Mar. 13, 1923. 1,448,073

O. D. LUCAS ET AL

PRODUCTION AND UTILIZATION OF SMOKE PRODUCING COMPOSITIONS

Filed May 24, 1922

Fig. 1.

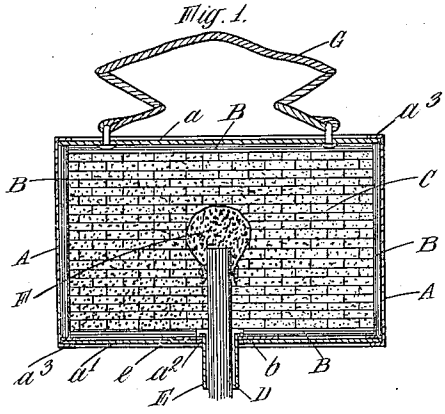


Fig. 2.

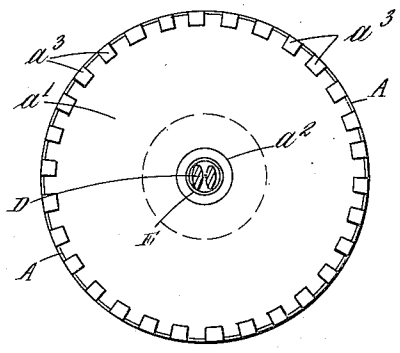


Fig. 3

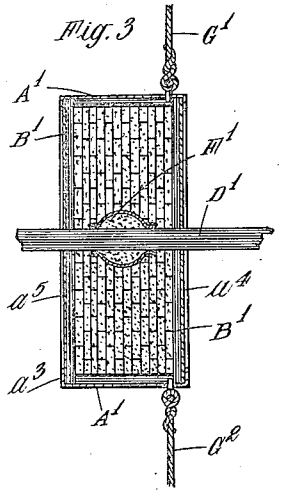
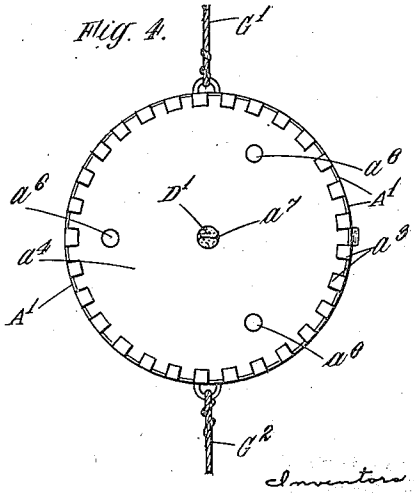


Fig. 4.



Inventors
Owen David Lucas
and
Frederick Geoffrey Lee Johnson
By Pennie, Davis, Marvin & Edmonds
Attorneys

Patented Mar. 13, 1923. 1,448,073

UNITED STATES PATENT OFFICE.

OWEN DAVID LUCAS, OF BAYSWATER, LONDON, AND FREDERICK GEOFFREY LEES JOHNSON, OF WESTMINSTER, LONDON, ENGLAND, ASSIGNORS TO VICKERS LIMITED, OF WESTMINSTER, LONDON, ENGLAND, A BRITISH COMPANY.

PRODUCTION AND UTILIZATION OF SMOKE-PRODUCING COMPOSITIONS.

Application filed May 24, 1922. Serial No. 563,314.

To all whom it may concern:

Be it known that we, OWEN DAVID LUCAS and FREDERICK GEOFFREY LEES JOHNSON, both subjects of the King of Great Britain, residing, respectively, at 49 Linden Gardens, Bayswater, in the county of London, England, and Vickers House, Broadway, Westminster, in the county of London, England, have invented certain new and useful Improvements in Production and Utilization of Smoke-Producing Compositions, of which the following is a specification.

This invention relates to the production and utilization of smoke producing compositions, especially coloured smoke for military and pyrotechnical purposes, and has for its chief object to increase the rate of evolution of smoke and to control it according to the conditions of smoke emission required.

According to the present usual method of utilizing smoke compositions in shells, bombs, rockets or other missiles and smoke screen producing apparatus, the container is either filled with a single large pellet or the composition is pressed into the container, with the result that the evolution of smoke does not start properly until some time after ignition, and continues at a rate depending on the composition itself.

According to this invention the container is filled with the smoke composition in the form of pellets or tablets of a predetermined size so as to provide a large surface for ignition and production of the smoke, which therefore starts at once in full volume and finishes sharply on the burning out of the composition. The composition employed may be of any type giving any desired colour and the relatively large surface of emission provided gives a very rapid action and prevents any great increase in temperature as the burning of the composition proceeds, so that the smoke is emitted at a fairly constant rate from ignition to the end of combustion.

The size of the pellets or tablets is determined according to the rate at which the smoke is to be emitted and according to the nature of the composition, the size being readily calculated from the known constants, depending on the rate and temperature of combustion, i. e., the more rapid the combustion of the composition the larger will be the pellets and vice versa. For example for typical red, yellow and black compositions of known type the following figures may be given:—

To produce large volumes of smoke in a short time standard red and yellow compositions may be in pellets $\frac{1}{16}''$ thick by $\frac{3}{8}''$ square and the black composition may have a thickness of $\frac{1}{8}''$ and a diameter of $\frac{1}{4}''$.

For the production of smoke at a less rate but lasting for a longer time the pellets may be $\frac{1}{4}''$ thick by $\frac{3}{8}''$ square for red and yellow and $\frac{1}{4}''$ thick by $\frac{3}{4}''$ diameter for black.

The pellets may be made by mixing the powdered composition with sufficient water, alcohol or other suitable liquid to produce a dough like mass, which is then moulded in any ordinary moulding apparatus into round, square or other suitably shaped pellets or tablets of regular size. Or the dough produced as above may be rolled or pressed into a flat cake or sheet of suitable thickness and cut into squares by cross cuts with a knife or other instrument and laid out to dry.

It has been suggested to use for the production of coloured smoke mixtures containing certain organic colouring matters, a comburent such as potassium chlorate and a combustible material such as lactose or shellac, as coloured smoke producing compositions. Lactose - containing mixtures possess the disadvantage of losing water when stored for any length of time, and especially in a warm place, with the result that the temperature at which the mixture burns becomes so high that the colouring material instead of being merely volatilized, is decomposed, and moreover the mixture may in time become violently explosive. We have found that the production of coloured smoke or gas from mixtures of the general type comprising a colouring material, a comburent, and a combustible material is dependent not only upon the nature and proportions of the various constituents of the mixture, but also upon the conditions of temperature and pressure under which the combustion takes place. In the first place the proportions of the several constituents of the smoke-producing mixture or composition should be adjusted so that sufficient heat may be derived from the burning of the combustible substance to volatilize the colouring material, while the temperature

attained during the burning of the mixture must not be high enough to cause any substantial decomposition of the colouring material. In the second place the conditions under which the combustion takes place must be so regulated that the pressure developed, while not exceeding certain limits, is sufficient to prevent the coloured cloud remaining too long in contact with the heated slag that results from the combustion, as if this were not the case decomposition of the colouring matter and destruction of the coloured cloud would result.

A smoke-producing unit comprises according to a further feature of this invention a mass of combustible composition stable at normal temperatures and containing volatilizable colouring matter, in a container in which it is adapted to be ignited, the said container having orifices so arranged that on ignition the temperature produced is sufficient to volatilize the colouring matter without substantial decomposition.

The accompanying drawings show two typical smoke charge containers embodying this invention, Figures 1 and 2 being respectively a section and an underside plan of the interior of one arrangement adapted to be suspended with its axis vertical and Figures 3 and 4 respectively a section and a face view of a container suspended from the side.

Referring to Figures 1 and 2 A is the outer cylindrical case usually of thin tinned iron, closed at top and bottom by the tinned iron plates or discs a, a' of which the latter is formed with a central hole a^2. The discs a and a' are secured in place by turning over the small tongues a^3 at the edges of the cylindrical case A. B is a lining of strawboard, asbestos or like heat insulating material enclosing the smoke composition pellets C on all sides, pierced with a central hole b. D is a quickmatch passing into the middle of the charge C through a small flanged copper tube E and terminating in a small powder bag F in the center of the charge. The tube E is held in place by the small disc e of xylonite or like composition lying under the flanged end of the tube and between the lining B and the bottom plate a'. G is a wire loop or suspension device attached to the top plate a to enable the container to be suspended from a parachute or other carrier.

On igniting the composition through the quickmatch and powder bag the burning starts in the middle of the mass and the smoke is driven out through the holes b, a^2, the quickmatch tube dropping away. The relation of the smoke emitting hole or holes to the nature of the smoke composition is a matter of great importance as will be shown hereafter.

In the second typical form shown in Figures 3 and 4 and general arrangement is similar, comprising a cylindrical case A′ with front and back plates a^4, a^5 which in this case may have, together with the lining B′, a number of small holes a^6 as shown in Figure 4, as well as a central hole a^7 to allow the passage of the quickmatch D′. The quickmatch in this case passes through both plates a^4 and a^5 and through a small central powder bag F′.

The container is suspended by the cord G′ attached to the cylindrical case A′ near one edge and a second cord G^2 may be provided for attachment to any other object. The smoke in this case issues from both sides of the container when the charge is ignited through the quickmatch D′ and powder bag F′.

In order to ascertain what colouring matters are suitable for use in connection with this invention, the powdered colouring matter may be blown through a tube heated to a sufficient and suitable temperature when the formation of the smoke cloud will indicate if it is suitable. For the combustible ingredient of the smoke producing composition a suitable substance is ordinary white sugar or flour, especially where a firmly pelleted and coherent substance is required, while for the comburent or oxygen carrier a suitable material is potassium chlorate. We have found that compositions in which white sugar or flour is employed as the combustible do not deteriorate on storage. The proportions of the various ingredients of the smoke-producing composition may vary within certain limits, the proportion of colouring material being of the order of fifty per cent, of the combustible twenty or thirty per cent, and of the comburent twenty to thirty per cent, of the total weight of the composition. A detrimental excess of any constituent of the composition may easily be ascertained by its behaviour. Thus an excess of the comburent usually destroys the color and frequently results in inflammation of the mixture, an excess of colouring material causes slow combustion and sometimes completely stops the ignition, whilst too low pressures or too large orifices may also produce partial destruction of the colour. Some compositions which are satisfactory in other respects, but which have a tendency to inflame, may be corrected in this respect by the addition of from one to five per cent. of sodium bicarbonate. The higher the proportion of sodium-bicarbonate used, the slower will be the combustion, whilst an excess of this substance tends to decolourize the smoke.

Rapidly burning compositions of the above type may be made by cutting up the dough like sheets already referred to into small pellets or cubes of from one quarter to one half inch in size, the size of the cubes

being dependent on the rate of combustion required and the intensity of combustion of the particular mixture employed. The larger the smoke cloud that is required to be developed in a given time the smaller must be the pellets, while the size of the pellets must be increased in accordance with the intensity of combustion of the composition to obtain equal rates of burning of various compositions. A characteristic size may be given as $\frac{1}{4}''$ thick by $\frac{3}{8}''$ square.

The following are examples of compositions which have been found to give satisfactory results:

Sugar mixtures.

(1) For yellow smoke:

Auramine	48 parts
Sugar	21 parts
Potassium chlorate	31 parts

(2) For red smoke:

Oil yellow	52 parts
Sugar	27 parts
Potassium chlorate	21 parts

(3) For purple smoke:

Purple dye No. 80260	50 parts
Sugar	20 parts
Potassium chlorate	30 parts

(4) For blue smoke:

Blue dye No. 80073	46 parts
Sugar	20 parts
Potassium chlorate	34 parts

Of the above compositions, the yellow has a tendency to inflame under certain conditions, but this may be corrected by the addition of sodium-bicarbonate in accordance with the following example:

(5) Auramine 47 parts
Sugar 20 parts
Potassium chlorate 31 parts
Sodium bicarbonate 2 parts

Flour compositions.

(6) For yellow smoke:

Auramine	48 parts
Flour	24 parts
Potassium chlorate	28 parts

(7) For red smoke:

Oil yellow	52 parts
Flour	25 parts
Potassium chlorate	23 parts

(8) For purple smoke:

Purple dye No. 80260	50 parts
Flour	23 parts
Potassium chlorate	27 parts

(9) For blue smoke:

Blue dye No. 80073	46 parts
Floor	24 parts
Potassium chlorate	30 parts

Of the dyes mentioned in the examples given above, the auramine is that termed "auramine O Conc" made by L. B. Holliday & Co., the oil yellow is British dyes No. 80069, the purple dye is British dyes No. 80260, and the blue dye is British dyes No. 80073.

Of the flour compositions the purple and blue are a little, while the red and yellow are considerably, slower than the corresponding sugar compositions.

It is not essential that the pelleted form of composition be employed in the containers. In some cases the composition may be pressed into the container under substantial pressure giving a much greater total mass than where loose pellets are used for filling.

The following table gives details of suitable sizes of orifice, weights of compositions employed, and the pressure at which they are compressed into the containers of about $2\frac{5}{8}$ inches diameter and $1\frac{1}{2}$ inches depth for various compositions in the unpelleted form:

Colour.	Orifices (one at top and one at bottom of container).	Weight of composition.	Pressure per square inch for each composition as pressed into the container.
	Inch.	*Grams.*	*Pounds.*
Red	$\frac{3}{4}$	100	50
Yellow	$\frac{1}{2}$	110	100
Purple	$\frac{1}{2}$	140	100
Blue	$\frac{1}{2}$	140	100
Black	1	200	100

For somewhat smaller containers and pelleted compositions the following examples may be given:

Colour.	Orifices, size and number.	Weight of composition.
Red	$\frac{1}{4}$ inch (4)	22 grams
Yellow	$\frac{1}{2}$ inch (4)	26 grams

Usually the pelleted compositions develop pressure somewhat quicker than the same compositions when merely pressed into the containers, and consequently a larger orifice may be used for the same weight of composition in the former as compared with the latter case.

What we claim and desire to secure by Letters Patent of the United States is:—

1. A smoke producing composition comprising coloring matter adapted to volatilize without substantial decomposition and intimately mixed self-combustible material made into pellets of predetermined uniform size, whereby the area of the initial ignition surface of the complete charge is controlled.

2. A smoke producing composition comprising coloring matter adapted to volatilize without substantial decomposition and intimately mixed self-combustible material, said composition being made in the form of a paste by the aid of alcohol and divided into pellets of predetermined uniform size, whereby the area of the ignition surface of the complete charge is controlled.

3. The method of making a smoke pro-

ducing unit of the type described, which consists in forming paste of coloring matter adapted to volatilize without substantial decomposition and a self-combustible material, and dividing the paste into pellets of predetermined uniform size, whereby the area of the ignition surface of the complete charge is controlled.

4. A smoke producing unit consisting of a mass of combustible composition stable at normal temperatures and comprising a large proportion of volatilizable colouring matter, a comburent and a combustible ingredient, means by which the composition can be ignited and a container for the said composition closed on all sides, but provided with smoke emitting orifices so proportioned and arranged that on ignition the temperature produced is sufficient to volatilize the colouring matter but too low is produce substantial decomposition of the said colouring matter.

5. A smoke producing unit comprising a number of pellets or tablets of predetermined uniform size, said pellets consisting of smoke producing composition comprising organic coloring matter adapted to volatilize without substantial decomposition, a comburent, a combustible ingredient and a smaller portion of sodium bicarbonate mixed with the combustible material to control combustion.

6. A smoke producing unit consisting of a mass of combustible composition stable at normal temperatures and comprising a large proportion of volatilizable colouring matter, a comburent and a combustible ingredient, means by which the composition can be ignited and a container for the said composition comprising a thin metal case closed on all sides and provided with a heat insulating lining and having an aperture for admission of the ignitions means and smoke emitting orifices so proportioned and arranged that on ignition the temperature produced is sufficient to volatilize the colouring matter but too low to produce substantial decomposition of the said colouring matter.

7. A smoke producing unit consisting of a mass of combustible material in the form of pellets of regular predetermined size and of a composition comprising a volatilizable colouring matter, a comburent and a combustible ingredient, means for igniting the said pellets and a closed container in which the pellets are packed, said container having smoke emitting orifices so proportioned and arranged that on ignition the temperature produced is sufficient to volatilize the colouring matter but too low to produce substantial decomposition of the said colouring matter.

OWEN DAVID LUCAS.
FREDERICK GEOFFREY LEES JOHNSON.