

June 28, 1960

H. L. EDWARDS
APPARATUS FOR MOUNTING AND BONDING
A ROCKET GRAIN WITHIN A CASE

2,942,645

Filed Feb. 11, 1957

4 Sheets-Sheet 1

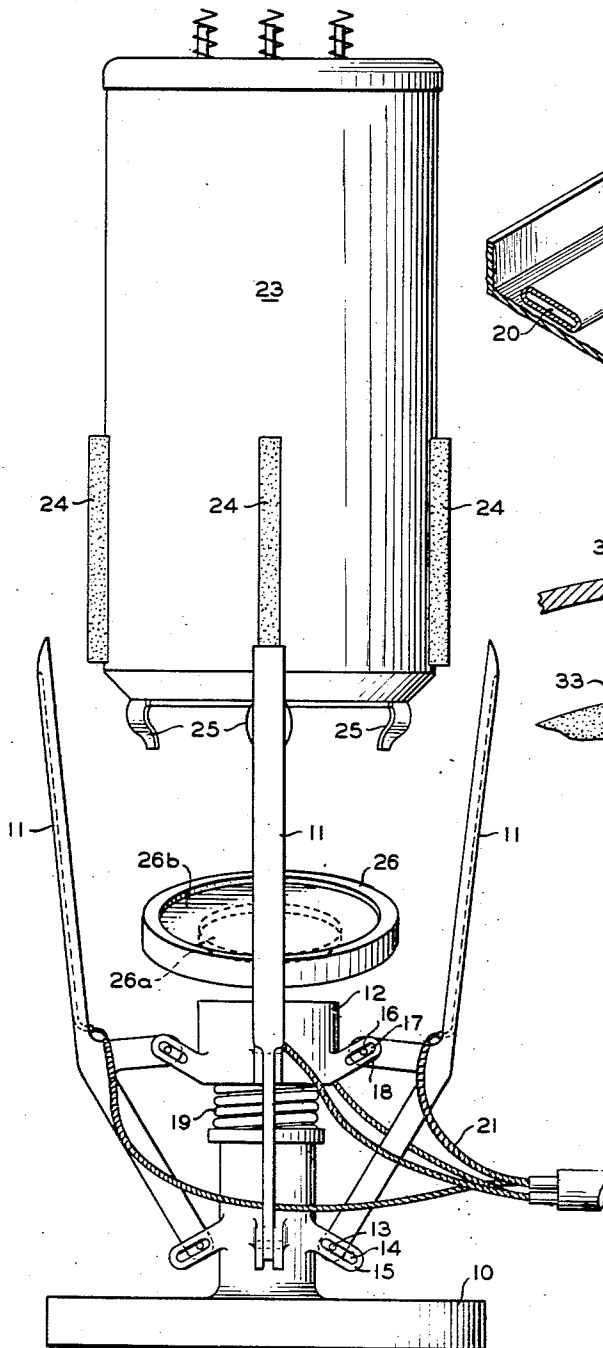


FIG. 1.

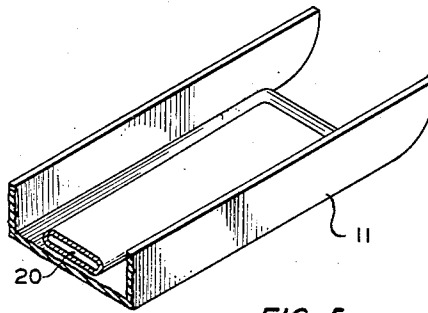


FIG. 5.

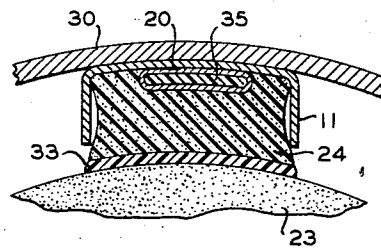


FIG. 6.

INVENTOR.
H. L. EDWARDS

BY
Hudson and Young
ATTORNEYS

June 28, 1960

H. L. EDWARDS
APPARATUS FOR MOUNTING AND BONDING
A ROCKET GRAIN WITHIN A CASE

2,942,645

Filed Feb. 11, 1957

4 Sheets-Sheet 2

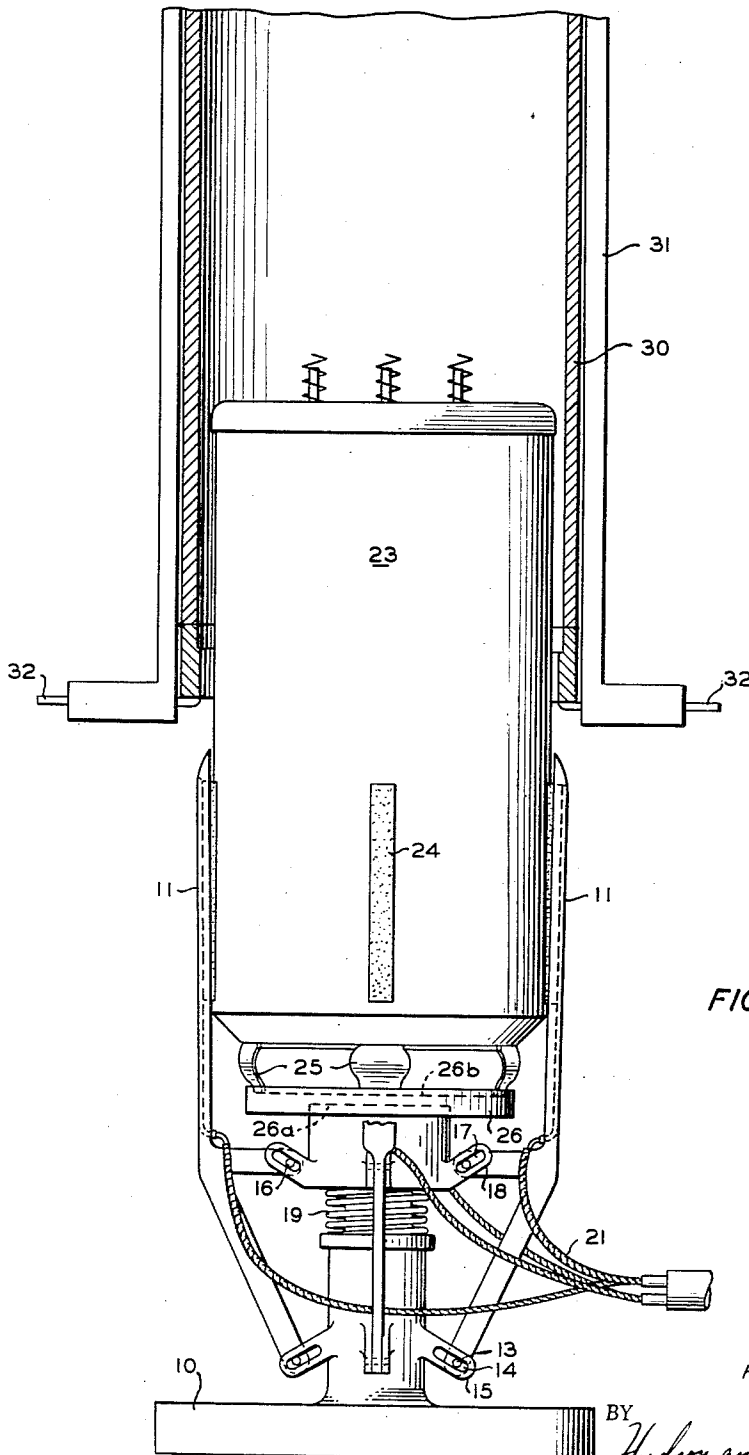


FIG. 2.

INVENTOR.
H. L. EDWARDS

BY
Hudson and Young
ATTORNEYS

June 28, 1960

H. L. EDWARDS
APPARATUS FOR MOUNTING AND BONDING
A ROCKET GRAIN WITHIN A CASE

2,942,645

Filed Feb. 11, 1957

4 Sheets-Sheet 4

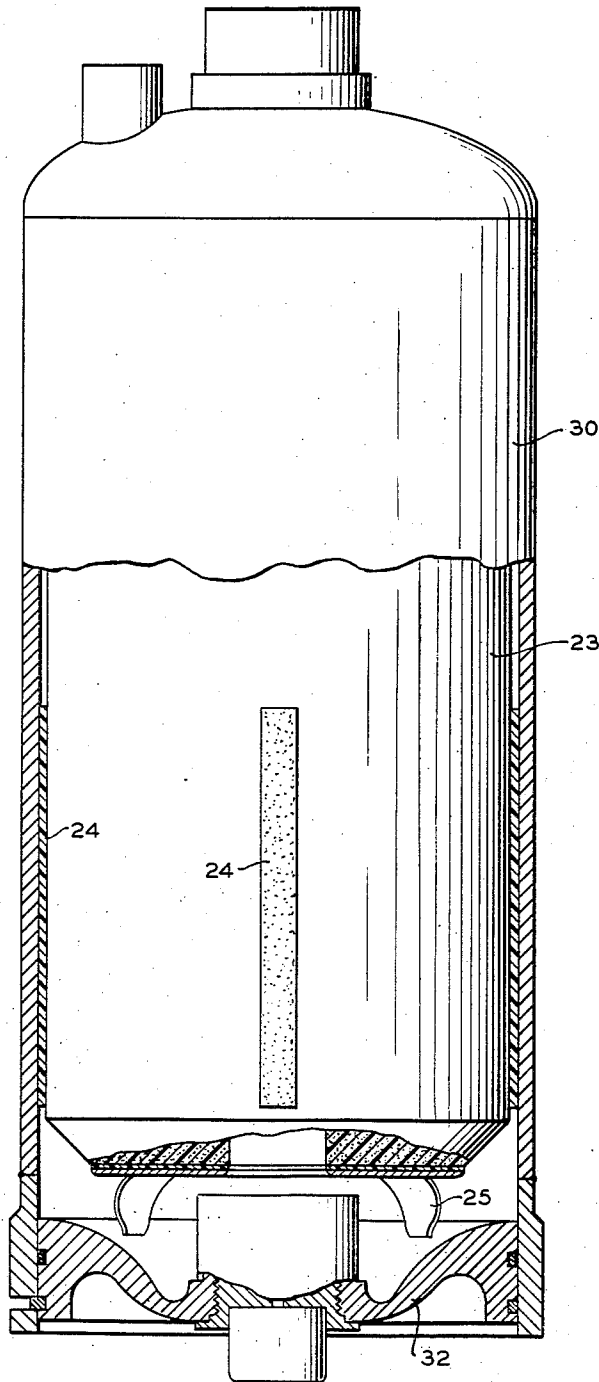


FIG. 4.

INVENTOR.
H. L. EDWARDS

BY
Hudson and Young
ATTORNEYS

1

2,942,645

APPARATUS FOR MOUNTING AND BONDING A ROCKET GRAIN WITHIN A CASE

Harold L. Edwards, Bartlesville, Okla., assignor to Phillips Petroleum Company, a corporation of Delaware

Filed Feb. 11, 1957, Ser. No. 639,255

7 Claims. (Cl. 154—1)

This invention relates to apparatus for resiliently mounting an inner rigid member within an outer rigid member.

This invention is particularly adapted to a method of mounting a rocket grain within a case although the apparatus is suitable for preparing other structures wherein the same problems are present. Rocket grains comprising a solid oxidant as a binder, such as asphalt or rubber, are widely used in order to provide thrust for aircraft. Even though a flexible binder is used, the resulting grain is somewhat fragile and the problem exists in that such grains are subject to breakage. If a grain fractures, the burning characteristics of the unit are changed and there is even a possibility of explosion. One attempt to solve this problem has been to provide a flexible mounting at at least one end of the grain so that the grain is resiliently mounted in the case. In some instances, this has not been satisfactory because some units so mounted have failed to pass a dropping test comprising dropping the unit from a four foot height, a widely used test.

A new approach comprises the addition of strips of resilient material positioned between the grain and the case. Rubber, particularly sponge rubber, and cork have been used for mounting the grain in the case and this appears to be satisfactory in preventing breakage. In order to provide good stability, such resilient strips are bonded to the grain and to the case in order to maintain the grain in position. This invention relates to apparatus for assembling the grain and the case and for applying a bonding material to the resilient strips after the grain is inserted in the case.

The following are objects of this invention.

An object of this invention is to provide apparatus for resiliently mounting a substantially rigid inner member within an outer substantially rigid member. A further object of this invention is to provide apparatus for supplying adhesive material to a resilient member positioned between a rocket grain and a case.

Other objects and advantages of this invention will be apparent to one skilled in the art upon reading the accompanying disclosure, including the accompanying drawing which comprises:

Figure 1, a vertical elevation of the assembling apparatus showing the rocket grain being lowered into position;

Figure 2, a similar view showing the rocket grain in position and the case being lowered over it, the case being shown in cross section;

Figure 3, a view similar to the Figure 2 showing the rocket case in position;

Figure 4, a vertical cross section of the completed rocket;

Figure 5, an isometric view of the end portion of one of the compression fingers; and

Figure 6, a horizontal cross section of one of the resilient strips in position between the rocket grain and

2

case before the compression fingers have been removed as shown on line 6—6 of Figure 3.

Referring to Figure 1, the apparatus comprises a base 10, compression fingers 11 and center support 12. Each finger 11 is attached to base 10 by a pin 13 in a slot 14 of ear 15. Each finger 11 is similarly attached to center support 12 by a pin 16 in the slot 17 of ear 18. A spring 19 separates center support 12 from the upper portion of base 10. Each finger 11 is provided with a relatively flat conduit 20 (Figure 5) which is connected to a flexible conduit 21 and to a pump 22 (Figure 3).

The rocket grain 23 has attached to its outer surface resilient strips 24. A plurality of supporting legs 25 are attached to the bottom of the grain. An adapter plate 26 is provided to rest upon the upper portion of center support 12 and to support rocket grain 23. This plate is provided with bottom depression 26a adapted to fit on center support 12 and top depression 26b adapted to engage supporting legs 25.

In the operation, when it is desired to assemble a complete rocket, the grain 23 to which are attached resilient strips 24 and legs 25, is lowered onto adapter 26 which rests on center support 12. Compression fingers 11 are spaced sufficiently far apart so as not to interfere with these strips 24 as the grain is lowered into position. However, when the weight of grain 23 rests on center support 12, this support is forced downward against the force of spring 19 thus causing ears 18 to exert a force on pins 16 towards the center line of the apparatus. In this way, fingers 11 are forced inward thus compressing strips 24.

With the grain in this position, illustrated in Figure 2, the rocket case 30 is lowered in position supported by a lifting frame 31 which is provided with slidable support pins 32. When the case 30 has been lowered completely over the grain 23, as illustrated in Figure 3, the pins 32 are moved inward in supporting relation with adapter 26. When lifting frame 31 is raised upward the entire assembly of case 30, grain 23, strips 24, and adapter 26 is lifted from the assembling apparatus. As the rocket assembly is raised, pump 22 is actuated to force bonding material through the flexible conduits 21 and the rigid conduits 20 and discharges it along the outer edge of strips 24. The rocket assembly is completed by inverting case 30, removing adapter 26, and installing end piece 32 (Figure 4).

Figure 5 is a view of the end portion of one of the fingers 11 showing conduit 20 in greater detail. Figure 6 is a cross section on line 6—6 of Figure 3. It shows a finger 11 in place between grain 23 and case 30. Adhesive layer 33, previously applied holds strip 24 in position on the grain. Adhesive 35 is shown in conduit 20 which is forced between strips 24 and case 30 as the fingers 11 are removed.

The presence of rubber strips 24 has a very slight effect upon the firing characteristics of a JATO unit so bonded. In one series of runs, 4 strips, one-inch by 3/8-inch by 10 inches of sponge rubber were applied to the forward end of a grain, the strips being placed 90 degrees apart. The strips were bonded with Dutch Brand 7-11 Rubber Cement, Rubber Bonding Cement and Thiokol Bonding Agent. The first two of these products are made by Van Clee's Bros., Inc. of Chicago, and the third by the Thiokol Corp. Strips so bonded required a pull of 1000 pounds or more to break the bonds and no signs of failure were observed when the units were dropped four feet.

As many possible embodiments can be made of this invention without departing from the scope thereof, it is to be understood that all matter herein set forth is

to be interpreted as illustrative and not as unduly limiting the invention.

I claim:

1. Apparatus for resiliently mounting a substantially rigid inner member within a substantially rigid outer member by means of resilient material bonded between said members comprising, a support base; a center support resiliently mounted on said support base; a plurality of fingers movably attached to said support base and said center support, said fingers being adapted to compress said resilient material; a bonding material supply conduit extending longitudinally of each said finger; means to supply bonding material to the bonding material supply conduit in each said finger; said elements being mechanically associated so that said plurality of fingers move inwardly when said center support moves downwardly.

2. Apparatus for resiliently mounting a rocket grain within a case by means of resilient material bonded between said grain and case comprising, a support base; a center support resiliently mounted on said support base; a plurality of fingers movably attached to said support base and said center support, said fingers being adapted to compress said resilient material; a bonding material supply conduit extending longitudinally of each said finger; means to supply bonding material to the bonding material supply conduit in each said finger; said elements being mechanically associated so that said plurality of fingers move inwardly when said center support moves downwardly.

3. Apparatus for resiliently mounting a substantially rigid inner member within a substantially rigid outer member by means of resilient material bonded between said members comprising, a support base; a center support resiliently mounted on said support base; a plurality of fingers movably attached to said support base and said center support; a bonding material supply conduit extending longitudinally of each said finger; means to supply bonding material to the bonding material supply conduit in each said finger; an adapter plate adapted to fit and rest on said center support, said adapter plate being adapted to support said inner member; said elements being mechanically associated so that said plurality of fingers move inwardly when said center support moves downwardly; a lifting frame; and a plurality of slidable support pins mounted in the lower end portion of said lifting frame, said pins being movable to a first position to support said outer member alone and to a second position to support said inner and outer members as a unit.

4. Apparatus for resiliently mounting a rocket grain within a case by means of resilient material bonded between said grain and case comprising a support base; a center support resiliently mounted on said support base; a plurality of fingers movably attached to said support base, and said center support; a bonding material supply conduit extending longitudinally of each said finger; means to supply bonding material to the bonding material supply conduit in each said finger; an adapter plate adapted to fit and rest on said center support, said adapter plate being adapted to support said grain; said elements being mechanically associated so that said plurality of fingers move inwardly when said center support moves downwardly; a lifting frame; and plurality of slidable support pins mounted in the lower end portion of said lifting frame, said pins being movable to a first position to support said case alone and to a second position to support said grain and case as a unit.

5. Apparatus for resiliently mounting a substantially rigid inner member within a substantially rigid outer member by means of resilient material bonded between said members comprising, a support base; a center support resiliently mounted on said support base; a plurality of slotted ears on said support base; a plurality of slotted

ears on said center support, each slotted ear on said center support being aligned with a corresponding ear on said support base, a finger adjustably mounted on each pair of aligned ears by means comprising two pins on each finger, one pin being adapted to ride in the slot in the ear on said support base and a second pin being adapted to ride in the slot in the ear on said center support, said fingers moving to compress material therebetween when said center support moves downwardly; a bonding material supply conduit extending longitudinally of each said finger; means to supply bonding material to the bonding material supply conduit in each said finger; an adapter plate movably mounted on said center support, said adapter plate being adapted to support said inner member; a lifting frame; a plurality of slidable support pins mounted in the lower end portion of said lifting frame, said pins being movable to the first position to support said outer member alone and to a second position to support said inner and outer member as a unit; and means to move said lifting frame.

6. Apparatus for resiliently mounting a substantially rigid inner member within a substantially rigid outer member by means of resilient material bonded between said members comprising a support base; a center support resiliently mounted on said support base; a plurality of fingers movably attached to said support base and said center support; an adapter plate adapted to fit and rest on said center support, said adapter plate being adapted to support said inner member, a bonding material supply conduit extending longitudinally of each said finger; and means to supply bonding material to the bonding material supply conduit in each said finger; said elements being mechanically associated so that said plurality of fingers move inwardly when said center support moves downwardly.

7. Apparatus for resiliently mounting a substantially rigid inner member within a substantially rigid outer member by means of resilient material bonded between said members comprising, a support base; a center support resiliently mounted on said support base; an adapter plate adapted to fit and rest on said center support, said adapter plate being adapted to support said inner member; a plurality of slotted ears on said support base; a plurality of slotted ears on said center support, each slotted ear on said center support being aligned with a corresponding ear on said support base; a finger adjustably mounted on each pair of aligned ears by means comprising two pins on each finger, one pin being adapted to ride in the slot in the ear on said support base and the second pin being adapted to ride in the slot in the ear on said center support; a bonding material supply conduit extending longitudinally of each said finger; and means to supply bonding material to the bonding material supply conduit in each said finger; said elements being mechanically associated so that said plurality of fingers move inwardly when said center support moves downwardly.

References Cited in the file of this patent

UNITED STATES PATENTS

1,949,772	Allen	Mar. 6, 1934
1,999,417	Lowe et al.	Apr. 30, 1935
2,334,558	Jones	Nov. 16, 1943
2,434,942	Magee	Jan. 27, 1948
2,482,133	Sweetser	Sept. 20, 1949
2,636,472	Vargo et al.	Apr. 28, 1953
2,755,840	Bartley	July 24, 1956
2,785,458	Thiry	Mar. 19, 1957
2,800,871	Hoag	July 30, 1957
2,825,477	Ross	Mar. 4, 1958

FOREIGN PATENTS

26,430	Great Britain	1907
--------	---------------	------