

April 4, 1944.

C. H. BOWMAN
EXPLOSIVE CARTRIDGE

2,345,654

Filed June 6, 1938

2 Sheets-Sheet 1

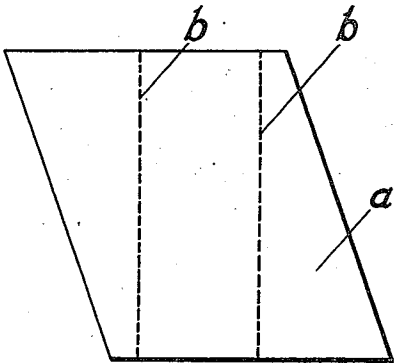


Fig. 1

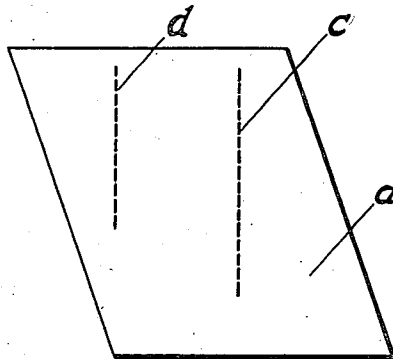


Fig. 3

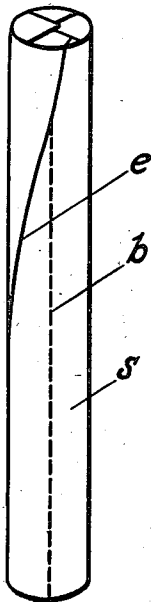


Fig. 2

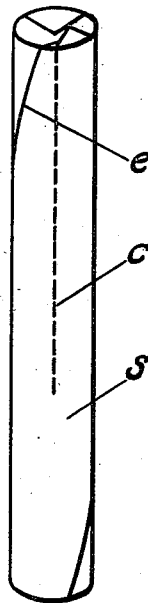


Fig. 4

INVENTOR
Charles H. Bowman
BY
Snelling and Snelling
ATTORNEYS

April 4, 1944.

C. H. BOWMAN

2,345,654

EXPLOSIVE CARTRIDGE

Filed June 6, 1938

2 Sheets-Sheet 2

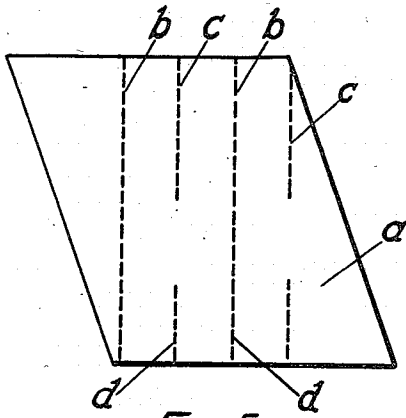


Fig. 5

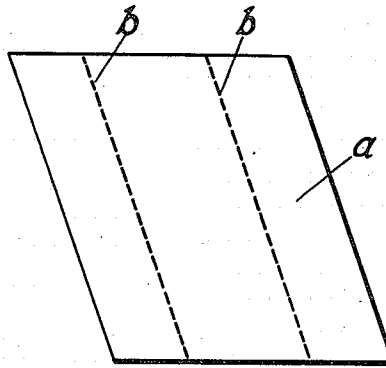


Fig. 7

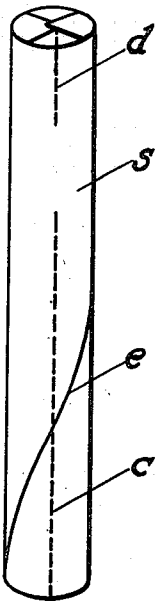


Fig. 6

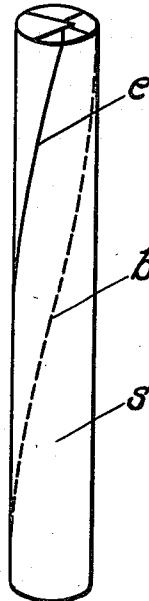


Fig. 8

INVENTOR
Charles H. Bowman.
BY
Snelling and Snelling,
ATTORNEYS

UNITED STATES PATENT OFFICE

2,345,654

EXPLOSIVE CARTRIDGE

Charles H. Bowman, La Grange, Ill., assignor to
Trojan Powder Company, Allentown, Pa.

Application June 6, 1938, Serial No. 211,978

11 Claims. (Cl. 102-24)

My invention relates to improvements in explosive cartridges and their use in blasting, and more particularly relates to improvements in expansible cartridges of high explosives, adapted to general mining and quarrying use, and the use of such improved cartridges in obtaining increased efficiency in blasting work.

High explosives are normally packaged in cartridges made of kraft, manila or other tough paper, for the purpose of affording a package that is convenient in size and shape for insertion into the drill holes in which mining and quarrying explosives are generally used, and for the purpose of protecting the explosive from the deteriorating effects of moisture. All commercial explosives contain substantial amounts of hygroscopic inorganic nitrates, particularly sodium nitrate and ammonium nitrate, and the imperforate paper shell or cartridge wrapper which encases the explosive forms a substantial protection to the explosive material from the absorption of moisture.

In order that a cartridge of explosive may be readily inserted into a drill hole or other opening provided for it in mining or quarrying, it is desirable that the cartridge should be smaller in diameter than the opening into which it is charged. For the purpose of obtaining maximum efficiency from the action of the explosive, however, it is desirable that the explosive charge should be of a non-rigid or deformable nature and should at the instant of firing be in contact at all points with the walls of the hole.

It will be seen from the above that until the time a cartridge of high explosive has been properly seated in the drill hole in which it is to be used, it is desirable that it should be of smaller diameter than the drill hole, but from the moment that the cartridge is properly positioned in the drill hole, it is desirable that it should completely fill the drill hole, and that there should be no space between the cartridge and the walls of the drill hole which would have the effect of forming an air cushion and that would reduce the efficiency of the action of the explosive. These considerations show the desirability of an expansible cartridge that can be conveniently made and transported, and that is capable of expanding or of being expanded at the time of charging the explosive cartridge into the bore hole.

I am aware that I am not the first to recognize the desirability of an expansible cartridge for blasting explosives, and Ellis, in U. S. 1,220,208, of March 27, 1917, has described an

admirable explosive cartridge made of fluted paper, which is designed to be readily expanded in the bore hole, to afford intimate contact with the sides of the bore hole. Although the device of Ellis is well adapted to the purpose which he had in mind, it has never to my knowledge come into practical use because of the difficulty and expense of making a cartridge of fluted paper, and for the further reason that any excess of paper over the minimum necessary in an explosive cartridge represents a disadvantage from the standpoint of the poisonous gases produced from the detonation of the explosive, the additional carbon present in the excess paper reducing the normal carbon dioxide-carbon monoxide equilibrium, and increasing the amount of poisonous carbon monoxide present in the explosive gases to a notable extent.

I have found that by making lines of perforations or slits or serrations in the paper of which explosive cartridges are made, and preferably thereafter filling these perforations, slits or serrations with a water-proofing material such as paraffin, I can obtain cartridges that meet the exacting requirements of the mining and quarrying industry, while still maintaining the cost of manufacture at such a figure as will permit my expansible cartridge to be manufactured and used under existing commercial conditions.

In the drawings forming part of this specification I have illustrated certain forms of cartridges and the paper from which the cartridges may be made, representing embodiments of my invention. In the drawings, Figures 1, 3, 5 and 7 are plan views of pieces of manila or kraft cartridge paper of the kind and strength commercially used in the cartridgeing of explosives, and Figures 2, 4, 6 and 8 are views in projection of cartridges made from the sheets of paper shown in the respective plan views.

In Figure 1, *a* is a piece of cartridge paper, preferably manila or light kraft paper, cut in the form of a rhombic parallelogram, and scored, slit or cut along one or more lines *b* perpendicular to two of the opposite parallel sides of the parallelogram. Figure 2 is a view of the cartridge made by wrapping the piece of cartridge paper shown in Figure 1, around a mandrel of the usual kind used in making cartridges for explosive, *s* being the body of the paper cartridge or shell while *b* is the scored, perforated or slitted line of weakness, and *e* is the overlapping edge of the cartridge paper. In Figure 3, *a* is similarly the cartridge paper, and *c* and *d* are lines of slits or the like, extending only partially across the

width of the paper. Figure 4 is a view of the finished cartridge made from the paper shown in Figure 3, *s* being the paper shell, *c* being the slitted line and *e* being the overlapping edge of the paper.

Figure 5 is a sheet of cartridge paper provided with four lines of slits or perforations, two of these lines *b*, extending entirely across the sheet, while two other lines are each made up of slitted portions, *c* and *d*, the length of which together is less than the total distance across the sheet, so as to produce after wrapping a shell of two thicknesses of paper, one of which has been weakened to a greater extent than the other. Figure 6 is a view of the cartridge made from the paper shown in Figure 5, *s* being the cartridge or shell, *e* being the overlapping edge of the paper, and *c* being a portion of a weakened or slitted line. Figure 7 shows a piece of cartridge paper provided with lines *b* parallel to two of the parallel sides of the rhomb, and Figure 8 is the cartridge made from the piece of paper shown in Figure 7, *s* being the shell, *b* being the line of slits now showing spirally around the cartridge, and *e* being the overlapping edge of the paper, also showing spirally around the cartridge.

It will of course be evident that these drawings show only a few of the many forms that my invention may take, and accordingly are given merely for the purpose of illustrating certain embodiments of my invention. Instead of my cartridge paper being cut in the form of a rhomb, it may be cut in the form of a trapezium or any other suitable form, although in this case the wastage of paper will be somewhat increased. In all the drawings I have shown the lines of weakness as lines of slits, but lines of perforations, circular, square or diamond-shaped, may be used if preferred, and scored lines, sufficient to weaken the paper but not cut wholly through it, may be employed as the full equivalent of lines of slits or perforations.

When the shell consists of more than one thickness or convolution of paper, lines of predetermined weakness can be positioned so as to lie directly over each other or to show any desired degree of offset. In the practice of my invention I prefer to seal the slitted lines by redipping the cartridge in paraffin wax or other weatherproofing agent, and when this preferred procedure is followed, it makes little difference from the standpoint of resistance to water whether the lines of predetermined weakness are positioned directly one over another, or offset to a small extent, but where the cartridges are not redipped in paraffin I find it desirable to have some offset in the lines of weakness in overlying convolutions of the paper, so that there will be no openings completely through two thicknesses of the cartridge shell paper through which water or moisture may find access to the explosive.

When employing serrated lines which do not extend entirely across the length of the cartridge, my purpose is to increase the strength of the shell to handling, by providing spaces not weakened to the same extent as other portions along the length of the cartridge. By providing two overlying lines of serrations, one longer than the other, but neither one extending clear across the length of the cartridge, I further improve the ability of my pre-slitted cartridge to withstand handling in the priming operation, for example, while still enabling it to expand satisfactorily by the application of easy pressure in the bore hole.

In the practice of my invention, I may employ

any suitable serrating, perforating or slitting means, for the purpose of making predetermined lines of weakness in the paper, preferably longitudinally with reference to the longest dimension of the cartridge, but spirally if desired, and I may then prevent such serrations, perforations or slits affording means of access of moisture to the explosive by filling such serrations or slits, or closing such perforations or openings, by paraffin or equivalent sealing means, such sealing means having resistance to water equal or greater than the water resistance of paper, but having a tensile strength or resistance to tear much lower than that of paper.

In the practice of my invention I may use containers or cartridges for my explosive, representing only a single thickness of the paper or equivalent cellulosic material used, but for most purposes I prefer to employ cartridges or cases for my explosive charge, containing more than one, but less than three convolutions or thicknesses of paper. I find it desirable to so space my lines of serration, slits or perforations on the cartridge paper before it is wrapped in the form of a shell that they will, in their final position in the rolled shell, be positioned in their desired relationship to each other. This is of course readily accomplished by properly spacing the lines along which rupture is facilitated by scoring, serrating, slitting or perforating the paper, so that when the paper is wrapped into the form of the final container or shell, the lines of perforations or the like will exactly coincide or will show exactly the desired degree of offset. It will of course also be evident that I may slit or perforate the shell after it has been rolled into its final shape, but in this case the lines of slits or perforations will of necessity coincide in both location and in length.

Although I prefer to produce zones of weakness extending lengthwise over the whole length of the shell, it is not an essential part of my invention that the lines of perforations or the like should extend the entire length of the shell, and for some purposes I may also extend such lines of weakness for half or two-thirds of the length of the shell, instead of these extending the whole length of the shell. The type of perforation, scoring, serration or slits that are used, as well as the length of such weakening means, will be determined in all cases by the consistency or plasticity of the particular explosive that is being packaged, and the strength of the paper or other cellulosic material of which the container is made.

In one modification of my invention I find it is desirable to employ different types and different lengths of scoring, serration, slits or perforations in two overlying layers of the cartridge fabric or material, the underlying line of weakening being longer and weaker than the corresponding line of weakness in the outer wrapper, and by this procedure I obtain a cartridge which is amply strong to resist rupture during ordinary careful handling in loading, but which readily ruptures and causes the explosive to completely fill the bore hole into which the cartridge has been inserted, by relatively light pressure on the part of the miner on the tamping stick, as the means of producing the rupture of the cartridge and the expansion of the explosive to completely fill the drill hole or bore hole.

I consider my invention to cover both the improved cartridge herein described, and the method or process of obtaining increased efficiency in blasting work, which consists in secur-

ing intimate contact of an explosive charge with the sides of the bore hole, by the use and rupture of such a cartridge in the bore hole prior to the detonation of the cartridge by the use of a blasting cap or an electric detonator, or other means.

If desired, I may employ a cartridge of more than one thickness of material, in which the layers of cellulosic material may be of different consistency or strength. For example, I may employ an inner wrapper of a tough paper, deeply serrated, or provided with large or easily separable lines of perforations or slits, and I may overlap or cover such basic container by a layer of a thinner and structurally much weaker cellulosic material, the purpose of the outer and structurally weaker cellulosic material being to increase the resistance of the underlying cartridge to moisture and to too easy mechanical bursting or rupture. The shell made from such a composite cellulosic material may be made in two operations, or may consist of a sheet of paper having portions of two different strengths, which may be rolled or formed into the final shell in a single shell-forming operation.

From the above it will be seen that the essence of my invention is a cartridge of paper or equivalent material containing a high explosive, the cartridge being intentionally weakened in certain predetermined directions or along certain predetermined lines by serrations, slits or perforations which would normally have the effect of increasing the tendency of the explosive to absorb moisture through the walls of the cartridge, and preferably with the subsequent waterproofing of the cartridge so made, by the closing or filling of the serrations, perforations, or slits by the application of a layer of a protecting cellulosic material or a waterproofing agent having less mechanical strength than the paper of which the cartridge is prepared.

I am aware that blasting cartridges for liquid oxygen explosives have been provided in the past with openings or perforations, to permit the absorption by such absorbent cartridges of liquid oxygen or liquid air, but my invention is clearly distinguished from such prior use of perforated cartridges in the fact that such perforations of the prior art have been of such a nature as to permit of ready absorption of liquid through them, while resisting rupture of the cartridge, while my invention relates to lines of perforation or the like of such arrangement and nature as to resist ready absorption of liquid through such lines of weakness, slits or perforations, while facilitating the ready rupture of the cartridge. I do not claim as any part of my invention a cartridge adapted or constructed to resist rupture along the lines of perforation or adapted or constructed to permit of ready passage of fluid through such lines of perforation or weakness, and my invention is directed to cartridges designed to permit ready rupture from the application of moderate pressure and adapted to resist the absorption of any fluid, liquid or gaseous, through the lines of serration, scoring, perforation or slitting provided for the purpose of rendering the cartridge readily rupturable.

I am also aware that blasting cartridges containing liquefied gases such as liquid carbon dioxide have in the past been provided with grooves for the purpose of facilitating the rupture of the cartridge at the instant of its explosion along certain desired lines, for the purpose of directionally controlling the action of such explosive cartridges. My invention is distinguished from

such very strong metal containers of the prior art in that my expansible cartridge is adapted to use with solid explosive materials and is adapted to be readily ruptured by moderate pressure applied to the cartridge when it is being loaded in the bore hole, and I do not claim as any part of my invention rupturable metal containers provided with means to directionally rupture such explosive containers from the action of expanding gases within the container, or to rupture such explosive container at the instant of its explosion. My invention relates exclusively to a mining cartridge, provided with a relatively weak cellulosic wrapper or shell, such shell being provided with lines of serrations, perforations or slits, and such serrations, perforations, or slits being preferably closed with paraffin wax or other equivalent material of lower tensile strength than paper, and such cartridge being adapted to readily expand in a bore hole, at the time of its being loaded, and prior to the time of its detonation, by the action of relatively slight pressure from a tamping rod, such as would be given by a miner pressing manually and relatively gently upon the tamping rod while the cartridge is being loaded and after the cartridge has been positioned at the desired point in the drill hole or bore hole.

Certain equivalents may be used in the practice of my invention, and instead of a shell made of paper I may employ a shell made of other packaging material, such as thin bituminized cloth, for example. Although I prefer to employ paraffin as the material for closing, sealing and waterproofing the serrations, perforations or slits used in the practice of my invention, my invention is not strictly limited to the use of paraffin or other like wax for this purpose. In one form of my invention I have employed lines of perforations, such as are used to insure the tearing of bank checks, toilet paper and the like along definite lines, and I have then closed such perforations by applying over them a thin sheet of adhesive waterproof glassine paper or the like, the strip of paper being of lower tensile strength than the cartridge paper, however, so as to have the effect of closing the perforations to the entrance of moisture while still permitting or allowing the paper to readily rupture along the line of the perforations that have been provided for the purpose set forth.

I claim:

1. An elongated cartridge suitable for mining use comprising a deformable charge of high explosive including hygroscopic material which should be protected against absorbing moisture through the walls of the cartridge, a container of water-resistant sheet material approximately of the strength of the kraft or manila paper ordinarily used for this purpose, said container having therein an elongated line of structural weakness extending generally in the direction of its length, and means for protecting the hygroscopic material against absorption of moisture through said line of weakness, whereby when the cartridge is placed in a bore hole the container may be ruptured along such line of weakness by slight pressure from a tamping stick so that the deformable charge in passing in part thru the rupture will shorten in length and expand in width to fill the hole, minimizing the formation of air cushions.

2. The device of claim 1 in which the line of weakness is formed by a series of perforations thru one or more convolutions of the sheet material.

3. A blasting explosive container comprising a tube of more than one and less than three complete convolutions or layers of a sheet of cellulosic, water-resistant material having therein a water-resistant line of weakness, said line of weakness extending generally lengthwise of the tube.

4. A tube rolled from a sheet of cellulosic material having in one convolution thereof a series of perforations forming a line of weakness extending generally in the direction of the length of the tube, and a waterproof strip of material covering the perforations.

5. The device of claim 4 in which the tensile strength of the sheet is greater than that of the strip.

6. A blank comprising a sheet of tough water-resistant paper having therein a plurality of parallel lines of weakness so spaced as to be substantially superposed when the sheet is rolled to form a tube of a plurality of convolutions of such diameter as to serve as the shell of a blasting explosive cartridge, said lines of weakness being of unequal weakness.

7. A blank comprising a sheet of tough water-resistant paper having therein a plurality of parallel lines of weakness so spaced as to be substantially superposed when the sheet is rolled to form a tube of a plurality of convolutions of such diameter as to serve as the shell of a blasting explosive cartridge, said lines of weakness being of unequal length.

8. A blank suitable for rolling to form a tubular container for a deformable charge of high explosive, comprising a sheet of tough water-resistant paper of the general strength of the kraft or manila paper ordinarily used for this purpose, said blank having two parallel sides and having a third side meeting the other sides to form an acute and an obtuse angle, said blank having crosswise thereof a plurality of lines of structural weakness, each line consisting of short slits and being filled with a water-proof substance where-

by the blank may protect the contained high explosive from moisture without further protection and whereby when the finished cartridge is placed in a bore hole the container formed from the blank may be ruptured along such lines of structural weakness by slight pressure from a tamping stick.

9. A substantially cylindrical explosive package comprising an explosive composition encased in a rolled shell, said shell being formed from a quadrilateral sheet of rupturable material having at least one set of parallel opposite sides perpendicular to the longitudinal axis of the filled cartridge, said sheet being characterized by at least one row of weakening perforations, said row being so sloped that it meets the parallel sides of the shell material at such an angle that relatively gentle pressure on a tamping stick by a miner will readily rupture the package and cause the explosive to fill the bore hole completely, said sheet being rolled into cylindrical form so that the perforations are spirally disposed on and extend substantially from end to end of the finished shell.

10. A substantially cylindrical explosive package comprising an explosive composition encased in a rolled shell, said shell being formed from a quadrilateral sheet of rupturable material having at least one set of parallel opposite sides perpendicular to the longitudinal axis of the filled cartridge, said sheet being characterized by at least one row of weakening perforations extending spirally from end to end of the finished shell, whereby when the package is loaded into a drill hole slightly larger than the substantially cylindrical package or cartridge, a relatively light and gentle pressure on a tamping stick by a miner will readily rupture the cartridge and cause the explosive to fill the drill hole completely.

11. The device of claim 1 in which the line of weakness is a row of perforations extending spirally from end to end of the cartridge.

CHARLES H. BOWMAN.