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S. RUBIN ET AL
MULTIPLE GRAIN ROCKET

2,728,295

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4 Sheets-Sheet 1

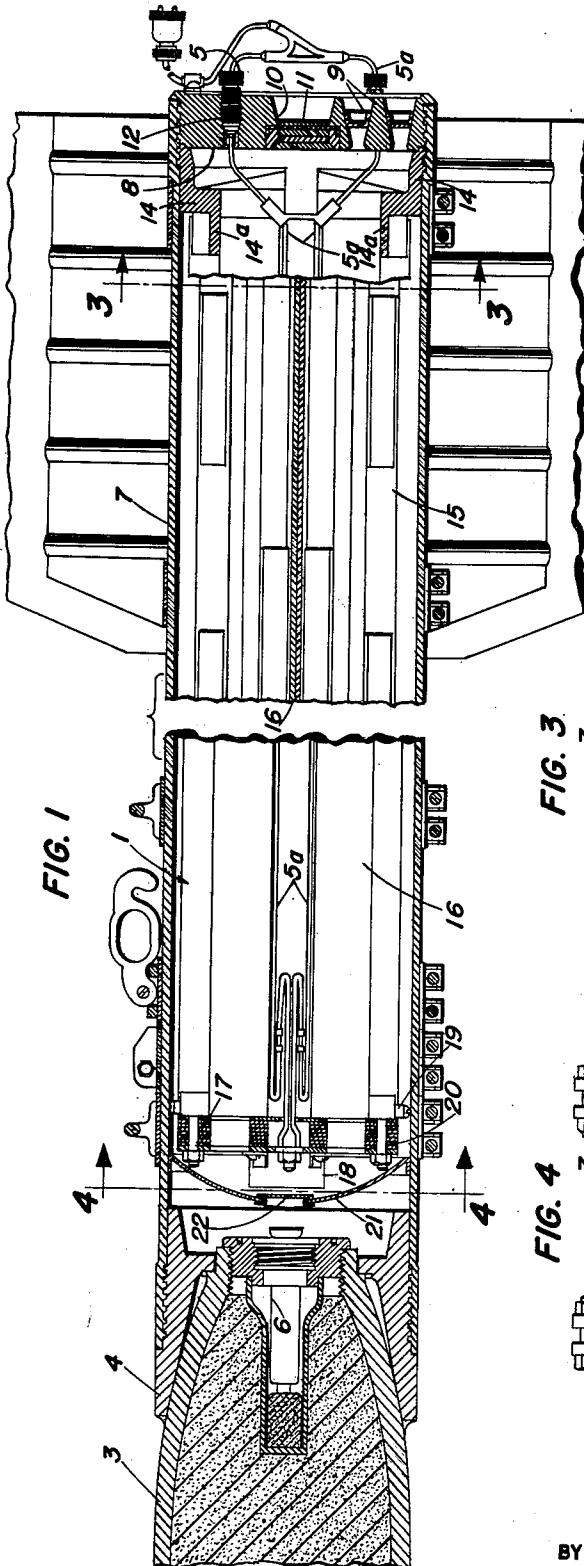


FIG. 1

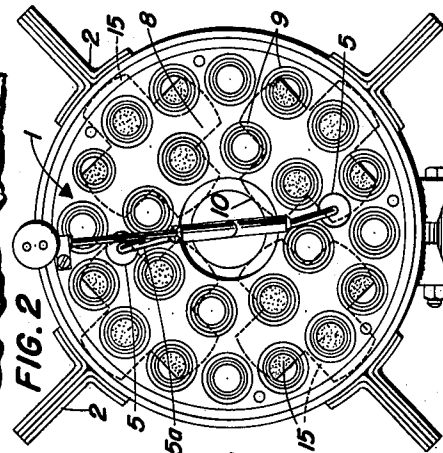


FIG. 2

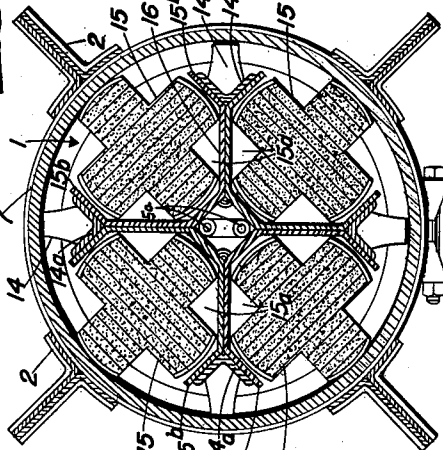


FIG. 3

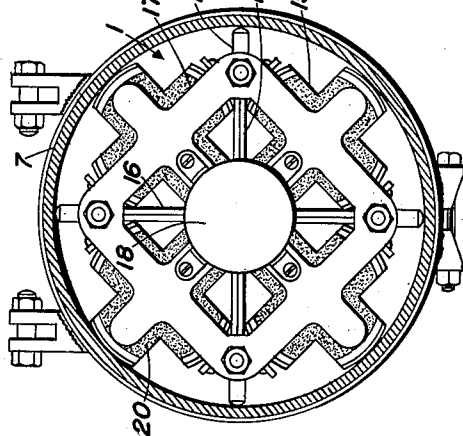


FIG. 4

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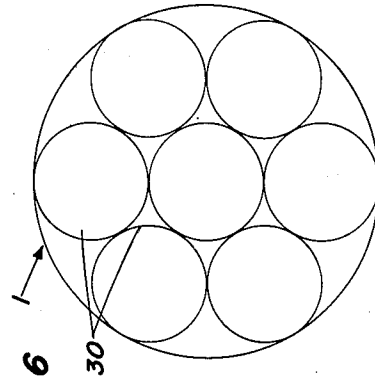
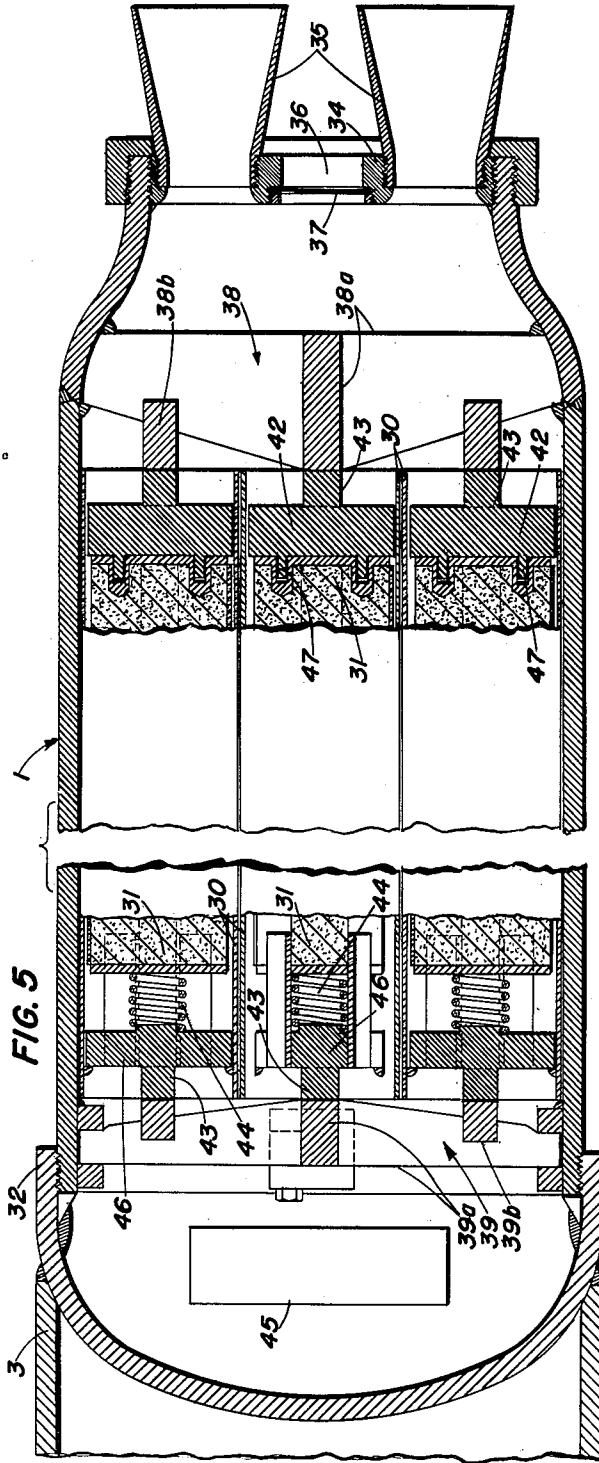


FIG. 6

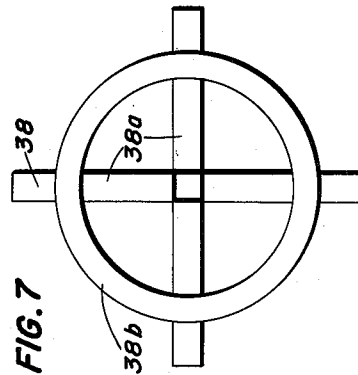


FIG. 7

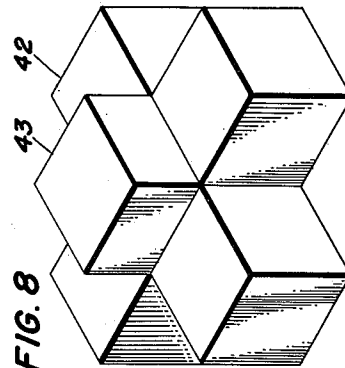


FIG. 8

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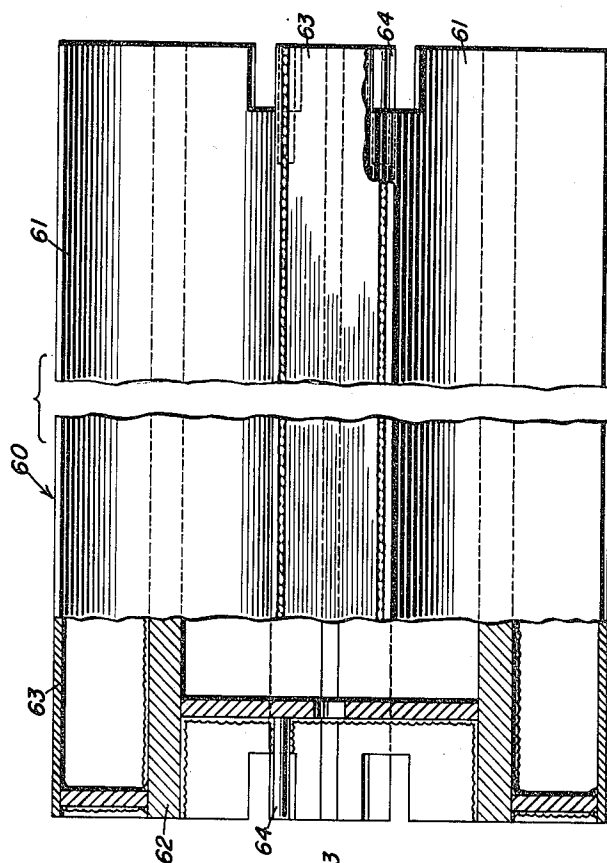


FIG. 11.

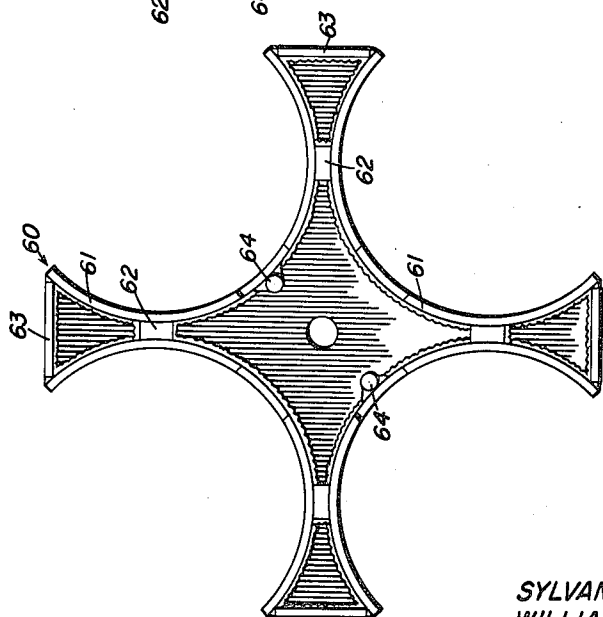


FIG. 12.

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MULTIPLE GRAIN ROCKET

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3 Claims. (Cl. 102—49)

This invention relates to rockets of the multiple grain type and is particularly directed to improvements in the rocket motor.

A principal object of the present invention is to provide a rocket capable of carrying a large pay load with a plurality of longitudinally disposed chambers for supporting propellant grains throughout their full length so that the tendency for the grains to break up or fracture during burning is minimized.

A further object of the present invention is to provide a multiple grain rocket wherein each of the propellant grains burns without affecting the burning of the other grains.

A still further object of the present invention is to provide a multiple grain rocket having a plurality of nozzles mounted thereon.

Still further objects, advantages and improvements will be apparent from the following description of the invention taken in connection with the accompanying drawings, of which:

Fig. 1 is a longitudinal sectional view of the multiple grain rocket.

Fig. 2 is a tail end view of the rocket.

Fig. 3 is a sectional view taken along 3—3 of Fig. 1.

Fig. 4 is a sectional view taken along 4—4 of Fig. 1.

Fig. 5 is a longitudinal sectional view of a modification of the present invention.

Fig. 6 is a diagrammatic view showing a cross section of the arrangement of the multiple grain support.

Fig. 7 is a front view of the grid utilized in the motor shown in Fig. 5.

Fig. 8 is a perspective view of a typical spacer element.

Fig. 9 is a side view partly in section of a further modification of the motor.

Fig. 10 is an end view of the multiple grain support utilized in the motor shown by Fig. 9.

Fig. 11 is a side view partly in section of a still further modification of the present invention.

Fig. 12 is an end view of the multiple grain support utilized in the motor shown by Fig. 11.

Referring now to the drawings on which like numerals of reference are employed to designate like parts throughout the several views, and more particularly to Figs. 1—4 inclusive, the numeral 1 indicates a motor unit of a multiple grain rocket having a pay load 3 mounted on the forward end thereof and a set of stabilizing fins 2 symmetrically disposed along the wall at the rear end of the motor unit 1. The pay load 3 consists of an armor piercing projectile, a demolition projectile or the like having a base fuse 6 and a rear portion of reduced diameter to which an adapter ring 4 is welded or otherwise secured. The rear portion of the adapter ring is threaded to receive a threaded portion on the forward end of a tubular shell 7 of the motor unit 1. On the rear end of the tubular shell 7 there is a nozzle plate 8 provided with two concentric rings of nozzles 9 and a centrally positioned relief nozzle 10 normally closed by a frangible or shear disc 11. The annular arrangement of the nozzles enables group-

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ing identical numbers of them in line with the propellant grain compartments 15a (Fig. 3) so that each group accommodates substantially identical volumes of gas jetting from the burning grains, as can be understood by comparing the nozzle positions with the dotted line powder grains in Fig. 2. A pair of openings 5 in the nozzle plate 8 permits the ignition lines 5a to extend there-through, and the fittings 12 which encircle the ignition lines 5a to be frictionally held therein to exclude the entrance of moisture into the motor 1. The ignition lines 5a extend through the length of the motor 1 and are connected at their free ends to an igniter 18 disposed at the forward end of the motor 1.

The molded and rigid cruciform propellant grains 15 are supported within the shell 7 by a unitary cage structure 16 inserted in and extending the full length of the motor 1 and made up of mutually secured sheet metal sections each roughly U-shaped in cross section with beveled corners (see Fig. 3). The U-shapes of said sections define the aforesaid compartments 15a for the annular series of propellant grains, being open as shown (Fig. 3) so that portions of the cross-sectionally cruciform grains may extend through and engage the shell wall. A four-point support is thus provided. The beveled corners of the U-shaped sections together with the sections themselves form four radiating Y-shaped arms extending between the grains 15, and a central tube of square cross section through which the ignition lines 5a extend. The beveled corners define valleys 15b which flare toward the shell.

A grid 17 mounted at the forward end of the shell 7 is secured to the forward end of the grain support or cage 16 maintaining the cage in centered and evenly spaced relationship around the internal wall of the shell 7 by means of a plurality of symmetrically disposed lugs 19. Mounted within the shell 7 adjacent the nozzle plate 8 is a grid 14 which includes components 14a (Fig. 1) fitted in and secured in the foregoing valleys to provide an end support for the cage 16.

An igniter case 18 which is secured in the grid 17 is connected to the free ends of the ignition lines 5a. A plurality of felt shock pads 20 are interposed between the forward ends of the propellant grains 15 and the forward grid 17. The motor unit 1 is sealed from the projectile 3 by means of a sheet metal closure plate 21 secured at its periphery to the shell 7 and having a rupturable closure disc 22 mounted at the central portion of the closure plate 21. Secured about the shell 7 are the conventional fittings for releasably mounting the rocket onto launching devices (not shown) on an airplane or other mobile launchers.

In Figs. 5—8 inclusive, a modification of the multigrain rocket motor is shown wherein an increased number of grains are utilized.

The motor 1 is cylindrical in shape having a dome shaped cap 32 secured to the forward end thereof. The rear portion of the motor 1 is reduced in diameter carrying a nozzle plate 34 upon which a plurality of nozzles 35 are symmetrically arranged about a common center. At the central portion of the nozzle plate 34 there is a blow-out port 36 normally closed by a rupturable disc 37.

The grains 31 extend longitudinally throughout substantially the length of the motor 1 and are arranged in a circle about the axis of the motor 1 with an additional grain centrally disposed (see Fig. 6). The grains 31 are housed in the cylindrical tubes 30 which are maintained securely within the motor 1 by a pair of grids 38 and 39 welded or otherwise secured to the motor 1 at the rear and forward ends, respectively.

The rear grid 38 consists of a pair of cross members 38a secured at their ends to the shell of the motor 1 and having an increasing width approaching the axis thereof.

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The grid 38 supports a ring 38b fitted into an annular groove situated on its forward or inward side. Spacer elements 42 (see Fig. 8) cruciform in cross section as are the grains 31, are provided with central bosses 43 on one face which engage the ring 38b and the cross members 38a and a pair of bosses 47, 47 on the opposite face fitting into companion openings in the rear end of the propellant grains 31. The front grid 39 is similar in construction to that of the rear grid 38 except that the front grid 39 is lighter in weight. A spring 44 is interposed between each of the front spacer elements 46 and each of the propellant grains 31 to maintain the grains 31 securely in position. An igniter 45 is positioned within the dome shaped cap 32 and connected to ignition wires (not shown).

Now referring to Figs. 9 and 10, a propellant grain support assembly 50 is shown consisting of four quarter cylinders 51 welded or otherwise secured together along their sides with their concave surfaces facing outwardly and having radially extending plates 52 secured to the adjacent sides of the quarter cylinders 51 to form four quadrants each of which receives a propellant grain of cruciform cross section. The grain support assembly 50 is maintained in position securely within the motor of the rocket by a pair of pins 53 welded to the inside surface of the quarter cylinders 51 extending beyond the end thereof, which pins 53 fit in slots in a grid which may be similar to the grid 38 shown in Figs. 5 and 7. A plurality of lugs 54 are secured to the forward end of the support assembly 50 and are adapted to receive between pairs of them one of the legs of a respective propellant grain.

Figs. 11 and 12 show a further modification of the grain support assembly comprising four half cylinders 61 positioned back to back having spacing blocks 62 placed therebetween and welded to the inside walls of the half cylinders 61. The longitudinal edges of the half cylinders 61 are connected by webs 63 to form a cross shaped structure having four semi-cylindrical pockets in which four cruciform grains are contained. At each end of the grain supports 60, a pair of pins 64 are secured along the inside wall of the half cylinders 61 which fit within suitable slots or openings in a grid front and rear grid (not shown) to maintain the support 60 firmly in position within the motor unit of the rocket.

While the invention has been described with reference to certain preferred examples thereof which give satisfactory results, it will be understood by those skilled in the art to which the invention pertains, after understand-

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ing the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is our intention, therefore, to cover in the appended claims all such changes and modifications.

We claim:

1. In a rocket motor, a cylindrical shell to contain an annular series of cross-sectionally cruciform propellant grains, a grain support centralized in said shell, said support consisting of identical sections mutually secured to form a compartmented open-sided cage structure and having beveled corners defining valleys flaring toward the shell, and a grid on at least one end of the shell, said grid having components fitting in and secured to the valleys.

2. In a rocket motor, a cylindrical shell, a motor unit contained by the shell including an annular series of propellant grains, a grain support in said shell, said support consisting of a cage which is compartmented to contain the grains, a grid in the shell holding the forward end of the cage in centered relation to the shell, shock pads interposed between the grid and the adjacent ends of the grains, and a closure plate peripherally secured in the shell ahead of the grid to seal off the motor unit from the outside of the shell especially prior to but also after attachment of a payload to the adjacent end of the shell.

3. A rocket motor comprising a cylinder, a powder grain support, said support being of cruciform cross section to form a plurality of chambers, one of said chambers being centrally disposed, hollow and coextensive with the grain support, a grid mounted at each end of said cylinder and secured to the respective end of said support, an igniter mounted externally of the support and at the forward end of said cylinder, ignition wires connected to said igniter, being housed by said centrally disposed chamber and a plate having a plurality of nozzles, said plate being mounted on the rear end of said cylinder and in abutment with the adjacent grid.

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