

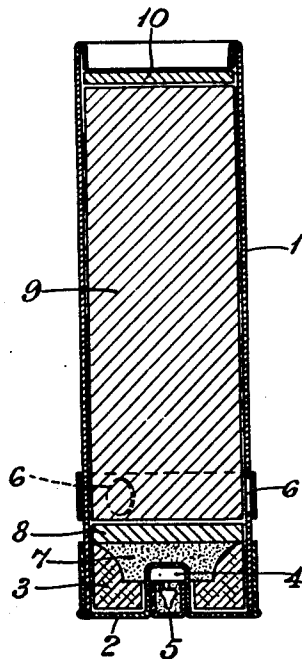
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CARTRIDGE FOR THE GENERATION OF GAS PRESSURES

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CARTRIDGE FOR THE GENERATION OF GAS PRESSURES

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22 Claims. (Cl. 102-12)

The present invention relates to the manufacture of charges, and cartridges containing charges, for the slow generation of gas pressures.

In recent years, attempts have been made to produce cartridges, comprising combustible charges, generating gas pressures in a slow and progressive manner suitable for the operation of mechanical devices of the kinds usually operated by hydraulic or other means; for instance motor car jacks, engine starters, fire extinguishers, and other devices. Difficulty has been experienced in producing suitable charges for such an object, particularly when considerable pressures are required; and the hitherto used charges have been unsatisfactory in that they produced an unduly high ratio of maximum to final pressure; or developed the maximum pressure in an inconveniently short time; or yielded a large proportion of solid residue after their combustion; or had other disadvantages.

In British Patent No. 454,091, however, substantially ashless charges or cartridges have been described, comprising a charge element capable of self-propagating combustion when ignited at substantially atmospheric pressure or at the pressure generated by a suitable igniting means, and, adapted for direct ignition therefrom, a further charge element capable of self-propagating combustion only when ignited at a pressure considerably in excess of atmospheric. Further charges or cartridges are also described and claimed therein in which additional charge elements are provided in successive ignition contact, each charge element being capable of self-propagating combustion when ignited at the pressure progressively generated by the preceding charge elements, including the igniting means, but incapable of self-propagating combustion at the minimum pressure required to ensure self-propagating combustion of the immediately preceding charge element.

The present invention relates to the provision of charges or cartridges for the slow generation of gas pressures for the above-mentioned general objects comprising a combustion train of two or more substantially ashless combustible charge elements of which at least one is an element incapable of supporting its own combustion when ignited locally at atmospheric pressure by means ineffective to heat the whole of it substantially above atmospheric temperature, but nevertheless capable of supporting its own combustion when ignited under the pressure generated by the combustion of the preceding element or elements under operating conditions; the in-

vention thus relates in part to the provision of substantially ashless charges or cartridges in accordance with the invention described in British Patent 454,091. More particularly, the present invention is directed to the preparation of a charge element constituting in a charge or cartridge of the kind described, one of the elements incapable of supporting its own combustion when ignited locally at atmospheric pressure.

According to the present invention a charge or cartridge of the kind described comprises at least one element capable of ignition only at a pressure substantially in excess of atmospheric pressure and consisting of compacted nitro-guanidine, if desired in admixture with a binding agent in quantity insufficient to cause appreciable deposition of free carbon under operating conditions.

In addition to the element or elements comprising compacted nitroguanidine, the charge or cartridge of the present invention may comprise other elements in association therewith.

Nitroguanidine is not readily compacted by itself, and the use of high compacting pressures, e. g. several tons per square inch, is necessary to produce the density that ensures the characteristic superficial type of burning desired. If, however, the nitroguanidine is compacted with the assistance of a binding agent, the pressure required to compact the material, and ensure suitable burning characteristics in the compacted elements is substantially less.

The binding agents are preferably non-hygroscopic, and are also preferably of such a nature that, when mixed with nitroguanidine, they burn without leaving a solid residue. These agents may be either colloidal or non-colloidal in character; and it will be understood that methods of application appropriate to the binding agent in use are to be employed.

As most of the generally available binding materials are (in the absence of oxidising agents) less capable of supporting their own combustion than nitroguanidine, the effect of the incorporation of most available binding materials is to increase the minimum pressure at which the composition is capable of propagating its combustion.

The amount of binding agent that may be employed in association with nitroguanidine according to my invention is limited by the requirement that the combustion of the charge element under operating conditions should not produce any substantial deposition of carbon. Nitroguanidine itself, although oxygen-deficient by 0.308 gm. oxy-

gen per gram, does not deposit carbon on combustion; and, in general, deposition of carbon will not occur if the total oxygen-deficiency of the composition does not exceed about 0.35 gm. oxygen per gram composition; the limiting value of the permissible oxygen deficiency depending to some extent on the nature as well as the compositions of the binder.

Guanidine nitrate is a substance which, when compacted by pressure, is incapable of supporting its combustion when ignited locally at atmospheric pressure, or even under very considerably increased pressure; and which is characterized by an even lower oxygen-deficiency than nitroguanidine (0.262 gm. oxygen per gram). Mixtures of nitroguanidine and guanidine nitrate containing more than about 20% guanidine nitrate can be satisfactorily compacted by the use of substantially lower pressures than are necessary for compacting nitroguanidine alone; and compacted mixtures containing nitroguanidine and guanidine nitrate form especially useful charge elements for the purposes of the present invention. When guanidine nitrate is employed as the binding agent, very considerable quantities may if desired be introduced; so that charge elements having very considerably higher minimum ignition pressures than nitroguanidine itself may thus be obtained. By employment of a succession of contiguous charge elements of increasing guanidine nitrate content, if desired in conjunction with a final charge element of compressed guanidine nitrate either alone or associated with a carbonaceous ingredient, extremely high pressures may be built up very slowly, and with the intermediate development of maximum pressures only slightly in excess of the final pressure.

If two or more charge elements prepared in accordance with the present invention are to be used in succession, it is of particular advantage that the proportion of the binding agent should be so adjusted, with respect to its effect on the minimum ignition pressure of the element, that the pressure at which a given charge element becomes capable of supporting its own combustion is less than that at which the succeeding charge element becomes capable of self-propagating combustion under the operating conditions.

It is also of particular advantage that the minimum ignition pressure of a particular charge element should not be considerably exceeding during the combustion of the preceding elements of the train.

It will be understood that there is used, in association with the most easily ignited charge element incapable of supporting its combustion at atmospheric pressure, a gas-generating element sufficient to build up the minimum pressure at which this charge element becomes self-propagating; and, if desired, this gas-generating element may itself be of a composite progressive nature, for instance, as indicated in my co-pending application Serial No. 59,630, filed January 17, 1936, which has matured into Patent Number 2,090,808, dated Aug. 17, 1937.

Binding agents other than guanidine nitrate which also tend to increase the minimum pressure at which the nitroguanidine can be ignited may, however, be employed, for example, cellulose derivatives, hydrocarbons, waxes, resins, gums, carbohydrates, fats and the like, or other colloidal or non-colloidal substances, preferably those of a nature as to permit the formation of compact elements when admixed with nitro-

guanidine. These materials may be employed in the form of solutions in appropriate volatile solvents, which are subsequently removed in any convenient manner, or they may be applied in other ways.

Such materials usually have a considerably higher oxygen deficiency than guanidine nitrate, and the use of such a quantity as will produce any significant carbon deposition on combustion of the charge element is to be avoided.

I may also employ as a binding agent nitrocellulose, gelatinised with an inert gelatiniser, and/or a volatile solvent.

Unlike the other binding agents to which I have referred, gelatinised nitrocellulose diminishes the minimum pressure at which compacted nitroguanidine can be ignited, consequently the use in a train of elements containing successively decreased proportions of nitrocellulose yields a series of charge elements having successively higher minimum ignition pressures.

In preparing these charge elements, however, the proportion of gelatinised nitrocellulose employed is less than that which would render the charge element capable of supporting its combustion when ignited locally at atmospheric pressure and temperature, i. e., less than about 7.5% when used as the sole binding agent. The presence of other binding agents may permit the use of a somewhat larger proportion of gelatinised nitrocellulose. When making such nitroguanidine gelatinised-nitrocellulose compositions, it is particularly important that the charge elements should be compacted to a bulk density greater than about 1.2 gm./ml. in order to avoid the risk of an excessively high rate of combustion.

If desired, a proportion of gelatinised nitrocellulose may be included in a charge element comprising nitroguanidine and a binding agent of the kind that raises the minimum ignition pressure of nitroguanidine, in order to facilitate binding.

Instead of nitrocellulose, we may use nitro-starch, nitrodextrin or nitro-algin to produce a similar effect, or any similar colloidable nitrated carbohydrate.

Nitroguanidine in the loose form can be decomposed by moderate heating at atmospheric pressure, but under these conditions it leaves an appreciable residue. The charge elements comprising the present invention, when burned under the increased pressure necessary for their ignition, are substantially ashless, and produce a satisfactorily high permanent gas volume, which may exceed 700 cc. per gm. calculated at N. T. P.

The charge elements of the kind comprising the present invention may contain, in addition to the binding material and the nitroguanidine, other materials capable of modifying the burning properties of the nitroguanidine, preferably so that the composition remains ashless under operating conditions.

In order to disclose my invention more clearly, as reference is made to the accompanying drawing which represents a sectional elevation of a cartridge according to my invention.

Referring in detail to the various numbered parts of the drawing, the paper shell 1 is a standard unlined 12 bore paper shot gun case having a metal base 2, a recessed cardboard base wad 3 and a cap chamber 4 containing the cap 5. A venting hole 6 is provided in the side of the case near the base of the cartridge, thus

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permitting the gases evolved by the charge to escape freely into any containing vessel. Within the recess of the wad 3 there is placed a priming charge 7 of Schultze powder loaded in close proximity to the percussion cap, and in contact with this priming charge, a disc of cordite, the plane of the disc being perpendicular to the axis of the case.

In conjunction with this igniting system the single charge element 8 is employed consisting of a compacted pellet of a composition containing nitroguanidine and nitrocellulose according to my invention. The composition of this pellet is hereinafter described in detail in Example 1.

The cartridge is closed by a disc 18 in the usual manner and may be fired by percussion. The invention is further illustrated by the following examples, in which cartridges containing charge elements in accordance with the present invention are described.

The cartridge cases employed in Examples 1 to 6 are standard unlined 12 bore paper shotgun cases with standard percussion caps for the initiation of the charge. The charge elements are in the form of solid cylindrical pellets, each occupying practically the full internal cross-section of the cartridge case, which is 18.3 mm. in diameter. The cases are loaded with the most easily ignited elements next the percussion cap, and the remainder in order of increasing minimum ignition pressure, the charge being designed to burn from the percussion cap towards the turnover end of the case.

In Examples 1 to 6 the pressure-generating characteristics of the cartridges are determined in a cylindrical closed vessel of 160 ml. capacity and 325 sq. cm. internal surface area. During testing they are contained in a cage or sleeve in which they are an exact fit lengthwise, the charge thereby being prevented from being ejected through the turnover end of the case on the initiation of the cap and priming charge.

On firing, the side of the paper cartridge case is burst open at a 1.0 cm. diameter hole in the side of the cage situated near the base of the cartridge, thus permitting the gases evolved by the charge to escape freely into the closed vessel.

Example 1

The gas-generating elements conveying the ignition to the charge element consist of a priming charge of 0.4 gm. of Schultze powder loaded in close proximity to the percussion cap and, in contact with this priming charge, a 1.0 gm. disc of Ardeer cordite (containing 29% nitroglycerine, 65% nitrocellulose and 6% diethyl diphenyl urea) 15.3 mm. in diameter, the plane of the disc being perpendicular to the axis of the case. This system of gas-generating elements produces a maximum pressure of about 140 lbs. per sq. in. in about 1.0 second and a final pressure of about 100 lb. per sq. in. when fired in the closed vessel described above.

In conjunction with this igniting system, a single charge element is employed consisting of a compacted pellet of a 100:5 nitroguanidine:nitrocellulose composition. The nitrocellulose employed in the composition used for this charge element is of the industrial extra-low viscosity type, and has a nitrogen content of 12.0%. It is mixed with the finely divided nitroguanidine in the form of a solution in acetone containing 1 gm. of nitrocellulose to 5 gm. of acetone. After the dough has been thoroughly incorporated it is compressed into pellets in a die. The bulk of

the acetone is subsequently eliminated by drying the pellets for a few days in an oven at 35°-45° C. This pellet, 17.5 mm. in diameter, has a bulk density of approximately 1.5 gm./ml. and weighs 6.9 gm. Such pellets are not capable of supporting their own combustion when ignited locally at atmospheric pressure, but become so when ignited at a pressure of approximately 60 lb./sq. in. This pellet is loaded into the cartridge case so that one end is in contact with the cordite disc described above, and the cartridge case is closed by a thin Celluloid disc secured by the usual type of shotgun turnover or crimp.

The cartridge generates a maximum pressure of approximately 1500 lb./sq. in. in about 0.5 sec., the final pressure being about 750 lb./sq. in. The latter figure is equivalent to an average gas yield of approximately 990 ml./gm. measured at 760 mm. pressure and 50° C. The loading density is 0.052 gm./ml.

Example 2

In this example the cartridge case and gas-generating elements are as described in Example 1, except for the disc of Ardeer cordite which weighs 0.6 gm.; the maximum pressure of 120 lbs./sq. in. being developed in about 1 sec., the final pressure being 75 lbs./sq. in. The cartridge contains in addition four charge elements in accordance with the present invention, the first being loaded in contact with the cordite disc consisting of a 1.3 gm. pellet of the 100:5 nitroguanidine:nitrocellulose composition made as described in Example 1, the compacting pressure being sufficient to produce a density of the pellet of 1.4 gm./ml. The second charge element, loaded in contact with the first charge element, consists of a 3.3 gm. pellet of a 75:25:2.5 nitroguanidine:guanidine nitrate: nitrocellulose composition of bulk density approximately 1.4 gm./ml. and diameter also 17.5 mm. In making this composition the guanidine nitrate is first sieved through an 80 mesh B. S. sieve and the nitrocellulose is added to the mixture of nitroguanidine and guanidine nitrate in the form of a solution in acetone, as used in Example 1, the three components being then thoroughly incorporated, and shaped by pressure in a die. The bulk of the acetone is removed by stoving at 35-40° C. for a few days. Such pellets require a minimum gas pressure of about 250 lb./sq. in. before they become self-supporting when ignited locally. The third charge element, loaded in contact with the second charge element, consists of a 3.1 gm. pellet of a compacted 30:50:2.5 nitroguanidine:guanidine nitrate: gelatinized nitrocellulose composition compressed to a bulk density of approximately 1.4 gm./ml., the diameter of the pellet being about 18.2 mm. The pellet is made in a manner similar to that described above for the second charge element, and requires a pressure of some 600 lb./sq. in. before it becomes self-sustained when ignited locally. The fourth charge element consists of a 9.2 gm. pellet of a 25:75:2.5 nitroguanidine:guanidine nitrate: gelatinized nitrocellulose composition made as described above for the second charge element, the bulk density and diameter of the pellet being approximately 1.4 gm./ml. and 18.2 mm. respectively. This pellet becomes self-propagating when ignited locally at a pressure of some 850 lb./sq. in. When tested in the apparatus described this cartridge develops a maximum pressure of about 1400 lb./sq. in. in approximately 32 sec., the final pressure being about 1200 lb./sq. in. The latter

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is equivalent to an average gas yield of about 735 ml./gm. at atmospheric pressure and a temperature of 50° C. The total charge in the cartridge is 17.9 gm., giving a loading density of 0.112 gm./ml. in the above-described testing apparatus.

Example 3

The cartridge case, the method of loading and the preliminary gas-producing elements in this example are the same as those described in Examples 1 and 2, except that 1.2 gm. of Ardeer cordite, 15.2 mm. in diameter, are employed in contact with the priming charge. The gas-producing elements of this cartridge produce a maximum pressure in the above apparatus at 210 lb./sq. in. in approximately 1 second, the final pressure being about 130 lb./sq. in. The remainder of the charge comprises a single charge element of a compacted pellet of a 100:5 nitroguanidine:acetone-soluble cellulose acetate composition loaded in contact with the 1.2 gm. disc of Ardeer cordite. The bulk density and diameter of this pellet, which is made with the aid of acetone, are 1.1 gm./ml. and 17.7 mm. respectively. When fired in the apparatus described, this cartridge develops a maximum pressure of about 1100 lb./sq. in. in approximately 14 seconds, the final pressure being 700 lb./sq. in. The last figure is equivalent to an average gas yield of about 990 ml./gm. at atmospheric pressure and a temperature of 50° C. The total charge in the cartridge is 7.8 gm. giving a loading of 0.049 gm./ml. when fired in the above closed vessel.

Example 4

In this example, the cartridge case, the method of loading and the preliminary gas-producing elements are the same as described in Example 3. The first charge element in accordance with the present invention, loaded in contact with the disc of Ardeer cordite, consists of a 5.7 gm. pellet of a 100:5 nitroguanidine:acetone-soluble cellulose acetate mixture; the density and diameter of the pellet being 1.44 gm./ml. and 16.2 mm. respectively. The second charge element, loaded in contact with the first charge element, consists of a 7.0 gm. pellet of a 75:25:5 nitroguanidine:guanidine nitrate:acetone-soluble cellulose acetate composition compressed to a bulk density of 1.40 gm./ml., the diameter of the pellet being 18.2 mm. This charge element is prepared with the aid of an acetone solution of the cellulose acetate, the guanidine nitrate being sieved through an 80 mesh sieve and mixed with the nitroguanidine previous to the addition of the solution of cellulose acetate. The third charge element, loaded in contact with the second, comprises a 4.4 gm. pellet of a compacted 50:50:5 nitroguanidine:guanidine nitrate:acetone-soluble cellulose acetate composition made in a similar fashion. The bulk density and diameter of the pellet are 1.57 gm./ml. and 18.2 mm. When this cartridge is fired in the apparatus described above, a maximum pressure of about 1700 lb./sq. in. is developed in approximately 45 seconds, the final pressure being about 1500 lb./sq. in., the latter being equivalent to an average gas yield of about 875 ml./gm. at atmospheric pressure and 50° C. The total charge in the cartridge is 18.7 gm., giving a loading density of 0.117 gm./ml. in the above apparatus.

Example 5

In this example, the method of loading and the preliminary gas-generating elements are the

same as in Example 1, except that a 1.5 gm. disc of Ardeer cordite is employed. This system of gas-generating elements develops a maximum pressure of about 260 lb./sq. in. and a final pressure of about 160 lbs./sq. in. in the closed vessel. The remainder of the charge comprises a single charge element consisting of a 0.0 gm. pellet of a 100:2.5 nitroguanidine:gum-tragacanth, composition, the bulk density and diameter of the pellet being 1.38 gm./ml. and 16.2 mm. respectively. This charge element is loaded in the cartridge case in contact with the disc of Ardeer cordite, the case being closed by a thin Celluloid disc secured by the usual type of shotgun turnover. In making this composition the gum tragacanth is first dissolved in water, 1 gm. of gum to 6 gm. of water, and the solution incorporated with the finely divided nitroguanidine. The composition is compacted in a die, and the pellets are dried in an oven for a few days at 35-40° C.

When tested in the closed vessel, this cartridge develops a maximum pressure of about 670 lb./sq. in. in approximately 16 seconds, the final pressure being about 690 lb./sq. in. The latter is equivalent to an average gas yield of about 990 ml./gm. at atmospheric pressure and a temperature of 50° C. The total charge in the cartridge is 7.8 gm., giving a loading density of 0.049 gm./ml. when fired in the closed vessel.

Example 6

The preliminary gas-generating elements are the same as in the preceding examples, the weight of the disc of Ardeer cordite being 1.1 gm. The system of preliminary gas-generating elements produces a pressure of 170 lb./sq. in. in approximately 1 sec. and a final pressure of about 115 lbs./sq. in. Two contiguous charge elements in accordance with the present invention are used in the cartridge, the first of these, next to the disc of Ardeer cordite, weighing 7.0 gms. and consisting of nitroguanidine compacted with 2½% of its weight of a resinous material containing polymerised methyl methacrylate and dibutyl phthalate in the proportion 90:10. This charge element is prepared by pressing a dough made up from the finely divided nitroguanidine and an acetone solution of the said resinous material. The density of the dried charge element is 1.40 gm./ml. and the diameter 18.2 mm. The second charge element which is contiguous to the one already described, consists of 5.45 gms. of a pressure-compacted mixture of equal weights of finely divided nitroguanidine and guanidine nitrate. In this case no volatile material is used to assist the compacting, which is effected by pressure alone. The density of the compacted material is 1.47 gm./ml. and the diameter 18.2 mm. The minimum pressure at which this second charge element will propagate its combustion is somewhat in excess of 880 lbs. per square inch. The cartridge produces a maximum pressure of 1200 lbs. per sq. inch in about 43 seconds, the final pressure being 1150 lbs. per sq. inch. This final pressure corresponds to an average gas evolution of about 900 ml. per gram of charge calculated at atmospheric pressure and 50° C.

As many apparent and widely different embodiments of this invention may be made without departing from the spirit thereof, it is to be understood that I do not limit myself to the foregoing examples or descriptions except as indicated in the following patent claims.

I claim:

1. In a combustion charge for the slow genera-

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tion of gas pressure comprising a multiplicity of charge elements, one of which is incapable of supporting its own combustion when ignited locally at atmospheric pressure by means ineffective to heat the whole of it substantially above atmospheric temperature but capable of supporting its own combustion when ignited under the pressure generated by the combustion of a preceding element under the conditions of operation, a combustible element comprising compacted nitroguanidine.

2. In a combustion charge for the slow generation of gas pressure comprising a multiplicity of charge elements, one of which is incapable of supporting its own combustion when ignited locally at atmospheric pressure by means ineffective to heat the whole of it substantially above atmospheric temperature but capable of supporting its own combustion when ignited under the pressure generated by the combustion of a preceding element under the conditions of operation, a combustible element comprising compacted nitroguanidine and a binding agent.

3. The invention of claim 2, in which the nitroguanidine is in admixture with a non-hygroscopic binding agent.

4. The invention of claim 2, in which the binding agent is free of solid residue upon combustion of the charge.

5. The invention of claim 2, in which the binding agent is capable of supporting its own combustion.

6. The invention of claim 2, in which the binding agent has a lower oxygen deficiency than nitroguanidine.

7. The invention of claim 1, in which the nitroguanidine is in admixture with a binding agent comprising a carbonaceous ingredient.

8. The invention of claim 1, in which the nitroguanidine is in admixture with a binding agent comprising acetone-soluble cellulose acetate.

9. A combustion charge for the slow generation of gas pressure comprising an arrangement in serial order of a plurality of charge elements in ignition relationship with each other at least one of which supports its own combustion when locally ignited under atmospheric pressure by means insufficient to heat the whole of the element to a temperature substantially above atmospheric, and at least one of which does not support its own combustion when subjected to such ignition means at atmospheric pressure and comprises compacted nitroguanidine.

10. A combustion charge for the slow generation of gas pressure comprising an arrangement in serial order of a plurality of non-hygroscopic ashless charge elements in ignition relationship with each other at least one of which supports its own combustion when locally ignited under atmospheric pressure by means insufficient to heat the whole of the element to a temperature substantially above atmospheric, and at least one of which does not support its own combustion when subjected to such ignition means at atmospheric pressure and comprises nitroguanidine compacted with a binding agent.

11. The invention of claim 10 in which the charge element containing nitroguanidine is of such composition that its negative oxygen balance does not exceed about 0.35 gm. per gm.

12. The invention of claim 10 in which the

binding agent is a colloidal nitrated carbohydrate in the colloid condition.

13. The invention of claim 10 in which the binding agent is a colloid.

14. The invention of claim 10 in which the binding agent is guanidine nitrate.

15. The invention of claim 10 in which the binding agent is gelatinized nitrocellulose.

16. The invention of claim 10 in which the binding agent is acetone-soluble cellulose acetate.

17. The invention of claim 10 in which the element comprising nitroguanidine is compacted to a density not less than 1.2 grams per millilitre.

18. A combustion charge for the slow generation of gas pressure comprising an arrangement in serial order of a plurality of ashless non-hygroscopic charge elements in ignition relationship with each other in which each element supports its own combustion when locally ignited under the pressure produced by the combustion of all the preceding elements under the conditions of operation, but is incapable of supporting its own combustion under the pressure at which the immediately preceding element first supports its own combustion, and in which at least one of the elements, excluding the first, comprises compacted nitroguanidine.

19. The invention of claim 10 in which the proportion of binding agent used in the element comprising nitroguanidine exceeds 20% of the weight of the element.

20. The invention of claim 10 in which the nitroguanidine is associated with a binding agent having a higher oxygen deficiency than nitroguanidine in such a proportion that the oxygen deficiency of the element as a whole does not exceed about 0.35 gram oxygen per gram.

21. A combustion charge for the slow generation of gas pressure comprising an arrangement in serial order of a plurality of non-hygroscopic ashless charge elements in ignition relationship with each other at least one of which supports its own combustion when locally ignited under atmospheric pressure by means insufficient to heat the whole of the elements to a temperature substantially above atmospheric, and at least one of which does not support its own combustion when subjected to such ignition means at atmospheric pressure and comprises nitroguanidine compacted with a binding agent comprising an organic compound having a higher oxygen deficiency than nitroguanidine and incapable of propagating its own combustion out of contact with the atmosphere.

22. A combustion charge for the slow generation of gas pressure comprising an arrangement in serial order of a plurality of non-hygroscopic ashless charge elements in ignition relationship with each other at least one of which supports its own combustion when locally ignited under atmospheric pressure by means insufficient to heat the whole of the element to a temperature substantially above atmospheric, and at least one of which does not support its own combustion when subjected to such ignition means at atmospheric pressure and comprises nitroguanidine compacted with a binding agent comprising gelatinized nitrocellulose up to 7.5% of the weight of said element.

JOHN MACFIE HOLM

CERTIFICATE OF CORRECTION.

Patent No. 2,165,263.

July 11, 1959.

JOHN MACFIE HOLM.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 52, for the word "exceeding" read exceeded; page 4, first column, line 44, Example 4, for "1.44 gm./ml." read 1.44 gm./ml.; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of September, A. D. 1959.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.