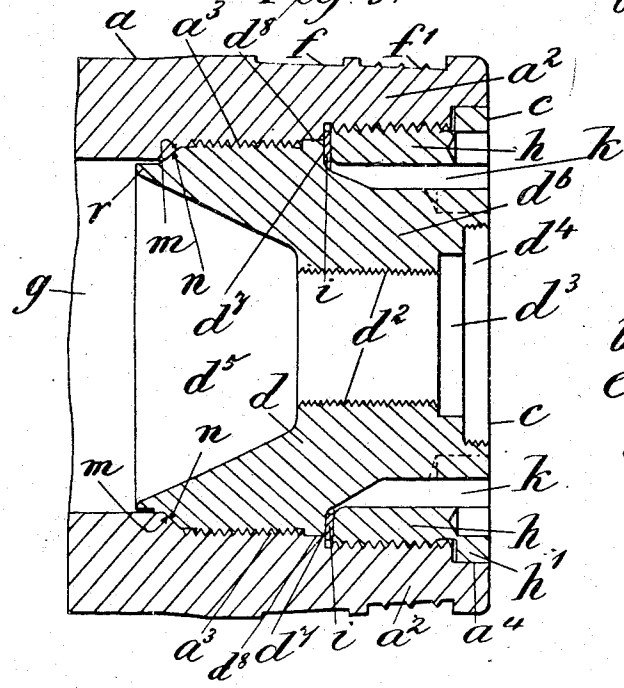
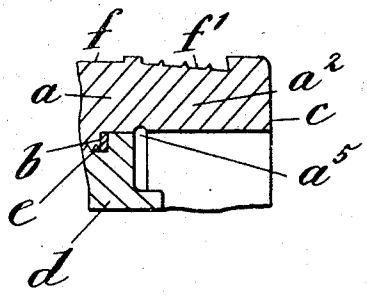


Fig. 4.



INVENTORS
ROBERT A. HADFIELD
AUGUSTUS B. H. CLERKE

BY J. Rose Williams.
ATTORNEY

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UNITED STATES PATENT OFFICE

ROBERT ABBOTT HADFIELD, OF WESTMINSTER, AND AUGUSTUS BASIL HOLT CLERKE, OF SHEFFIELD, ENGLAND

ARMOR PIERCING PROJECTILE

Application filed January 19, 1931, Serial No. 509,654, and in Great Britain January 22, 1930.

As is well known, when an armor piercing projectile is passing through a relatively thick hard faced armor plate, particularly when striking obliquely at a high angle, corresponding to long range fire, the base portion of the projectile is subjected to considerable lateral pressure which sometimes fractures it in such a way that the fracture extends through the wall of the projectile to the charge chamber with the result that the subsequent detonation of the explosive charge within the chamber produces very little destructive effect.

Various means have heretofore been proposed and adopted for avoiding this serious disadvantage but none of them have proved entirely satisfactory and reliable at all times and under various conditions of attack of a hard faced armor plate.

The present invention has for its object so to construct an armor piercing projectile and its base plug, hereinafter referred to as the adapter, that if the base end portion of the projectile should be fractured or broken off under the circumstances mentioned, the line of fracture or cleavage shall not extend to the charge chamber within the projectile and interfere with the subsequent proper detonation and effective bursting action of the charge within the chamber.

For this purpose, the invention consists broadly in securing the adapter, in a gas tight manner, in a forward position within a portion of the wall of the projectile that is substantially in advance of the rear end face of the projectile so as to leave a hollow base end portion of the projectile unsupported directly from within by the adapter. By this means, should the base end portion of the projectile which is subjected to the greatest lateral pressure when passing through a relatively thick hard faced armor plate, be fractured or broken off, the line of fracture or cleavage will be more or less behind the part of the wall of the projectile in which the adapter is secured, and therefore will not be liable to extend to the charge chamber within the projectile and adversely affect the subsequent detonation and bursting effect of the explosive charge within that chamber. Furthermore, as the adapter does not directly support the hollow base portion of the projectile from within, it will not adversely be affected, should such hollow base portion of the projectile be bent inwardly, instead of being fractured or broken off, by external lateral pressure thereon.

With a view to localizing the position of any fracture or cleavage of the wall of the projectile that may take place when the projectile is passing through a hard faced armor plate, to a position at or near the rear end of the portion of the wall of the projectile in which the adapter is secured, and in the region of the driving band groove, or forward driving band groove, if two grooves be used, the hollow vase end portion of the projectile not directly supported from within by the adapter, may be made to offer less resistance to lateral inward pressure than the said portion of the wall of the projectile in which the adapter is secured. For this purpose, the said hollow base end portion of the wall of the projectile may be made thinner than the portion of the wall in which the adapter is secured; or an internal annular groove may be formed in the said hollow base end portion of the wall of the projectile in the region of the said rear end portion of the wall of the projectile in which the adapter is secured; or both of such devices may be used.

According to one construction, the base end portion of an armor piercing projectile is bored out to a greater diameter than that of the charge chamber and to such an axial length, as to form an annular seat or shoulder the surface of which is in or adjacent to a plane that is transverse to the axis of the projectile and passes through the wall of the projectile in the region of the driving band groove therein, or of the forward groove, if two are used, that is to say, at a part of the base end portion of the projectile that is in front of or adjacent to the part thereof where fracture is most liable to occur under the circumstances hereinbefore explained. The adapter is screwed into the wall of the charge chamber in advance of the said annular seat or shoulder, and may be provided at the rear end with an annular flange or collar that is

caused to bear tightly against the seat or shoulder so as, with the aid of an interposed packing ring or washer, to make a gas tight joint therewith.

By the construction described, should the hollow base end portion of the projectile become fractured or broken off, for the reason above mentioned, the line of fracture or cleavage will be behind the said annular seat or shoulder and thus be sufficiently far removed from the charge chamber as not to affect the subsequent effective detonation of the charge therein.

According to a modification, the gas tight joint between the adapter and projectile may be made between the forward end portion of the adapter and an annular seat formed within the charge chamber.

Into the hollow base end portion of the projectile, is or may be screwed a metal bush that serves to support the hollow rear end portion of the projectile and enable it to withstand the gas pressure set up behind the projectile by the explosion of the firing charge used to eject the projectile from a gun, but which will not offer sufficient internal support to the said hollow rear end portion of the projectile as to prevent fracture or inward bending thereof by external pressure. For this purpose, the bush may be made of a relatively brittle material. The front end of the metal bush may be caused to bear tightly against the rear side of an annular surface on the adapter, for instance that of the aforesaid flange on the adapter, and form, with the aid of another packing ring or washer, a gas tight joint therewith, and thus assist in securely closing the rear end of the charge chamber in a gas tight manner. The rear end of the bush may be provided with an external flange arranged to extend into an annular recess in the base end of the projectile.

The forward end portion of the adapter is recessed to such an extent that the normal capacity of the charge chamber, of which the recessed portion of the adapter forms part, will not be unduly reduced by reason of the advanced position of the adapter within the projectile.

In order to admit of the recess or cavity in the forward portion of the adapter being made of such capacity that the ordinary capacity of the charge chamber shall not be reduced, or very little reduced, by reason of the forward position of the adapter in the projectile, the adapter may be provided with a central rearward extension to accommodate the fuse, or part thereof, which is screwed into it. By this construction the recess in the forward end portion of the adapter can be made of greater axial length than it could be made if the adapter be not provided with a rear extension. The said recess may be made of more or less truncated conical, ogival or other desired shape. The rearward extension of the adapter, which may extend to the rear face of the projectile, is made of an external diameter substantially less than the internal diameter if the aforesaid hollow base end portion of the projectile, or of the metal bush screwed therein, if such a bush be used.

The dimensions and arrangement of the parts of the base end portion of an armor piercing projectile and its adapter, embodying the invention, can be varied to suit requirement.

In the accompanying illustrative drawings, Figs. 1, 2 and 3 show, in longitudinal section, three different constructions of the rear end portion of an eight inch armor piercing projectile with an adapter constructed and arranged according to the invention. Fig. 4 is a sectional detail view.

In the example shown in Fig. 1, the rear end portion of the wall of the projectile a is bored out so as to form an annular seat b situated at a substantial distance, for instance about two to three inches in the case of an eight inch projectile, from the rear end face c of the projectile. d is an adapter screwed into the wall of the projectile in advance of the seat b and formed with an annular flange d^1 adapted, by the aid of a packing ring e, to make a gas tight joint with the seat b and leave a hollow rear end portion a^2 of the wall of the projectile unsupported from within by the adapter. In this example, the projectile a is formed with two driving band grooves f, f^1 and the annular seat b is situated in a transverse plane that transverses the wall of the projectile at a part thereof behind the front end of the forward groove f and in front of the forward end of the rearward groove f^1. If the projectile be formed with a single driving band groove, the said transverse plane would transverse the wall of the projectile between the front and rear ends of the groove. The adapter is bored out and screw threaded at d^2, and formed with an annular recess at d^3, to receive the usual fuse, and recessed and screw threaded at d^4 to receive a rear cover plate as usual. The front end of the adapter is formed with a recess d^5 of such capacity that the normal capacity of the charge chamber g formed partly within the projectile and partly by the said recess, will not be unduly reduced by reason of the advanced position of the adapter within the projectile. As will be seen, by the construction described, the hollow base end portion a^2 of the projectile is thinner than the portion of the projectile into which the adapter is screwed and is thus weaker than the latter portion, and is not supported from within by the adapter.

In the example shown in Fig. 2, the adapter d is shown provided with a rearward extension d^6 which is bored out centrally and screw threaded at d^2 to accommodate the fuse used

with the adapter, the fuse extending through the adapter to the rear end of the recess d^5 in the front end thereof. The flanged rear end of the fuse is secured in an annular recess d^3 formed in the rear end of the rearward extension d^6 and is protected, when in place, by a cover plate screwed in position in another annular recess d^4 in the rearward extension. The rearward extension is, in the example shown, made partly of conical shape and partly of cylindrical shape externally. The rear face of the rearward extension d^6 may, as shown, be flush with the rear face c of the projectile. The axial length of the adapter with its rearward extension, may be of the order of 5 to 6 inches, and the recess d^5 may have an axial length of about 3¼ inches and be made of part ogival shape, as shown, so as to form a large rearward extension of the charge chamber g. The annular seat b for the flange d^1 of the adapter d is, in this example, shown at a greater distance from the rear face c of the projectile than it is in Fig. 1, so that the said flange, as viewed transversely, is opposite the front end portion of a single driving band groove f. In this example, the distance between the seat b and rear face c is about three and three quarter inches. This example also shows the hollow base end portion a^2 of the projectile screw threaded internally and fitted with a metal bush h of the kind and for the purpose hereinbefore described, the front end of the bush being caused to bear tightly against the flange d^1 of the adapter, and form, by the aid of a packing ring i, a gas tight joint therewith. The external diameter of the rearward extension d^6 and the internal diameter of the metal bush h is such as to form an annular space k between them. This space is of such radial width, for instance about 0.6 to 0.7 inches, that the rearward extension d^6 of the adapter will not be likely to be affected by any inward bending of the hollow base end portion a^2 of the projectile and bush h, that might take place under the action of external pressure.

In the modified construction shown in Fig. 3, the base end portion of the armor piercing projectile a is bored out to a greater diameter than that of the charge chamber g, so as to form between the charge chamber and the bored out portion a^3, an annular shoulder or seat m that is located well in front of the driving band groove f, or of the forward driving band groove, if more than one groove be used, as shown, and the bored out portion a^3 of larger diameter is, at least for a portion of its length, screw threaded, as shown, to receive the externally screw threaded adapter d the front end of which is formed with an annular bearing surface n shaped to bear tightly against the said annular shoulder or seat m when the adapter is screwed finally into position for use, so as to form therewith, it may be by the aid of an interposed packing ring, a gas tight joint. The surface of the annular shoulder or seat m may be of conical, convex or concave shape, in longitudinal section, or it may be flat and arranged in a plane transverse to the axis of the projectile, the forward annular bearing portion n of the adapter being shaped to suit. In the example, the seat m and the forward bearing surface n, are shown as of conical shape. The adapter may be formed with a plain forward portion r arranged to extend a short distance into the rear end of the charge chamber g and fit the same for part, as shown, or the whole, of its length. Or the forward portion r of the adapter may terminate at or near the said annular shoulder or seat m and thereby enable the capacity of the recess d^5 in the adapter to be increased in order further to minimize the reduction in the capacity of the charge chamber g by reason of the forward position of the adapter.

The adapter d is provided at the rear of its screw threaded portion with an annular or circular seat d^7 against which may be caused to bear the forward end of an externally screw threaded metal bush h screwed into the hollow base end portion a^2 of the bored out rear end of the projectile so as to form therewith, it may be by the aid of an interposed packing ring i, a gas tight joint, as in the construction of the base end portion of the projectile hereinbefore described with reference to Fig. 2. In this case, the rear end portion of the base of the projectile is bored out to two different diameters, the forward one, of less diameter to receive the adapter d, and the rearward one to receive the metal bush h. The said annular or circular seat d^7 may, as shown, be flat, and be arranged in a plane transverse to the axis of the projectile and passing through the driving band groove, or the forward driving band groove f, if two grooves f, f^1 be used, as in the example shown. The said annular or circular seat d^7 may however be of conical or other desired shape if desired. The rear end of the forward portion of the adapter d is not in this case provided with an annular flange extending outward beyond the screw threaded portion a^3 of the adapter, but is preferably provided, as shown, with a short plain annular portion d^8 of about the same diameter as the outer diameter of the screw thread at a^3. The arrangement is such as to admit of the adapter being screwed forward, without restraint, tightly against the forward annular shoulder or seat m at the rear of the charge chamber g. The rear end of the metal bush h may be formed, as in the example shown in Fig. 2, with an annular flange h^1 extending into a corresponding recess a^4 in the extreme end portion of the projectile. The adapter d is shown provided with a rearward extension d^6, as and for the purpose hereinbefore described.

The hollow rear end portion a^2 of the pro-

jectile may, in each case, and as shown in Fig. 4, be provided with an annular groove a^4, adjacent to the seat b, or equivalent part of the projectile a, for the purpose hereinbefore mentioned.

As will be seen, the complete adapter d, d^1 shown in Fig. 2, is secured in position in a gas tight manner within the projectile at a part of its length more or less midway of its length, and, in Fig. 3, both at a part more or less midway of its length and also at its front end, instead of being secured, in a gas tight manner, at its rear end to the rear end of the projectile, as in armor piercing projectiles as heretofore constructed.

A metal bush h such as shown in Figs. 2 and 3, may also advantageously be used in the construction of projectile and adapter shown in Fig. 1 for the purposes described.

What we claim is:—

1. An armor piercing projectile the rear end portion of the wall of which is bored out to different diameters and has an annular shoulder arranged between the adjacent ends of the bored out portions and at a substantial distance from the rear end face of said projectile, an adapter screwed into the forward bored out portion of said wall and out of contact with the rearward bored out portion of said wall and means for effecting a gas tight joint between the rear end of the screw threaded portion of said adapter and said shoulder.

2. An armor piercing projectile having an adapter secured within a portion of the projectile substantially in advance of the rear end face of the projectile and in advance of the position of the rear end of the driving band groove usually provided in the projectile so as to leave a weakened hollow base end portion of the projectile unsupported directly from within by the adapter.

3. An armor piercing projectile having its adapter screwed within a portion of the projectile that is substantially in advance of the rear end face of the projectile and in advance of the position of the rear end of the driving band groove usually provided in the projectile so as to leave a weakened hollow base end portion of the projectile unsupported directly from within by the adapter, one end of the screw threaded portion of the adapter being arranged to form a gas tight joint with the projectile.

4. An armor piercing projectile according to claim 2 wherein the front end of the adapter is recessed to such an extent that the normal capacity of the charge chamber within the projectile is not reduced or unduly reduced by reason of the forward position of the adapter within the projectile.

5. An armor piercing projectile according to claim 2, wherein the rear end of the portion of the projectile in which the adapter is directly secured, is in or adjacent to a transverse plane passing through the wall of the projectile at a part in the region of the driving band groove or grooves formed therein.

6. An armor piercing projectile according to claim 2, wherein the hollow base end portion of the projectile is adapted to offer less resistance to lateral inward pressure than the portion of the wall of the projectile in which the adapter is directly secured.

7. An armor piercing projectile, the base end portion of which is bored out to form an annular face substantially in advance of the rear end face of the projectile and in advance of the position of the rear end of the driving band groove usually provided in the projectile and is internally screw threaded in advance of the said face, and an adapter secured in the screw threaded portion of the projectile and out of contact with the hollow rear end portion of the projectile behind said annular face, said adapter being arranged to make a gas tight joint with the projectile.

8. An armor piercing projectile the base end portion of which is formed with co-axial forward and rearward bores having between them an annular seat arranged at a substantial distance from the rear end face of the projectile, and an adapter secured in a gas-tight manner in the forward and smaller bore, the inner surface of the rearward bore extending continuously from said seat to the said rear end face of the projectile and being out of contact with said adapter whereby the rearward hollow portion of the projectile behind said seat is unsupported from within by said adapter.

9. An armor piercing projectile the base end portion of which is formed with co-axial forward and rearward bores having between them an annular seat arranged at a substantial distance from the rear end face of the projectile, and an adapter secured in the forward and smaller bore and having a flange adapted to form a gas-tight joint with said seat, the inner surface of the rearward bore extending continuously from said seat to said rear end face of the projectile and being out of contact with said adapter whereby the rear hollow portion of the projectile is unsupported from within by said adapter.

10. An armor piercing projectile the base end portion of which is bored out to different diameters and has an annular seat arranged at a substantial distance from the rear end face of the projectile and at the rear end of the forward bore, and an adapter the forward end portion of which is secured in a gas tight manner in the forward bore and the rear end portion of which is located within the rearward bore but spaced a distance from the inner surface thereof, whereby the hollow rearward portion of the projectile surrounding the rearward portion of the adapter is unsupported from within by the latter.

11. An armor piercing projectile the base end portion of which is bored out to different diameters and has an annular seat located at a substantial distance from the rear end face of the projectile and at the rear end of the forward and smaller bore, an adapter secured in the forward and smaller bore and having behind the portion thereof secured in said forward and smaller bore, a circular face and a bush, adapted to function as set forth, secured in the rearward bored out portion of the projectile and adapted to form a gas tight joint with the said circular face on the adapter, but unsupported from within by said adapter.

12. An armor piercing projectile having an adapter the forward end portion of which is secured in a gas-tight manner within a portion of the projectile substantially in advance of the rear end face of the projectile and in advance of the position of the rear end of the driving band groove usually provided in the projectile so as to leave a hollow base end portion of the projectile unsupported directly from within by the said forward portion of the adapter, the rear end portion of the adapter being located within but spaced at a distance from the said hollow base end portion of the projectile.

13. An armor piercing projectile according to claim 12, wherein the adapter is provided with an annular shoulder or seat arranged to form a gas-tight joint with an annular shoulder or seat formed in the wall of the projectile in advance of the position of the rear end of the driving band groove usually provided in the projectile.

14. An armor piercing projectile according to claim 12, wherein the adapter is provided with an annular shoulder or seat arranged to form a gas-tight joint with an annular shoulder or seat formed in the wall of the projectile, and the rear end of the said forward portion of the adapter is formed with an annular face that is in a transverse plane passing through the wall of the projectile in the region of the driving band groove or grooves therein.

15. An armor piercing projectile according to claim 2, wherein the hollow base end portion of the projectile is grooved internally at or near its forward end for the purpose set forth.

16. An armor piercing projectile according to claim 2, wherein the hollow base end portion of the projectile is provided with a metal bush adapted to function as described, and unsupported from within by the adapter.

17. An armor piercing projectile according to claim 2, wherein the adapter is provided with an annular shoulder or seat arranged to form a gas-tight joint with an annular shoulder or seat formed in the wall of the projectile, and a metal bush, adapted to function as described, secured within the hollow base end portion of the projectile and unsupported from within by the adapter, the front end of the bush being arranged to form a gas tight joint with an annular face on the adapter.

18. An armor piercing projectile the rear end portion of which is bored out to a greater diameter than that of the charge chamber within the projectile, an adapter the forward portion of which is secured in a gas tight manner within the projectile in advance of the said bored out portion and is recessed on its front side to form an extension of the charge chamber, and the rearward portion of which is located within the said bored out portion of the projectile and is adapted to carry a fuse, and a bush secured in the hollow rear end portion of the projectile and adapted to function as set forth, said bush being arranged to form a gas tight joint with an annular seat on the rear end of the said forward portion of the adapter but being out of contact with the rearward portion of the adapter extending within it.

19. An armor piercing projectile according to claim 18, wherein the rearward portion of the adapter is partly of conical and partly of cylindrical shape externally and forms an annular space with said bush.

20. An armor piercing projectile having its base end portion bored out to a larger diameter than the charge chamber within the projectile so as to form between the two an annular seat located substantially in advance of the rear end face of the projectile, an adapter having a centrally recessed forward portion screwed into the rear end of the charge chamber in advance of said seat, a rearward portion located within the said bored out portion of said projectile and adapted to carry a fuse, and an annular flange intermediate of its length and arranged to form a gas tight joint with said annular seat, and a metal bush, adapted to function as set forth, arranged to form a gas tight joint with said flange and between which and the rearward portion of the adapter there is an annular space.

21. An armor piercing projectile according to claim 20, wherein the rearward portion of the adapter gradually decreases in diameter from the flange for a portion of its length and the remainder is of cylindrical shape.

Signed at London, England, this fifteenth day of December, 1930.

ROBERT ABBOTT HADFIELD.
AUGUSTUS BASIL HOLT CLERKE.