Nov. 14, 1944. A. L. YARBROUGH 2,362,738

CARTRIDGE

Filed Feb. 10, 1941

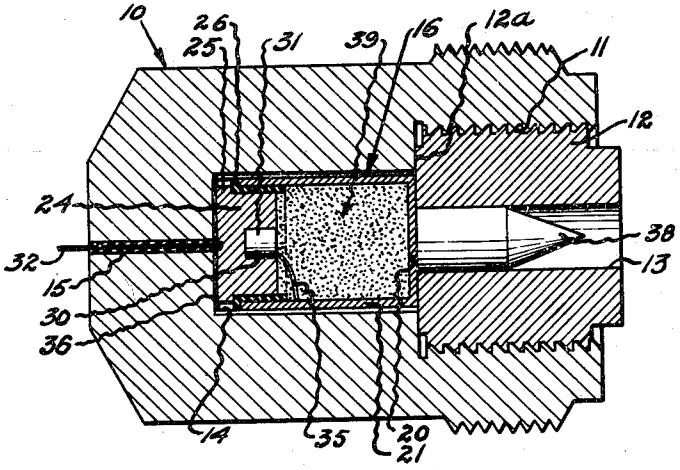


Fig. 1.

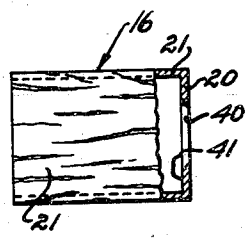


Fig. 1a.

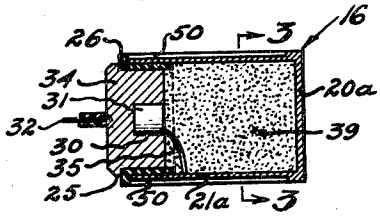


Fig. 2.

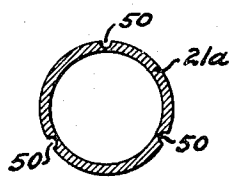


Fig. 3.

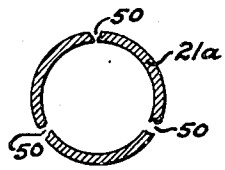


Fig. 3a.

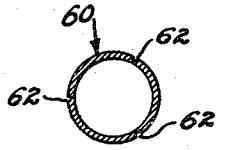


Fig. 6.

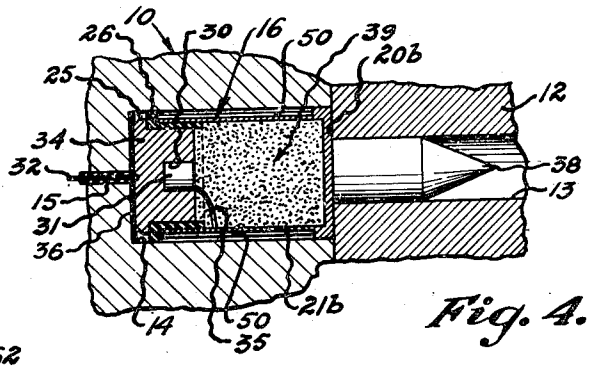


Fig. 4.

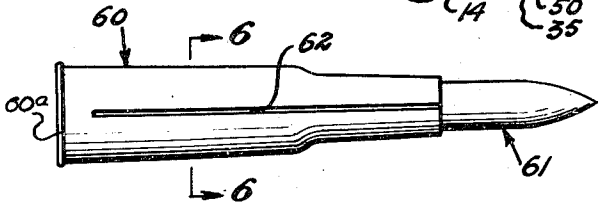


Fig. 5.

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Application February 10, 1941, Serial No 378,255

13 Claims. (Cl. 164—0.5)

This invention relates generally to cartridges, and particularly to cartridges employing a comparatively large powder charge and which develop relatively high explosive pressure, such as casing perforating gun cartridges, or cartridges for high velocity or large rifles.

It is common practice in the casing perforating gun art to provide a cardboard or paper container or cartridge for the powder charge. Such a cartridge, however, is no more than a mere container, and has no inherent strength such as would enable it to withstand the high hydrostatic fluid pressures existing deep in a well. Accordingly, the openings of the gun which lead to the chamber containing such a cartridge must be provided with fluid tight seals. This is a disadvantage and attempts have been made to provide a practical cartridge with metal walls of sufficient strength and rigidity to withstand the high fluid pressures in the casing. A cartridge of this kind would also have the advantage of protecting the cartridge chamber from burning by the powder. However, these efforts have met with failure, owing to the fact that the explosive pressure developed in the cartridge is extremely high, and the result of the explosion is to expand the metal side walls of the cartridge very tightly against the chamber wall, in fact to more or less embed them into the chamber surface. The result is that the task of extracting the cartridge following firing is exceedingly difficult.

A similar situation exists with relatively high velocity or large caliber rifle cartridges. Large caliber machine guns, for instance, are frequently stopped by the sticking of an expanded cartridge in the breech.

The general object of the present invention is accordingly to provide a rigid or metal cartridge of such a nature as to be incapable of becoming expansively bound in the cartridge chamber.

In accordance with the invention there is provided a cartridge having a rigid but frangible side wall, which will be shattered or mutilated by the explosion pressure in such a way as will prevent binding within the chamber. The term frangible as herein defined denotes capability for being completely shattered, or shattered or ruptured in part, or so deformed, mutilated or weakened as to be incapable of becoming bound within the firing chamber. For the purpose of a cartridge for a casing perforating gun, the walls are preferably made of sufficient strength to withstand the extreme hydrostatic fluid pressures existent deep down in well casing, though of course the present invention is not necessarily limited in application to situations in which the cartridge is actually subjected to external fluid pressure. And in the specific field of casing perforating guns, the cartridge of the present invention is of advantage even if the pressure fluid be independently sealed out, in that it greatly protects the cartridge chamber against burning by the direct effects of the explosion, while at the same time the easy removability of the cartridge following firing is assured. In the case of a cartridge for a rifle, there is of course no high hydrostatic fluid pressure to contend with, and the walls of the cartridge hence need not have the same thickness and inherent strength as in the casing perforating gun cartridge.

The invention will be best understood from the following detailed description of certain selected illustrative embodiments thereof, reference for this purpose being had to the accompanying drawing, in which:

Fig. 1 is a longitudinal medial section of an illustrative cartridge in accordance with the invention mounted in a conventional type of casing perforating gun barrel;

Fig. 1*a* shows the cartridge of Fig. 1 after firing;

Fig. 2 is a longitudinal medial section through a modified form of cartridge in accordance with the invention;

Fig. 3 is a transverse section on line 3—3 of Fig. 2;

Fig. 3*a* is a view similar to Fig. 3, but showing the results of discharging the cartridge;

Fig. 4 is a view similar to Fig. 2 but showing another modification;

Fig. 5 is an elevation of a cartridge in accordance with the invention designed for a rifle, machine gun or the like; and

Fig. 6 is a section taken on line 6—6 of Fig. 5.

In Fig. 1 numeral 10 designates generally a chamber block of conventional type for a perforating gun, formed in one end with an internally screwthreaded socket 11 into which is threaded a barrel 12 containing a shooting bore 13, the barrel 12 being set up against the shoulder at 12*a*. In back of socket 11 is a cylindrical cartridge chamber 14, of a diameter less than the diameter of socket 11, but greater than that of bore 13. A drill hole 15 extends from the bottom of chamber 14 out through the end of the chamber block 10, and is designed to receive an electrical conductor through which the fuse contained in the cartridge is fired. The construction as so far described will be understood to be conventional in perforating guns and to form

no part of the present invention. Any other suitable barrel and chamber structure may be utilized.

An illustrative form of cartridge in accordance with the present invention comprises a cartridge shell designated generally at 16 in Fig. 1, being shown as positioned in the cartridge chamber 14 of chamber block 10, as illustrated. In the illustrative form of Fig. 1, the cartridge shell comprises a front end wall or head 20 and an integrally formed cylindrical side wall or skirt 21, made up of some suitable frangible material, such for instance as cast iron, adapted to be shattered or cracked by the force of the explosion occurring inside the cartridge shell. Head 20 and skirt 21 are of sufficient thickness to withstand comparatively high external hydrostatic fluid pressure, so that if sealing means between the barrel and chamber block are not provided, the cartridge will not be subject to crushing. That is to say, the cylindrical shell made up of head 20 and side walls 21 is a rigid member, not subject to crushing in the event of exposure to the external hydrostatic fluid pressure, either in the event of leakage past any fluid sealing means that may be provided, or in the event of non-provision of fluid sealing means. In this sense the shell is to be distinguished from an ordinary easily deformable paper, cardboard or fibre shell such as has heretofore been in common use, but which is entirely incapable of withstanding external hydrostatic fluid pressure.

Various types of rear end closures for the cartridge may be provided. I here illustrate one suitable form of rear end closure comprising a plug 24 having a cylindrical portion adapted to fit within the cartridge shell 16 and a flange 25. Interposed between the plug 24 and the skirt 21 of the cartridge shell 16, and between the flange 25 and the extremities of said skirt 21, is a sealing and insulating washer or gasket 26 which both electrically separates the plug 24 and cartridge shell 16 and forms a fluid-tight seal. The flange 25 is smaller than the diameter of the socket or chamber 14, as well as the outside diameter of the cartridge shell 16, so that when centered in the chamber 14 by the cartridge shell its periphery is not in electrical contact with the side walls of the chamber. Plug 24 is here shown as provided with an axial socket 30 adapted to receive an electrically fired fuse 31. An electrical conductor 32 soldered to plug 24 and passing out through the rearward end of block 10 via passageway 15 conducts current to the insulated plug, the current passing through the plug to the fuse. This fuse may typically and preferably be of a "match-head" type, such as manufactured by the Atlas Powder Company, and projects a flame from its forward end when heated by passage of an electrical current. Such fuses are known and will require no detailed description herein. As stated, the fuse is provided with one electrical connection consisting of the above mentioned conductor 32. The circuit is completed to ground via a second conductor 35 which may be grounded to the inside of side wall 21. While shell 16 contacts blocks 10, plug 24 is maintained out of electrical contact therewith by the provision of an insulation washer 36 at the inner end of chamber 14 as well as the space afforded between the flange 25 and the side walls of the chamber 14.

A usual projectile 38 is positioned in bore 13 in contact with cartridge head 20. Projectile 38 may be fastened to or integral with cartridge head 20, or it may simply be positioned against it. The cartridge contains the usual charge of explosive, as indicated at 39.

To fire the cartridge, an electrical current is passed through conductor 32 to fuse 31, which ignites and burns the powder charge. The explosive pressure generated by the burning powder charge builds up until it becomes sufficient to rupture the head end 20 of the cartridge. When rupturing pressure is reached, a plug is sheared out of head 20 and the plug and projectile 38 are propelled from the shooting bore. The force of the explosion cracks, fractures or shatters the cylindrical wall 21 of the cartridge, and places it in such a condition that it can be readily extracted from chamber 14. To promote fracture by expansion and subsequent looseness the cartridge originally may have a slight looseness of cylindric fit in the chamber. Fig. 1*a* shows the condition of the cartridge after firing, a hole 40, of approximately the diameter of shooting bore 13, having been punched in its forward end, and the wall 21 being cracked from end to end. The fractured cartridge is loose inside chamber 14, and it is only necessary to remove barrel 12 and then to engage the cartridge underneath the shoulder left at 41 with any suitable hooked tool in order to draw it forth.

Figs. 2, 3 and 3*a* show a modification, in which the frangibility characteristics of the cartridge result from the provision of a series of scores, preferably running longitudinally of the cartridge. The cartridge again comprises, preferably, a head and integral cylindrical side wall, designated in this instance by numerals 20*a* and 21*a*, respectively, and a rear end closure plug 34, the latter being typically the same as described in connection with Fig. 1. Head 20*a* and side wall 21*a* may in this instance be made up typically of steel, and side wall 21*a* is provided with a plurality of longitudinally extending grooves 50 sunk in its outer surface. Insofar as frangibility characteristics are concerned, these longitudinal grooves 50 may or may not extend the full length of the cartridge, though they are here shown terminating somewhat short of the head end of the cartridge. Head 20*a* is again of course of such a thickness dimension as will permit rupturing upon development of the desired explosive force inside the cartridge. As this explosion occurs, the metal between the bottoms of the grooves 50 and the inside peripheral surface of wall 21*a* is ruptured, as indicated in Fig. 3*a*. The explosive gases discharging through the longitudinal slots thus formed in side wall 21*a* tend to equalize the pressures inside and outside the cartridge, and thus the expansion of the cartridge and resulting binding is greatly reduced. Moreover, and probably still more important, the longitudinal slots thus formed in the side wall of the cartridge weaken it to such an extent that it is entirely incapable of exerting any substantial degree of outward force on the wall surfaces of the cartridge chamber. Thus in this form of the invention, the side wall of the cartridge is provided with longitudinally extending frangible portions, which are completely ruptured or blown out as the explosion occurs, leaving the cartridge in such a condition that it can be very readily extracted.

In this form of cartridge the thickness of the cylindric wall at the scores is sufficient to withstand the external hydrostatic pressures, but insufficient to withstand the internal explosive pressures. And this form of cartridge may also have a slight cylindric looseness of fit in the chamber,

in which case it will be expansively torn apart along the scores and then be loose in the chamber.

Fig. 4 shows a modification of the grooved form of Figs. 2, 3 and 3*a*, in which the head end **20***b* of the cartridge is slightly larger in diameter than wall **21***b*, and fits comparatively snugly within chamber **14**. The side wall thus again does not initially fit tightly within the cartridge chamber. The grooves **50** may be the same as in Figs. 2, 3 and 3*a*.

Figs. 5 and 6 show the invention embodied as a rifle cartridge, numeral **60** designating a metal cartridge shell having the usual closure or head **60***a*, and numeral **61** designating the projectile fitted in its end. Shell **60** is formed throughout the major portion of its length with longitudinal grooves **62**. It may also have some looseness of fit within the cartridge chamber or breech. When the cartridge is fired, the metal between the inner surface of the shell and the bottoms of these grooves is ruptured the same as in the case of the casing perforating gun cartridge of the types of Figs. 2 to 4, thereby weakening the shell or destroying its rigidity to such an extent that there is complete assurance against binding within the breech of the gun.

It will now be understood that I have provided a cartridge having a frangible side wall, or frangible (weakened) side wall parts, such that when the cartridge is fired, the resulting explosive force fractures or ruptures the side wall of the shell, or parts of it, with the result that the rigidity and form of the cartridge are reduced and changed to such an extent and in such a way that expansive binding of the cartridge within the cartridge chamber is made impossible.

I have now shown for illustrative purposes several typical embodiments of my invention; it will be understood, however, that these are for illustrative purposes, and that various changes in design, structure and arrangement may be made without departing from the spirit and scope of the invention or of the appended claims.

I claim:

1. A gun cartridge for guns having a gun bore and a powder chamber of larger diameter than the gun bore, comprising: a single piece cup-shaped shell having a closed end covering the gun bore and a skirt portion extending substantially the length of the powder chamber, and restrained thereby against endwise displacement; and an explosive resistant cap for the open end of said shell to form therewith a compartment for an explosive, the skirt of said shell having at least a longitudinally extending portion of its periphery spaced from the walls of said chamber, said portion being incapable of withstanding the explosive pressure generated in said shell and adapted to rupture longitudinally within the area defined by said portion and the opposing chamber walls upon expansion of said shell into contact with said chamber walls under urge of said explosive.

2. A cartridge for guns having a gun bore and a cylindrical powder chamber larger in diameter than the gun bore, comprising: a metallic shell adapted to contain an explosive charge and having an end portion covering said gun bore and an integral skirt portion extending substantially the length of said powder chamber, said skirt defining with said chamber a clearance area extending substantially the length of said skirt and occupying at least a portion of its periphery, the portion of said skirt defining said clearance area adapted, when expanded radially therein under urge of explosive pressures, to exceed its yield point and therefore rupture, splitting the skirt longitudinally.

3. A cartridge construction, as set forth in claim 2, which includes: a bullet secured to said end portion and extending therefrom into said gun bore, and said end portion adapted to restrain said bullet until the pressure within said powder chamber has risen to a predetermined value.

4. The combination with a gun perforator having a cylindrical cartridge chamber, a screw-threaded barrel socket of larger diameter than said chamber and extending therefrom, and a barrel fitting said socket and having a gun bore smaller than said chamber, of a cartridge unit comprising: a cup-shaped metallic shell having a rupturable end portion covering said gun bore, and a skirt portion extending substantially the length of said cartridge chamber; the skirt portion of said shell defining with the cylindrical walls of said cartridge chamber an annular clearance space sufficiently great that said shell ruptures substantially completely on expanding into contact with said chamber walls under urge of an explosive charge in said shell, the juncture of the skirt and end of said shell forming an explosive resistant means for confining the pressure area against said gun barrel to the area of said cartridge chamber.

5. A cartridge construction, as set forth in claim 4, which includes: a bullet secured to said rupturable end portion and extending into said gun bore, said end portion adapted to restrain the bullet until the explosive pressure in said cartridge exceeds a predetermined value.

6. The combination with a gun perforator having a cartridge chamber, an electrical contact in the rear end of said cartridge chamber and a gun bore extending from the outer end thereof, of a cartridge comprising: a cup-shaped metallic shell having an end portion covering said gun bore, and a skirt portion extending toward the rear end of said chamber; a pressure resistant contact block engageable with and bridging said electrical contact, said contact block closing the open end of said shell, said contact block being electrically isolated from said cartridge chamber and said shell; an explosive charge and electrical igniter in said shell; said cartridge adapted to fit in said cartridge chamber with said contact block supported against explosive pressures by the rear end of said cartridge chamber, the skirt of said shell having at least a portion of its periphery along its length spaced from the walls of said chamber, said portion being incapable of withstanding the explosive pressures generated in said shell, and adapted to rupture longitudinally within the area defined by said portion when expanded under urge of said explosive charge.

7. A cartridge construction, as set forth in claim 6, wherein said shell and contact block form a liquid-tight closure capable of withstanding the hydrostatic pressure of liquid when the gun perforator is submerged in the liquid contained in a well bore.

8. A cartridge construction, as set forth in claim 6, wherein the end portion of said shell covering said gun bore is adapted to be ruptured when the explosive pressure in said cartridge exceeds a predetermined pressure; and a bullet attached to said end portion.

9. The combination with a gun perforator adapted to be submerged to great depths in liquids contained in a well bore, and having a cartridge chamber and a gun bore extending there-

from of a cartridge unit comprising: a fluid-tight metallic case containing an explosive charge and adapted to withstand the external hydrostatic pressure of well fluids in which the gun perforator is immersed, and fitting loosely in said cartridge chamber, portions of said case defining with the walls of said cartridge chamber a clearance space of sufficient area that said portions rupture upon expansion of said case under urge of said explosive charge; and a bullet extending from said case into said gun barrel.

10. The combination with a gun perforator adapted to be submerged to great depths in liquids contained in a well bore, and having a cartridge chamber and a gun bore extending therefrom, of a cartridge unit comprising: a fluid-tight metallic case containing an explosive charge and adapted to withstand the external hydrostatic pressure of well fluids in which the gun perforator is immersed, at least portions of said case defining with the walls of said cartridge chamber a clearance space of sufficient longitudinal and radial extent that said portions rupture upon expansion of said case under urge of said explosive charge; a bullet extending from said case into said gun barrel; means including a fluid seal for making electrical connection from said gun perforator into said case; and an electrical igniter in said case.

11. The combination with a gun perforator adapted to be submerged to great depths in liquids contained in a well bore, and having a cartridge chamber, an electrical contact at the base end of said cartridge chamber, and a gun bore extending from the outer end, of a cartridge comprising: a fluid-tight metallic case containing an explosive charge and adapted to withstand the external hydrostatic pressure of well fluids in which the gun perforator is immersed, and fitting loosely in said cartridge chamber, portions of said case defining with the walls of said cartridge chamber a clearance space of sufficient area that said portions rupture upon expansion of said case under urge of said explosive charge; a bullet extending from said case into said gun barrel; an electric contact incorporated in said case and engageable with the electric contact of said gun perforator; a fluid seal means for the junction of said contacts; and an electrical igniter in said case.

12. A construction, as set forth in claim 9, wherein a portion of said case covers said gun bore and is adapted to give way when the explosive pressure in said case exceeds a predetermined value, and a bullet is attached to said portion and extends into said gun bore.

13. A construction, as set forth in claim 11, wherein a portion of said case covers said gun bore and is adapted to give way when the explosive pressure in said case exceeds a predetermined value, and a bullet is attached to said portion and extends into said gun bore.

ARTHUR L. YARBROUGH.