United States Patent

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[33] **France**
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[54] **SOLID PROPELLANT IGNITER**
7 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **102/70R,** 102/70.2A
[51] **Int. Cl.** **F42c 19/12**
[50] **Field of Search** ..... 102/49.7, 70, 70.2; 60/39.82 E, 254

[56] **References Cited**
UNITED STATES PATENTS

2,995,088	8/1961	Asplund	102/70
3,062,147	11/1962	Davis et al.	102/70
3,151,447	10/1964	Bornstein	102/70X

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ABSTRACT: An igniter suitable for use with solid propellant rockets comprises a substantially cylindrical body formed of a flexible plastic material having an axial bore and axially extending cylindrical cavities symmetrically distributed around the axial bore with the axes of the cavities lying on at least one ring centered on the bore axis. Radial passages connect the cavities with the axial bore and with the outside of the body. A primary charge, preferably of black powder contained in a latticework casing, and means for assembling the primary charge are located in the axial bore, and an ignition charge comprising alumino-thermic pellets are symmetrically located in the cavities.

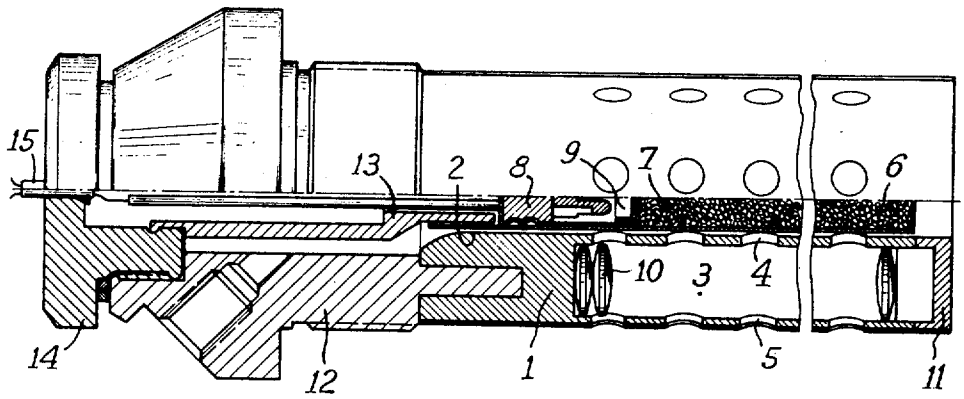

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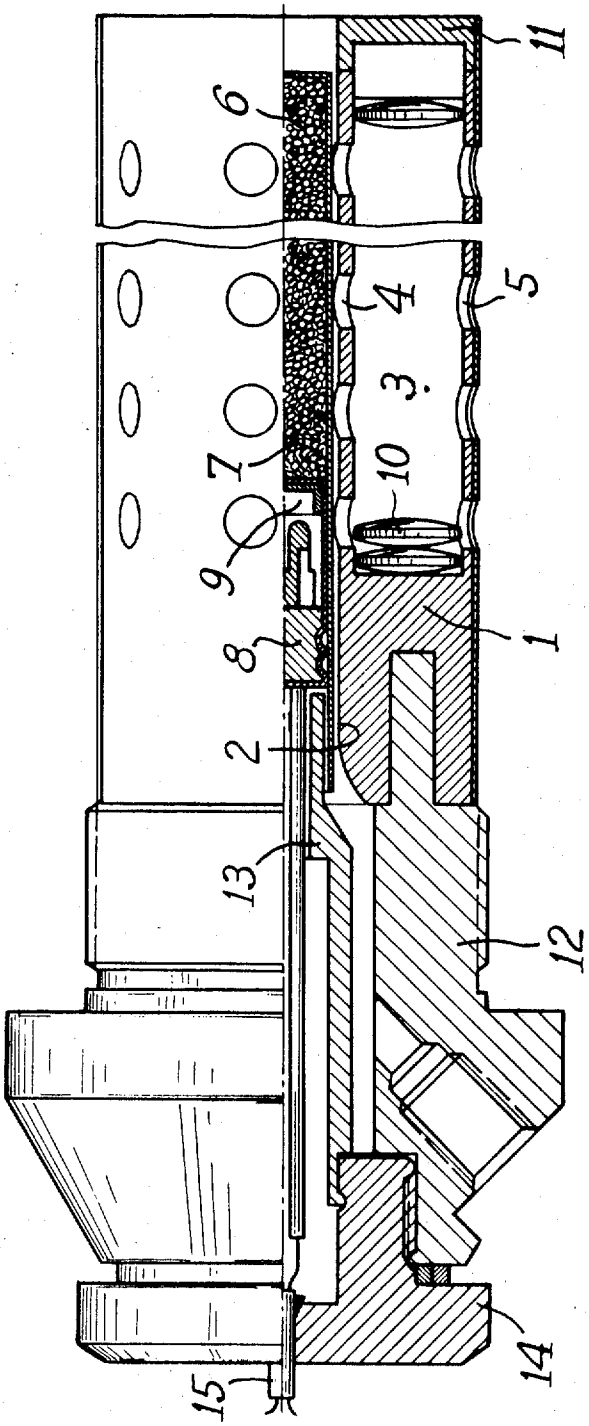
Fig. 1



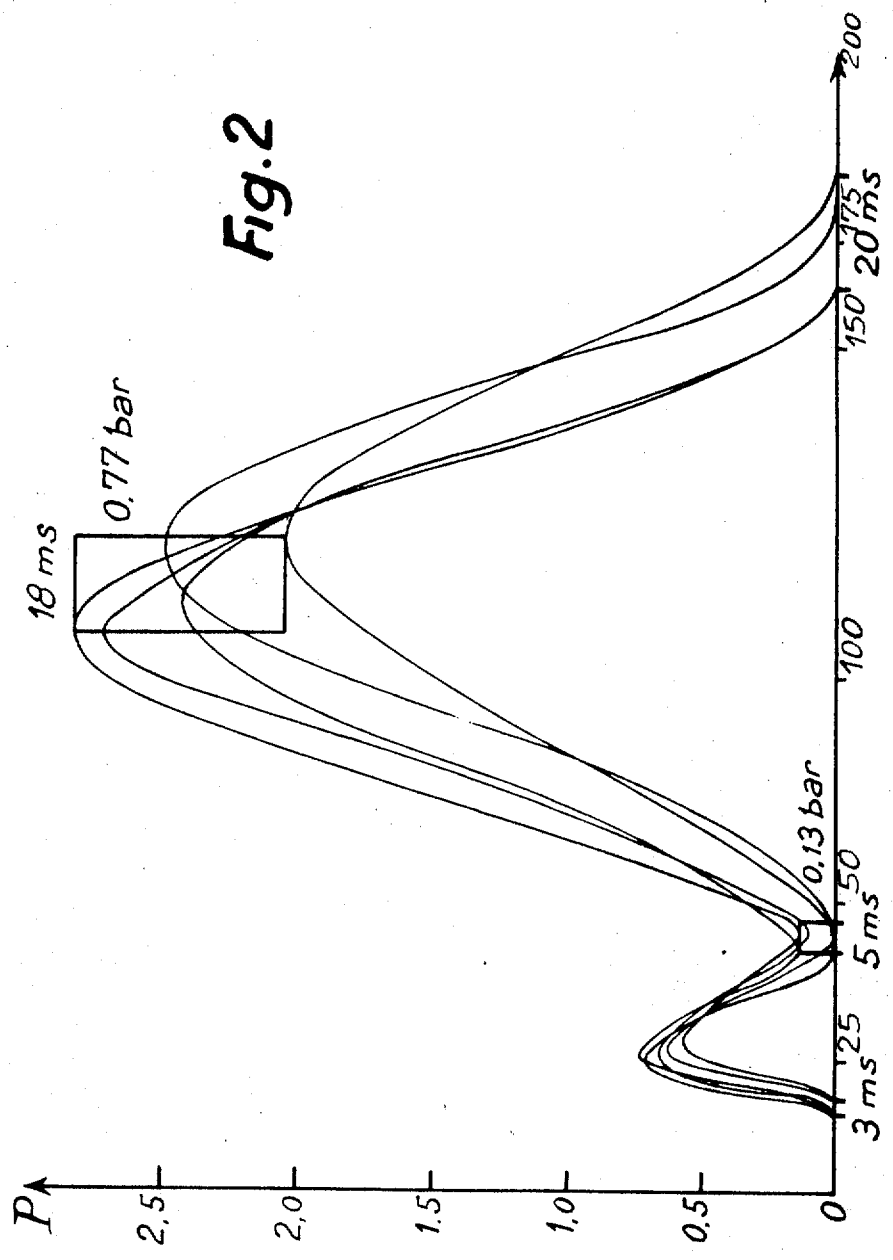


Fig.2
P
2,5
2,0
1,5
1,0
0,5
0
25
50
100
150
175
200
3 ms
5 ms
20 ms
0,13 bar
0,77 bar
18 ms

SOLID PROPELLANT IGNITER

This invention relates to a solid propellant igniter for use in rockets and in propulsion units utilizing blocks of solid propergols.

One type of conventional igniter for solid propellant systems consists of a primary charge of gunpowder-type black powder and an ignition charge of alumino-thermic pellets, the pellets being loosely placed in a perforate, rigid plastics material cage surrounding the primary charge. This type of igniter has a poor resistance to vibration, to temperature variations, and gives irreproducible results with respect to the pressure and duration of the ignition. Since the pellets are loosely disposed in the rigid plastics cage they are liable to break or crumble, particularly on mechanical impact.

We have now developed an igniter which has an increased mechanical performance and gives more reproducible ignition characteristics and according to the present invention, therefore, we provide an igniter suitable for use with solid propellant rockets, which comprises a substantially cylindrical body, formed of a flexible plastics material, having an axial bore and axially extending cylindrical cavities symmetrically distributed around the axial bore with the axes of the cavities lying on at least one ring centered on the bore axis, radial passages connecting the cavities to the axial bore and to the outside of the body, a primary charge and means for assembling the primary charge located in the axial bore, and an ignition charge comprising alumino-thermic pellets symmetrically located in the cavities.

The primary charge may be a black powder of the gunpowder-type or one which does not give a high detonation pressure (e.g. alumino-thermic powders such as ALCLO which is a trade designation of Aerojet-General Corporation). The primary charge is contained in a latticework casing having a plastics cover, the charge being detonated by an electric ignition device associated with a pyrotechnic system or by a purely pyrotechnic system.

The ignition charge comprises alumino-thermic pellets symmetrically disposed in the cavities. The diameter of the cavities is preferably between 0.1 and 0.4 times the diameter of the igniter and is preferably substantially equal to that of the pellets so that they are held closely in the cavities. The diameter of the pellets is typically from 1 to 30 mm.

In order that the invention may be more fully understood, a preferred embodiment of the igniter will now be described, by way of illustration only, with reference to the accompanying drawings, in which:

FIG. 1 is a partially sectional elevation of a preferred embodiment of an igniter according to the invention, and

FIG. 2 is a graph of the ignition pressure against ignition duration showing the reproducibility of ignition using igniters according to the invention.

With reference to FIG. 1, the igniter comprises a substantially cylindrical body 1 made of flexible plastics material, e.g. a polyurethane containing an alkaline-earth metal oxalate filler, having an axial bore 2 holding the primary charge and cylindrical cavities 3 symmetrically distributed in an annular relationship around the axial bore and holding the ignition charge. Radial holes 4 and 5 are provided to connect the cavities to the axial bore and to the exterior of the igniter.

The axial bore holds a primary charge consisting of 1.7 g of gunpowder-type black powder 6 in a latticework cage 7 having a polyethylene cover, the charge being detonated by an electric ignition device 8 via a pyrotechnic system 9.

The ignition charge consists of 25 g of alumino-thermic ignition pellets 10 (comprising a mixture of potassium perchlorate, aluminum and a binder such as aluminum stearate). The pellets are 9.5 mm. in diameter, 2.5 mm. thick, and weight 0.26 g each, and are symmetrically stacked in the cylindrical cavities 3 around the central bore 2.

The igniter body is sealed at one end by a stopper 11, and the other end is secured to an adapter 12 for assembling the igniter in the front part of the propulsion unit. The primary charge is attached to a tube support 13 which in turn is rigidly secured to a member 14.

The point 15 where the wires of the electric ignition device enter the tube support is sealed by packing materials, and the point where the wires enter the adapter is also sealed by conventional sealing compounds.

The flexible plastics igniter body can be manufactured by molding in an open mold and by subsequently piercing the shaped body with radial holes. The flexible plastics material can be any of the known plastics which do not deteriorate under the conditions produced by the combustion of the propergol blocks. Polyurethane resin containing an alkaline-earth metal oxalate filler is particularly suitable, since it is very easily worked, is extremely flexible, and has a high resistance to elevated temperatures, with the result that it need not be ejected from the unit in use. If, in fact, the igniter is ejected, then there is no danger that the pipe will be destroyed.

This igniter has an improved mechanical resistance to vibration and to temperature variations. It also gives results which are closely reproducible with regard to ignition duration and pressure characteristics. Typical ignition duration and pressure variations do not exceed 15 percent and 10 percent of the average values, respectively, whereas for a conventional igniter the variations are more than 39 percent and 23 percent, respectively.

The reproducibility of ignition is demonstrated by tests which were carried out on an inert block into which 5 identical igniters according to the invention were successively fired. The curves given by the 5 igniters are all shown on FIG. 2. On this graph, the relative pressure in bars is shown as ordinates and the duration of ignition in ms is shown as abscissae.

On the graph, the time scatter is 3 ms., 5 ms., 18 ms. and 20 ms., and the pressure scatter is 0.13 bar and 0.77 bar.

The igniter was also subjected to vibration under very sever conditions without any dust being produced from the charges, whereas a conventional igniter subjected to much less severe vibration conditions produced 2.5 percent of dust. Furthermore, no pellet was broken in the igniter according to the invention, whereas in the conventional igniter the number of broken pellets was relatively high.

I claim:

1. An igniter suitable for use with solid propellant rockets, which comprises
   - i. a substantially cylindrical body formed of a flexible plastics material,
     - a. said body having an axial bore,
     - b. said body having axially extending cylindrical cavities therein symmetrically distributed around said axial bore with the axes of said cavities lying on at least one ring centered on said bore axis, and
     - c. said body having radial passages therein connecting said cavities to said axial bore and to the outside of said body,
   - ii. a primary charge and means for assembling said primary charge located in said axial bore, and
   - iii. an ignition charge comprising alumino-thermic pellets symmetrically located in said cavities.

2. The igniter set forth in claim 1, which comprises means for attaching the igniter to the propulsion unit of a solid propellant rocket.

3. The igniter set forth in claim 1, wherein the primary charge and said assembling means comprise black powder contained in a latticework casing and the primary charge is associated with a pyrotechnic system for detonating said primary charge.

4. The igniter set forth in claim 3, wherein said pyrotechnic system is associated with an electric ignition device.

5. The igniter set forth in claim 1, wherein the diameter of said cylindrical cavities is substantially equal to that of said alumino-thermic pellets forming said ignition charge.

6. The igniter set forth in claim 4, wherein the diameter of said cylindrical cavities is from 0.1 to 0.4 times the diameter of the igniter.

7. The igniter set forth in claim 1, wherein said body is formed of polyurethane having as filler therein an alkaline earth metal oxalate.