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BLASTING EXPLOSIVE CARTRIDGE OR BOREHOLE CHARGE

Albert Greville White, Saltcoats, Scotland, assignor to Imperial Chemical Industries Limited, a corporation of Great Britain

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This invention relates to blasting explosive cartridges or borehole charges suitable for use in quarries and non-fiery mines.

According to the present invention a composite blasting cartridge or borehole charge comprises in juxtaposition a continuous charge of a burning explosive having a relatively high rate of combustion, e. g. black powder, and an exothermic power-producing combustible mixture having a rate of combustion lower than that of the said burning explosive and comprising a carbonaceous combustible material and an inorganic oxidizing agent.

It will be understood that the terms "burning explosive" and "combustible mixture" are used hereinafter for convenience in order to distinguish the two components of the composite charges of the invention. These terms are not mutually exclusive; thus, for example, the exothermic combustible mixture may itself be a burning explosive adapted for blasing purposes, but insofar as such a composition is employed in the invention it is essential that it should be associated in the manner described with another burning explosive having a higher rate of combustion.

The charge of burning explosive is conveniently employed in the form of a core extending throughout substantially the whole length of the cartridge, the combustible mixture being arranged around the core in the form of a sheath or annulus. Alternatively, the burning explosive may form the annulus surrounding a core of the combustible mixture. In either modification, since the continuous charge of burning explosive extends throughout substantially the whole length of the cartridge or charge, the ignition is readily transmitted from the faster to the slower burning composition.

The burning explosive employed in the present invention may be any such explosive as is commonly used or suitable for blasting purposes. The preferred explosive, however, is black powder and this may conveniently be employed in the form of a compressed pellet and the combustible mixture may, if desired, be compressed around the pellet to form a coherent unit. The black powder may also be employed in the form of a hollow compressed pellet into which the combustible mixture may be inserted with the aid of cementing ingredients such as wax or hydrocarbons or nitro-hydrocarbons, these cementing ingredients forming part of the combustible composition itself. A composite cartridge may also be prepared by retaining the charges of burning explosive and of combustible mixture in juxtaposition by means of appropriate wrappings.

The relatively slow burning combustible mixture employed in the present invention preferably consists of a mixture of charcoal or woodmeal with ammonium nitrate and/or an alkali metal perchlorate and/or ammonium perchlorate. The salts mentioned are particularly valuable on account of the high power value of compositions containing the same. The mixtures described may, if desired, be made by impregnating a carbonaceous ingredient such as woodmeal with concentrated aqueous solutions of the oxidizing salt or salts, and drying. The product may subsequently, if necessary, be mixed with a further quantity of one or more oxidizing salts and may then be pressed around a core consisting of a black powder pellet. The ingredients, however, may usually be mixed together in the dry way. As the slow burning combustible mixture there may also be used a mixture of the ingredients used in the manufacture of black powder, such mixture having been lightly incorporated and not having undergone the full milling and granulating processes which are an essential feature of the manufacture of black powder itself. It is also possible to employ sodium nitrate black powder which is characterized by a lower rate of combustion than black powder manufactured with potassium nitrate. Similarly a lightly incorporated mixture of the ingredients of sodium nitrate black powder may be used.

If desired, other ingredients may be employed to assist in forming the slow burning combustible mixture into a coherent product, for instance, wax, hydrocarbons, nitro-hydrocarbons, resins and the like.

It will be understood that the composition of the combustible mixture may also include minor proportions of other ingredients such as sensitizing ingredients, and it is sometimes desirable to include a proportion of waterproofing agents amongst the carbonaceous materials. For this purpose resins and waxes are particularly useful besides enabling the mixture to be moulded whether by partial fusion or with the aid of pressure.

It will be understood that the composition of the combustible mixture will usually be arranged so as to avoid noxious gases; thus where ammonium perchlorate is used it is often convenient to employ in addition a proportion of an alkali nitrate.

The proportion of the burning explosive to the relatively slow burning combustible mixture may

depend upon the extent of the free space in the borehole, since the rate of propagation of the ignition through the slow burning constituent will in general be very much accelerated once a moderate pressure has been built up, and in order to facilitate the rapid building up of such a moderate pressure, the proportion of the burning explosive should be substantial. Excellent results have been obtained with a ratio of burning explosive to combustible mixture ranging from about 1:2 upwards.

The invention is further illustrated by the following examples, in which the parts are parts by weight:—

Example 1

A composite cartridge is made by forming a lightly compacted annular cylinder from a moist composition containing ammonium nitrate, charcoal and paraffin wax in the ratio 93:6:1, and then drying the annular cylinder and introducing into it a blackpowder pellet of equal length as a core. The weight of the blackpowder pellet is half that of the annular cylinder of ammonium nitrate composition, and the pellet is provided with a recess for the fuse. The cartridge is wrapped in waxed paper.

Example 2

A pellet made from the product obtained by lightly milling the ingredients of a normal blackpowder for about one third of the usual period was introduced as a core into an annular cylindrical pellet of blackpowder provided with a suitable recess for the fuse; the core and the annulus being of approximately equal weight.

The present invention renders it possible to employ for blasting purposes composite cartridges or charges containing a considerable proportion of exothermic combustible mixtures which are themselves characterized by a rate of combustion which is either too low to afford satisfactory results when such mixtures are used as blasting explosives or even too low to permit of their use for such purposes at all. The composite cartridges or charges have a rate of combustion comparable to the relatively high rate of combustion of the burning explosive which forms an integral part thereof. The possibility of using relatively slow burning combustible mixtures for blasting purposes presents advantages, for example in respect of cost, convenience and ease of manufacture. Thus the combustible mixtures may in certain cases contribute more power than an equivalent quantity of the burning explosive similarly located in the cartridge or borehole charge. For example, mixtures of carbonaceous material with ammonium nitrate or perchlorate or alkali metal perchlorates in amount at least sufficient to afford a satisfactory oxygen balance may be utilized in a composite cartridge in the manner of the invention, and the resultant cartridge is characterized by a greater power value than a cartridge of equal weight consisting of the burning explosive alone. Furthermore, the invention renders it possible to use as constituents of the composite charge or cartridge, compositions not normally suitable for use for blasting purposes, e. g. a mixture of blackpowder ingredients, which has been prepared in a simple manner and without the exhaustive processing necessary in the manufacture of blackpowder.

As the burning explosive for use in the present invention I may use any suitably prepared mixture of one or more highly oxygenated salts with one or more carbonaceous materials and with or without other combustible ingredients such for example as sulphur. Suitable salts are the nitrates, chlorates or perchlorates of the alkali metals, or ammonium perchlorate. Suitable carbonaceous materials are charcoal, carbon black, woodmeal, carbohydrates such as starch or sugar or hydrocarbons such as naphthalene. It is to be noted that the use of carbohydrates or wax-like hydrocarbons cause a reduction in the burning speed of the composition.

In order to illustrate the invention the properties of a number of compositions are set out in the following table:

Ref. No.		Composition by weight	Physical condition	Comparative values for—	
				Maximum pressure produced by given charge	Time of burning of given charge in given space
		Percent			
1	Potassium perchlorate	80.5	Well milled and granulated.	1.7	0.8
	Charcoal	19.5			
2	Ammonium perchlorate	78	Well milled and granulated.	3.0	0.9
	Charcoal	22			
3	N. P. blasting blackpowder (standard)	----------	Well milled and granulated.	1.0	1.0
4	N. S. blasting blackpowder	----------	Well milled and granulated.	1.1	3.0
5	Ammonium perchlorate	78	Ground, mixed and granulated.	3.0	3.0
	Charcoal	22			
6	N. S. blackpowder composition	----------	Ground, mixed and granulated.	1.1	16.0
7	Ammonium nitrate	91	Ground, mixed and granulated.	2.7	30.0
	Charcoal	9			

In forming the composite cartridges of the present invention I may associate a relatively fast with a relatively slow burning composition as set out in the above table. Thus for example I may associate two charges of equal weight of compositions numbers 3 and 7. The maximum pressure developed by this composite cartridge amounts to about 1.8 measured on the same scale as in the foregoing table, while the burning time similarly is only slightly greater than 1.0 which is the period for the fast burning composition number 3. Thus the composite charge is more

powerful than an equal weight of blackpowder, yet half of the blackpowder has been replaced by the cheaper and less expensively processed ammonium nitrate-charcoal mixture. Similarly a composite cartridge may be made from a mixture of numbers 4 and 6, in which the expense of intensively milling the blackpowder ingredient may be avoided without a consequent loss of efficiency.

It is to be noted that materials numbers 6 and 7 are useless for blasting purposes when employed separately under most ordinary blasting conditions.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiment thereof except as defined in the appended claims.

I claim:

1. A composite blasting cartridge or borehole charge comprising in juxtaposition a continuous charge of a relatively faster burning explosive having a relatively high rate of combustion, and a charge of a relatively slower burning exothermic power-producing combustible mixture having a rate of combustion lower than that of the said faster burning explosive and comprising a carbonaceous combustible material and an inorganic oxidizing agent.

2. The composite blasting cartridge or borehole charge of claim 1 wherein the burning explosive is blackpowder.

3. The composite blasting cartridge or borehole charge of claim 1, wherein the inorganic oxidizing agent comprises ammonium nitrate.

4. The composite blasting cartridge or borehole charge of claim 1, wherein the inorganic oxidizing agent comprises amonium perchlorate.

5. The composite blasting cartridge or borehole charge of claim 1, wherein the inorganic oxidizing agent comprises an alkali metal perchlorate.

6. The composite blasting cartridge or borehole charge of claim 1 wherein the exothermic combustible mixture comprises a lightly incorporated mixture of ammonium nitrate and a carbonaceous material.

7. The composite blasting cartridge or borehole charge of claim 1 wherein the exothermic combustible mixture consists of incompletely incorporated blackpowder ingredients.

8. The composite blasting cartridge or borehole charge of claim 1, wherein the exothermic combustible mixture consists of a carbonaceous ingredient impregnated with the inorganic oxidizing agent.

9. The composite blasting cartridge or borehole charge of claim 1 wherein the burning explosive is arranged as an annulus around a core of the exothermic combustible mixture.

10. The composite blasting cartridge or borehole charge of claim 1 wherein the exothermic combustible mixture is arranged as an annulus round a core of the burning explosive.

ALBERT GREVILLE WHITE.