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ROCKET PROPELLANT GRAIN WITH HELICALLY GROOVED PERFORATION

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Fig. 1.

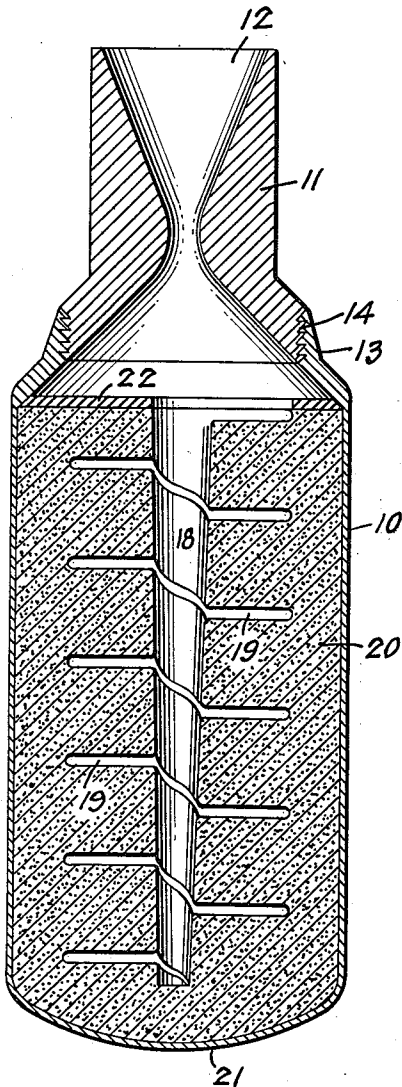
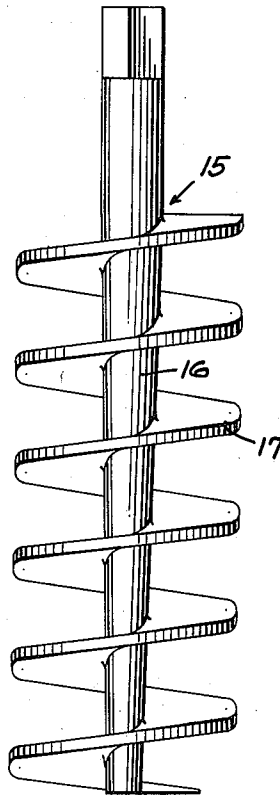


Fig. 2.



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ROCKET PROPELLANT GRAIN WITH HELICALLY GROOVED PERFORATION

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2 Claims. (Cl. 60—35.6)

This invention relates to a single grain propellant powder charge and a method for forming same.

Molded rocket propellant grains having central cavities of star configuration have been found to inherit many disadvantages of earlier types and also give low loading density or long burning times.

It has been found that by forming a helical slot or cavity around an axial bore in a single grain propellant charge that high loading density and short burning time is accomplished, also the charge has the ability to withstand stresses due to centrifugal loading (in spin stabilized rounds) and temperature cycling. When used in spin stabilized rockets, regressive burning of the single grain charge lessens the combined rotational and pressure stresses. The increased surface exposed to ignition by the helical slot throughout the length of the single grain promotes rapid outward burning and reduction in the formation of slivers of the charge.

From tests of various propellants it has been concluded that polysulfide perchlorate propellant is best suited for the present purpose. Because of its elastomerlike properties the aforesaid propellant has the ability to withstand set-back forces and considerable deformation can be tolerated before cracking or breaking occurs. The tapered axial bore in the grain provides for uniform gas velocity throughout the length of the grain and combined with the short burning time of the grain produces a high speed motor with a much greater range than formerly attained.

An object of the invention is to provide a single grain propellant powder charge which will withstand linear and rotational set-back forces.

Another object of the invention is to provide a propellant powder charge interiorly formed to effect a shorter burning time and to improve ballistic performance.

Another object of the invention is to provide a propellant powder charge having a central axial bore surrounded by and in open communication with a continuous helical slot to promote fast outward burning time.

Other objects and advantages will be apparent from the following detailed description and the accompanying drawings, in which:

Figure 1 is a longitudinal section of a rocket motor body showing the cast propellant therein; and

Figure 2 is a side elevation of the mandrel.

In the drawings, wherein for the purpose of illustration is shown one form of the invention, the reference character 10 indicates the body of a rocket motor, and 11 indicates a nozzle having an exit cone 12 of any desired configuration. The nozzle 11 is secured to a diametrically reduced portion 13 of the motor body by the screw threaded connection 14.

A mandrel 15 having a tapered central core 16, and a helically disposed fin 17 of constant pitch secured thereto, is employed to form an axial passageway 18 and a helical recess 19 in a pourable propellant charge 20 within the body 10 of the rocket motor. After the propellant has hardened the mandrel 15 is unscrewed therefrom. The tapered surface of the core 16 effect easy removal after the grain is cured.

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It will be noted that the thread 17 of the mandrel 15 has a relatively low pitch so as to provide a plurality of complete revolutions of the helical recess 19 in the propellant grain.

The method of forming the single grain propellant of the invention is as follows:

The motor body 10 is set up in a vertical position, before the nozzle has been attached, and the mandrel 15 is lowered therein. Means (not shown) position the mandrel on the longitudinal axis of the motor body and with its inner end spaced from the forward end wall 21 thereof. The uncured propellant charge is then poured into the motor body to a level coincident with, but not covering the upper end of the helix 17. The assembled motor body, mandrel and propellant are placed in a curing oven at controlled temperature and the propellant is cured. Removal of the mandrel is accomplished by unscrewing from the finished grain. An inhibitor 22 of preferred composition is applied to the rear end of the grain and the motor is then ready to be assembled with the nozzle 11 and an igniter (not shown).

While I have disclosed a form of the invention presently preferred by me, various changes and modifications will occur to those skilled in the art after a study of the present disclosure. Hence the disclosure is to be taken in an illustrative rather than a limiting sense; and it is my desire and intention to reserve all modifications falling within the scope of the scope of the subjoined claims.

Having now fully disclosed the invention what I claim and desire to secure by Letters Patent is:

1. A rocket motor having a substantially cylindrical casing, a cast propellant grain inclosed within said casing, said propellant grain coaxially oriented with respect to said casing and snugly fitting the walls thereof, a nozzle mounted at the aft end of said casing, a tapered cavity opening rearwardly of said propellant grain and extending substantially the entire length thereof, said tapered cavity lying on the axis of said propellant grain, a helical recess in surrounding relation to said tapered cavity and in communication with said tapered cavity along the whole length thereof, said helical recess having a relatively low pitch angle to a plane transverse to said grain axis, and said nozzle aligned and in communication with said tapered cavity to accommodate axial flow of combustion gases.

2. A rocket motor having a substantially cylindrical casing, a propellant grain inclosed with said casing, said propellant grain coaxially oriented with respect to said casing and snugly fitting the walls thereof, a nozzle mounted at the aft end of said casing, a tapered cavity opening rearwardly of said propellant grain and extending substantially the entire length thereof, said tapered cavity lying on the axis of said propellant grain, a helical recess in said grain in surrounding relation to said tapered cavity along the whole length thereof, said helical recess having a relatively small pitch so as to provide a plurality of complete revolutions of said recess surrounding said cavity, and said nozzle being aligned and in communication with said tapered cavity to accommodate axial flow of combustion gases.

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