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GAS-PRODUCING DEVICE HAVING OBTURATING MEANS PROTECTING THE CHAMBER WALLS FROM COMBUSTION GASES

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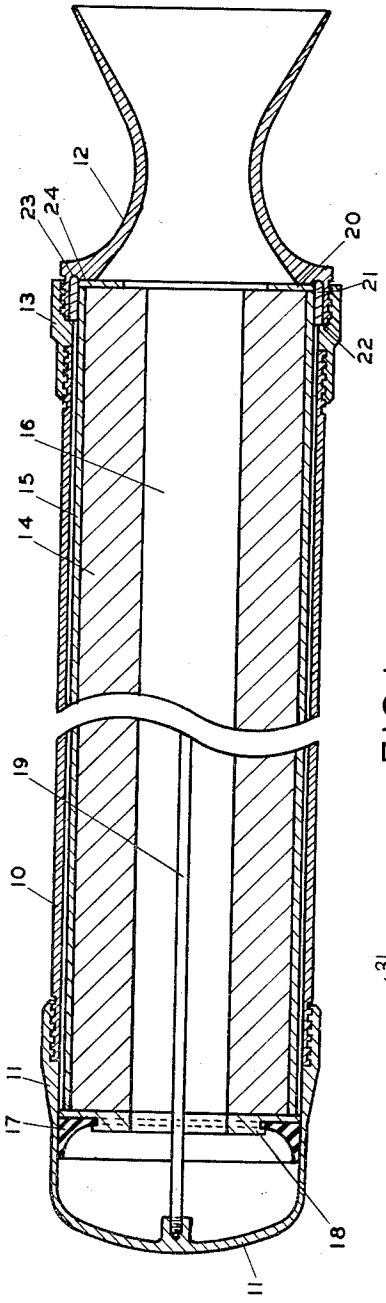


FIG. 1

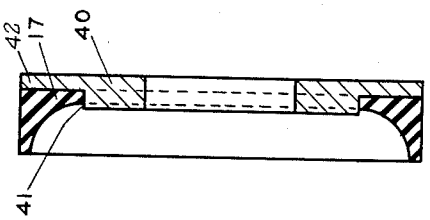


FIG. 3

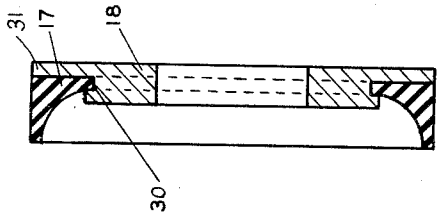


FIG. 2

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GAS-PRODUCING DEVICE HAVING OBTURATING MEANS PROTECTING THE CHAMBER WALLS FROM COMBUSTION GASES

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This invention relates to gas-producing devices and more particularly to sealing means whereby the walls of the combustion chamber may be isolated from hot combustion gases.

Combustion chambers for gas-producing devices have generally been constructed of steel because of its high strength over a wide range of temperatures. In order to obtain this strength at high temperature ranges, however, it has been necessary to sacrifice the decided weight advantage which would be inherent in the use of a lighter material of construction. This is particularly true in the case of smaller rocket applications where the amount of propellant is limited. The ratio of propellant to the inert weight of such rockets developed in recent years has been somewhat less than one with velocities generally ranging between 1000 to 2000 feet per second. Since this ratio is the determining factor governing the maximum obtainable velocity of the particular device, it is highly desirable to raise the ratio to the highest possible value. This is clearly seen if the equation is examined which relates the ratio between the mass of propellant (m) and the mass of the jet device without propellant (M), the gas velocity of the burning propellant (V) and the highest theoretically obtainable velocity of the jet device (V max.) as follows:

$$V_{max}=2.303V \log_{10}\left(1+\frac{m}{M}\right)$$

If it is possible to decrease M by 10%, and increase the amount of propellant to give the same total initial weight (V max.) would be increased by a factor

$$\frac{\log_{10}\left(1+\frac{1.1}{0.9}\right)}{\log_{10}\left(1+\frac{1}{1}\right)}$$

of about 1.15 or an improvement of 15% in obtainable velocity without any increase in initial weight.

Consequently, it is highly desirable to use lighter materials for construction of the combustion chambers of jet-actuated devices, e.g., materials such as high-strength aluminum or magnesium and their alloys. However, while these materials have high weight/strength ratios at low temperatures, they lose strength rapidly at the advanced temperatures encountered during combustion. If the lighter materials are to be used, therefore, it is essential that the chamber walls be isolated from the hot combustion gases. Such isolation has been attempted but the various procedures devised have been unreliable and impractical, particularly for mass production, or else so heavy as to defeat the purpose for which they were installed.

One of the principal problems to be overcome is that presented by the difference in the coefficient of expansion of the charge and its casing during both storage and combustion. Thus, because of temperature changes encountered during storage or combustion, differential expansion is usually encountered. Consequently, while

sealing means at one end of the charge may be fixed, that at the other end of the charge must allow for the expansion or contraction of the charge or casing and still maintain a highly efficient seal.

It is therefore an object of this invention to present a gas-producing device, the combustion chamber walls of which are completely isolated from the hot combustion gases by lightweight, inexpensive, easily manufactured and easily installed sealing means.

It is a further object of this invention to present a gas-producing device incorporating a fixed seal at one end of the charge and a slidable seal at the other end of the charge which will allow for expansion of the charge and still completely isolate the chamber walls from the hot combustion gases.

Generally described, the present invention relates to a gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; and slidable sealing means affixed to at least one end of the charge to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable sealing means comprising an elastomer obturating ring secured to the charge in slidable relationship to the casing. If a slidable seal is employed at only one end of the charge, then a fixed sealing means is employed at the other end. In its preferred form, the fixed seal comprises an annular disc of flame-resistant material bonded to the end of the charge, said disc having a diameter equal to that of the inhibited charge, and a ring of flame-resistant material bonded to the inhibiting jacket and the edge of the annular disc.

Having generally indicated its nature and purpose, the present invention will now be more specifically described with reference to the attached drawings.

FIG. 1 is a sectional view of a jet-actuated gas-producing device according to one embodiment of the invention.

FIG. 2 is an enlarged sectional view of the slidable sealing means employed in FIG. 1.

FIG. 3 is a sectional view of another embodiment of a slidable sealing means in accordance with the invention.

FIG. 1 illustrates a jet-actuated device wherein a tubular aluminum body member **10** forms the combustion chamber and has a steel sealing head member **11** threadedly engaged at one end and a steel discharge nozzle member **12** threadedly engaged to the other end by means of a steel adaptor **13**. A grain of combustible gas-producing material **14**, inhibited from burning on its peripheral surface by a jacket of cellulose acetate **15** and containing a centrally located cylindrical perforation **16**, is disposed within body member **10**. A slidable seal is disposed in head member **11** at the forward end of the gas-producing grain **14** which comprises an elastomer ring of cavetto configuration **17** held in sealing relationship with the inside wall of head member **11** and the end of grain **14** by a flanged annular disc of cellulose acetate **18**. As gas pressure increases within the head member **11**, the elastomer ring is forced against the head member wall and the end of the grain in a sealing but sliding relationship, completely preventing the combustion gases from passing between the inhibiting jacket **15** and head member **11** and reaching the tubular body member **10**. A metal resonance rod **19** is centrally secured to the interior of the head member **11** and projects rigidly into the perforation **16**.

A fixed seal is provided at the after end of the grain **14**. An annular disc of cellulose acetate **20** having a diameter

equal to that of the grain 14 plus the inhibiting jacket 15 is bonded to the end of the grain. A ring of cellulose acetate 21 is bonded to the inhibiting jacket 15 and to the edge of the annular disc 20. The shoulder formed by the forward edge of the ring 21 rests against the inner adaptor flange 22 while the after edge projects beyond the disc 20 and is seated in an accommodating annular recess 23 in the flange 24 of the discharge nozzle 12. When the grain 14 is loaded into the combustion chamber within body member 10 and the discharge nozzle 12 is threaded into place, a seal is formed which completely prevents gases of combustion from passing between the inhibiting jacket 15 and the adaptor 13 to reach the body member 10.

The jet-actuated device shown in FIG. 1 is preferably assembled by first threading the adaptor 13 on the after end of the tubular body member 10. The forward end of the gas-producing grain 14, already equipped with both slidable and fixed sealing means, is then introduced into the body member 10 from the after end and pushed forward until the shoulder formed by the forward end of the ring 21 rests against the adaptor flange 22. The discharge nozzle 12 is then tightly threaded into the adaptor, the projection of the ring 21 being tightly seated in the annular recess 23. The head member 11, with the resonance rod 19 secured thereto, is then passed over the slidable seal, now protruding from the forward end of the body member 10, and tightly threaded into place. The resonance rod 19 is used to dampen vibrations which might otherwise cause breakup or "slivering" of the charge. The rod may be made of any flame-resistant metallic substance but steel is preferred. A conventional war head, fin assembly, and initiating means (not shown) complete the jet-actuated device.

While the fixed seal as described has been found satisfactory, its strength can be further enhanced in the higher pressure ranges by applying a conventional sealing compound such as zinc chromate sealing compound to the shoulder of the ring 21. Although pressures necessitating such additional sealing means are generally not encountered in the range of useful rocket pressures, the additional strength furnished by the sealing compound does provide a greater safety factor which is, of course, highly desirable.

In FIG. 2 is shown an enlarged sectional view of the slidable sealing means employed in FIG. 1, which comprises a flanged annular disc of cellulose acetate 18 and an elastomer obturating ring of cavetto configuration 17. The inner edge of the ring 17 is seated in an annular recess 30 extending diametrically inwardly into the disc 18 at the base of the flange 31, and is thereby maintained in sealing but slidable relationship with the disc 18 and the inner wall of the head member.

FIG. 3 illustrates an additional embodiment of a slidable sealing means in accordance with the invention. This sealing means comprises a flanged annular retaining disc of cellulose acetate 40 and an elastomer obturating ring of cavetto configuration 17. The inner edge of the ring 17 rests on the shoulder 41 of the retaining disc and the lateral side of the ring 17 in contact with the flange 42 of the disc 40 and is securely bonded thereto. The elastomer ring 17 is thereby held in sealing but slidable relationship with the inner wall of the head member.

Having now specifically described the invention, the following examples are given to illustrate the functioning and effectiveness of the sealing means with which the gas-producing devices of the invention are equipped.

Example 1

Jet-actuated devices similar to that shown in FIG. 1 were made which were identical in all respects except for the materials from which the combustion chambers were constructed. The charged devices had the following specifications:

	Weight (lb.)		Length (in.)
	Type A (Steel)	Type B (Aluminum)	
Ignition assembly	1.00	1.00	72.00
Cap	6.00	6.00	5.72
Nozzle	11.00	11.00	10.60
Chamber	60.91	22.45	94.125
Powder	100.00	100.00	96.50
Total weight	178.91	140.45	

In type A, the combustion chambers were made from the conventional heat-resistant steel, from which the head member and discharge nozzle were constructed. In the type B device, the combustion chambers were made from a high-strength aluminum which had a high strength/weight ratio at ordinary temperatures. The type B devices were equipped with slidable and fixed sealing means of the invention while the type A devices were not. Both devices were charged with identical grains of combustible gas-producing material and were fired statically. After the completion of burning, both combustion chambers were intact. The remaining portions of the inhibiting jackets of the type A rounds were found to be charred on both the inner and outer surfaces due to passage of flame and hot powder gases between the restricted grain and the chamber wall. The remaining portions of the inhibiting jackets of the type B rounds were found to be charred only on the inside surfaces, the outside surfaces retaining their original appearance. This illustrated that the seals were functioning efficiently and were completely isolating the gases of combustion from the chamber walls.

Example 2

Type B rounds similar to those used in Example 1 were tested statically in comparison with type B rounds which were not fitted with the fixed and slidable sealing means. All rounds not fitted with the seals ruptured during burning, while the rounds equipped with seals functioned normally as in Example 1. Again it was noted that only the inside surfaces of the remaining portions of the inhibiting jackets were charred in the rounds equipped with seals.

Example 3

Four type B rounds were flight tested. The following table gives the weight specifications, the calculated drag-free velocity and observed velocity for each round fired. The difference in inert weight is due to variation in the war head.

	Weight		Calculated Velocity (ft./sec.)	Observed Velocity (ft./sec.)
	Powder	Inert		
1	103	128	3,769	3,307
2	102	112	4,125	3,570
3	103	110	4,223	3,747
4	101	95	4,634	4,094

All rounds functioned properly and exhibited normal flight behavior.

The theoretical increase in velocity obtainable through substitution of an aluminum chamber for a steel chamber may be easily computed by comparing the following rounds:

	Steel Round (weight in lbs.)	Aluminum Round (weight in lbs.)
Igniter assembly	1.00	1.00
Cap assembly	6.00	6.00
Nozzle	11.00	11.00
Chamber	60.91	22.45
Powder	100.00	100.00
Fin assembly	12.00	12.00
Restriction	10.00	10.00
Pay load	30.00	30.00
Total weight	230.91	192.45

Substituting in the formula,

$$V_{max}=2.303V \log_{10}\left(1+\frac{m}{M}\right)$$

wherein:

m=weight of propellant
M=weight of jet device without propellant
V=gas velocity of burning propellant
V_{max}=highest theoretically obtainable velocity

the following drag-free velocities are obtained:

	Ft./sec.
Steel round	3632
Aluminum round	4692

The sealing means of this invention may be generally employed in any type of gas-producing devices and their application is not restricted to rocket applications or the jet-actuated devices specifically illustrated in the drawings and employed in the examples. The head members, adaptors and members containing the discharge aperture may be made from any heat-resistant metal although ferrous metals and particularly steel are preferred. The body members or combustion chambers may be made from any light-weight, nonferrous metals or their alloys which have high weight/strength ratios at ordinary temperatures such as aluminum or magnesium. Aluminum and aluminum alloys are preferred because they are less expensive as well as completely satisfactory.

The discs and rings employed in the construction of the sealing means may be any substance such as plastic grade cellulose acetate or ethyl cellulose which has sufficient solidity, strength and flame resistance to maintain its strength and configuration during the combustion of the gas-producing charge. The flanged discs employed to support the cavetto elastomer rings of the slidable seals may be fabricated by molding or by cementing or otherwise bonding together a multiplicity of different size discs which will give the desired configuration.

The cavetto shaped obturating rings may be made from any desirable elastomeric substance of sufficient flame resistance to withstand the heat of combustion gases for the limited burning time of the gas-producing charges. Examples of operable materials are the natural rubbers; synthetic rubbers such as butadiene-styrene, butadiene-acrylonitrile, neoprene, chloroprene and the polyethylene-sulfides; and other flame-resistant polymeric substances having elastomeric characteristics. The cavetto rings may be molded or otherwise fabricated by any conventional process.

The gas-producing grains may be of any desired composition and configuration and may be inhibited by any flame-resistant substance such as plastic grade cellulose acetate and ethyl cellulose.

Thus, the present invention presents a gas-producing device containing a simple, inexpensive, and highly efficient means of isolating hot gases of combustion from the walls of the combustion chamber. When the sealing means of the invention are employed, it becomes possible to employ lightweight metals in construction of the combustion chambers. In rocket and other jet applications, use of such metals has the advantage of allowing higher velocities, higher weights of propellent charge, and greater payloads without any increase in weight over devices employing chambers constructed of heavy metals. It is evident from the general disclosure and the specific examples given that there are numerous factors which will influence conditions for the most satisfactory operation of this invention, the actual limits of which cannot be established except by a detailed study of each particular application. The invention is therefore to be considered as limited only by the scope of the appended claims and includes small gas-generating cartridges such as those used for the actuation of mechanical devices.

What I claim and desire to protect by Letters Patent is:

1. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; and slidable sealing means affixed to at least one end of the charge to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an elastomer obturating ring secured to the charge in slidable relationship to the casing.

2. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; casing for the charge; and slidable sealing means affixed to at least one end of the charge to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising a disc of flame-resistant material bonded to the end of the charge and an elastomer obturating ring mounted on the disc in slidable but sealing relationship with the casing.

3. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; and slidable sealing means affixed to at least one end of the charge to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising a disc of flame-resistant material bonded to the end of the charge and an elastomer obturating ring of cavetto configuration mounted on the disc in slidable but sealing relationship with the casing.

4. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; and slidable sealing means affixed to at least one end of the charge to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an annular disc of flame-resistant material having an outer peripheral flange, said disc being bonded to the end of the charge, and an elastomer obturating ring of cavetto configuration bonded to said flange with its concave surface facing away from the charge, said ring being disposed in slidable but sealing relationship with the casing.

5. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; and slidable sealing means affixed to at least one end of the charge to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an annular disc of flame-resistant material having an outer peripheral flange, said disc being bonded to the end of the charge and having an annular recess extended diametrically inwardly at the base of the flange, and an elastomer obturating ring of cavetto configuration mounted on the disc in slidable but sealing relationship with the casing, the inner edge of the ring being disposed in the recess at the base of the flange.

6. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface and a casing for the charge, said charge having a slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion

from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an elastomer obturating ring secured to the charge in slidable relationship to the casing.

7. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface and a casing for the charge, said charge having slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising a disc of flame-resistant material bonded to the end of the charge and an elastomer obturating ring mounted on the disc in slidable but sealing relationship with the casing.

8. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface and a casing for the charge, said charge having slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising a disc of flame-resistant material bonded to the end of the charge and an elastomer obturating ring of cavetto configuration mounted on the disc in slidable but sealing relationship with the casing.

9. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface and a casing for the charge, said charge having slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an annular disc of flame-resistant material having an outer peripheral flange, said disc being bonded to the end of the charge, and an elastomer obturating ring of cavetto configuration bonded to said flange with its concave surface facing away from the charge, said ring being disposed in slidable but sealing relationship with the casing.

10. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface and a casing for the charge, said charge having slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an annular disc of flame-resistant material having an outer peripheral flange, said disc being bonded to the end of the charge and having an annular recess extending diametrically inwardly at the base of the flange, and an elastomer obturating ring of cavetto configuration mounted on the disc in slidable but sealing relationship with the casing, the inner edge of the ring being disposed in the recess at the base of the flange.

11. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; a head member secured to one end of the casing and a discharge nozzle member secured to the opposite end of the casing; said charge having a slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an elastomer obturating ring secured to the charge in slidable relationship to the casing and said fixed means comprising an annular disc of flame-resistant material bonded to the end of the charge, the outside diameter of the disc being equal to the diameter of the inhibited charge, and a ring of flame-resistant material bonded to the outside of the inhibiting jacket and to the edge of the annular disc, the edge of the ring projecting past the disc, said projection being seated in an annular recess in the interior wall of the discharge nozzle, said nozzle exerting pressure on both disc and ring.

12. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; a head member secured to one end of the casing and a discharge nozzle member secured to the opposite end of the casing; said charge having a slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combution from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising a disc of flame-resistant material bonded to the end of the charge and an elastomer obturating ring mounted on the disc in slidable but sealing relationship with the casing and said fixed means comprising an annular disc of flame-resistant material bonded to the end of the charge, the outside diameter of the disc being equal to the diameter of the inhibited charge, and a ring of flame-resistant material bonded to the outside of the inhibiting jacket and to the edge of the annular disc, the edge of the ring projecting past the disc, said projection being seated in an annular recess in the interior wall of the discharge nozzle, said nozzle exerting pressure on both disc and ring.

13. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; a head member secured to one end of the casing and a discharge nozzle member secured to the opposite end of the casing; said charge having a slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising a disc of flame-resistant material bonded to the end of the charge and an elastomer obturating ring of cavetto configuration mounted on the disc in slidable but sealing relationship with the casing and said fixed means comprising an annular disc of flame-resistant material bonded to the end of the charge, the outside diameter of the disc being equal to the diameter of the inhibited charge, and a ring of flame-resistant material bonded to the outside of the inhibiting jacket and to the edge of the annular disc, the edge of the ring projecting past the disc, said projection being seated in an annular recess in the interior wall of the discharge nozzle, said nozzle exerting pressure on both disc and ring.

14. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; a head member secured to one end of the casing and a discharge nozzle member secured to the opposite end of the casing; said charge having a slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an annular disc of flame-resistant material having an outer peripheral flange, said disc being bonded to the end of the charge, and an elastomer obturating ring of cavetto configuration bonded to said flange with its concave surface facing away from the charge, said ring being disposed in slidable but sealing relationship with the casing and said fixed means comprising an annular disc of flame-resistant material bonded to the end of the charge, the outside diameter of the disc being equal to the diameter of the inhibited charge, and a ring of flame-resistant material bonded to the outside of the inhibiting jacket and to the edge of the annular disc, the edge of the ring projecting past the disc, said projection being seated in an annular recess in the interior wall of the discharge nozzle, said nozzle exerting pressure on both disc and ring.

15. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge; a head member secured to one end of the casing and a discharge nozzle member secured to the opposite end of the casing; said charge having a slidable sealing means and a fixed sealing

means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an annular disc of flame-resistant material having an outer peripheral flange, said disc being bonded to the end of the charge and having an annular recess extended diametrically inwardly at the base of the flange, and an elastomer obturating ring of cavetto configuration mounted on the disc in slidable but sealing relationship with the casing, the inner edge of the ring being disposed in the recess at the base of the flange and said fixed means comprising an annular disc of flame-resistant material bonded to the end of the charge, the outside diameter of the disc being equal to the diameter of the inhibited charge, and a ring of flame-resistant material bonded to the outside of the inhibiting jacket and to the edge of the annular disc, the edge of the ring projecting past the disc, said projection being seated in an annular recess in the interior wall of the discharge nozzle, said nozzle exerting pressure on both disc and ring.

16. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge constructed from a lightweight flame-resistant material; and slidable means affixed to at least one end of the charge to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an elastomer obturating ring secured to the charge in slidable relationship to the casing.

17. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge constructed from a lightweight nonferrous metal, said charge having a slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising an elastomer obturating ring secured to the charge in slidable relationship to the casing.

18. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface; a casing for the charge constructed from an aluminum alloy; a head member secured to one end of the casing and a discharge nozzle member secured to the opposite end of the casing, both of which are constructed from a heat-resistant ferrous metal; said charge having a slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising a cellulose acetate disc bonded to the end of the charge and an elastomer obturating ring mounted on the disc in slidable but sealing relationship with the casing and said fixed means comprising an annular disc of cellulose acetate bonded to the end of the charge, the outside diameter of the disc being equal to the diameter of the inhibited charge, and a ring of cellulose acetate bonded to the outside of the inhibiting jacket and to the edge of the annular disc, the edge of the ring projecting past the disc, said projection being seated in an annular recess in the interior wall of the discharge nozzle, said nozzle exerting pressure on both disc and ring.

19. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface by a jacket of cellulose acetate; a casing for the charge constructed from an aluminum alloy; a steel head member secured to one end of the casing and a steel discharge nozzle member secured to the opposite end of the casing; said charge having a slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising a cellulose acetate disc having an outer peripheral flange, said disc being bonded to the end of the charge, and an elastomer obturating ring of cavetto configuration bonded to said flange with its concave surface facing away from the charge, said ring being disposed in slidable but sealing relationship with the casing and said fixed means comprising an annular disc of cellulose acetate bonded to the end of the charge, the outside diameter of the disc being equal to the diameter of the inhibited charge, and a ring of cellulose acetate bonded to the outside of the inhibiting jacket and to the edge of the annular disc, the edge of the ring projecting past the disc, said projection being seated in an annular recess in the interior wall of the discharge nozzle, said nozzle exerting pressure on both disc and ring.

20. A gas-producing device having in combination a gas-producing charge inhibited from burning on its peripheral surface by a jacket of cellulose acetate; a casing for the charge constructed from aluminum alloy; a steel head member secured to one end of the casing and a steel discharge nozzle member secured to the opposite end of the casing; said charge having a slidable sealing means and a fixed sealing means at opposite ends thereof to prevent hot gases of combustion from passing between the inhibited peripheral surface of the charge and the casing, said slidable means comprising a cellulose acetate disc having an outer peripheral flange, said disc being bonded to the end of the charge and having an annular recess extended diametrically inwardly at the base of the flange, and an elastomer obturating ring of cavetto configuration mounted on the disc in slidable but sealing relationship with the casing, the inner edge of the ring being disposed in the recess at the base of the flange and said fixed means comprising an annular disc of cellulose acetate bonded to the end of the charge, the outside diameter of the disc being equal to the diameter of the inhibited charge, and a ring of cellulose acetate bonded to the outside of the inhibiting jacket and to the edge of the annular disc, the edge of the ring projecting past the disc, said projection being seated in an annular recess in the interior wall of the discharge nozzle, said nozzle exerting pressure on both disc and ring.

No references cited.