

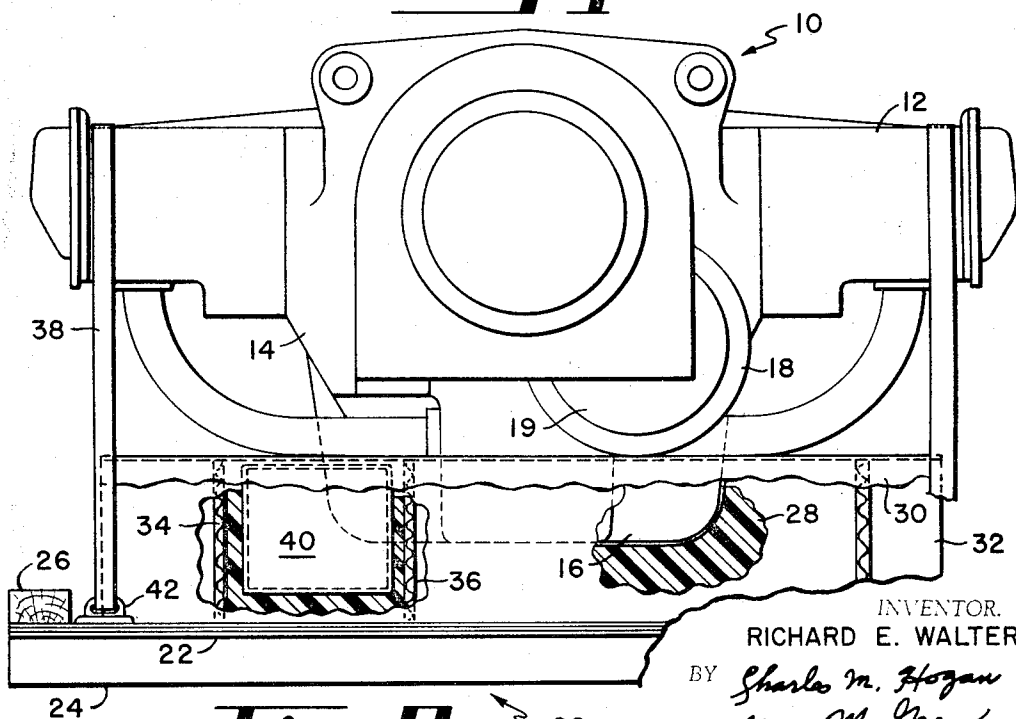
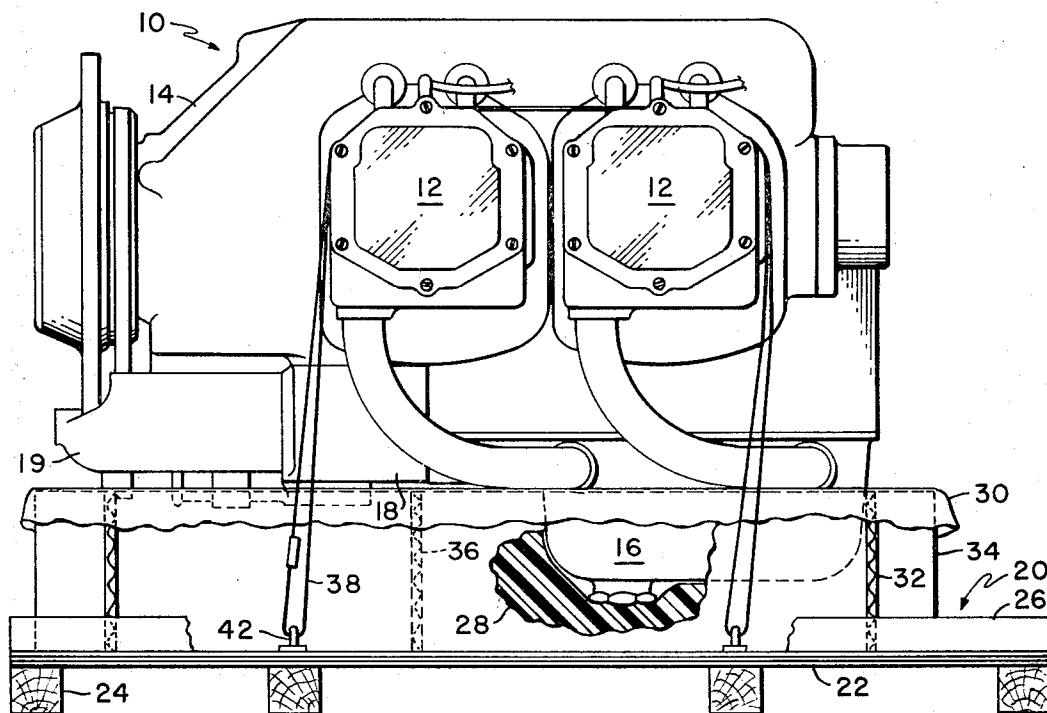
Nov. 18, 1969

R. E. WALTERS
SHIPPING APPARATUS

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3 Sheets-Sheet 1



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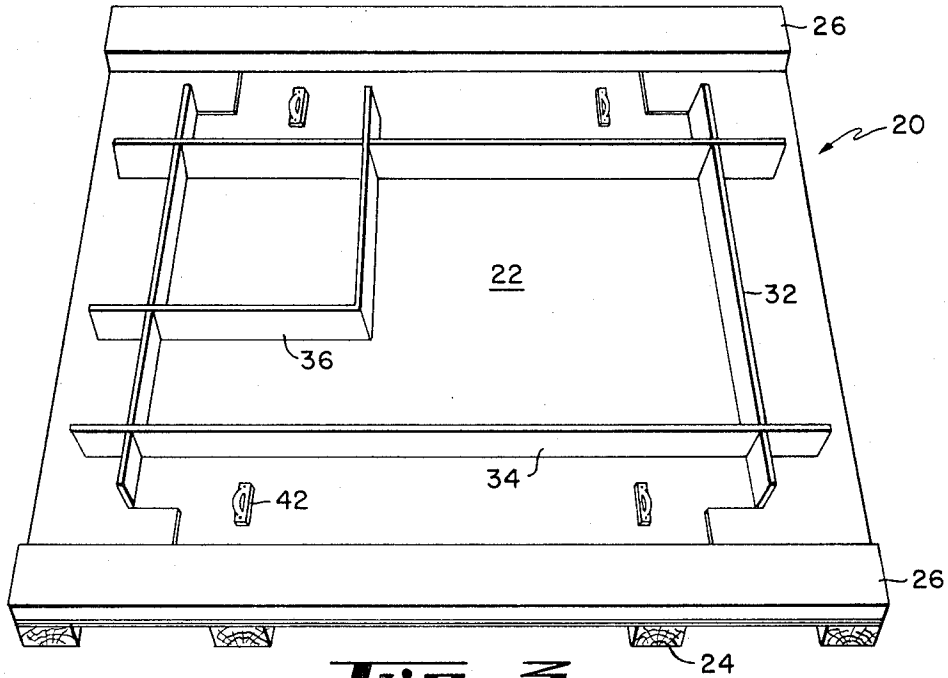


Fig 3

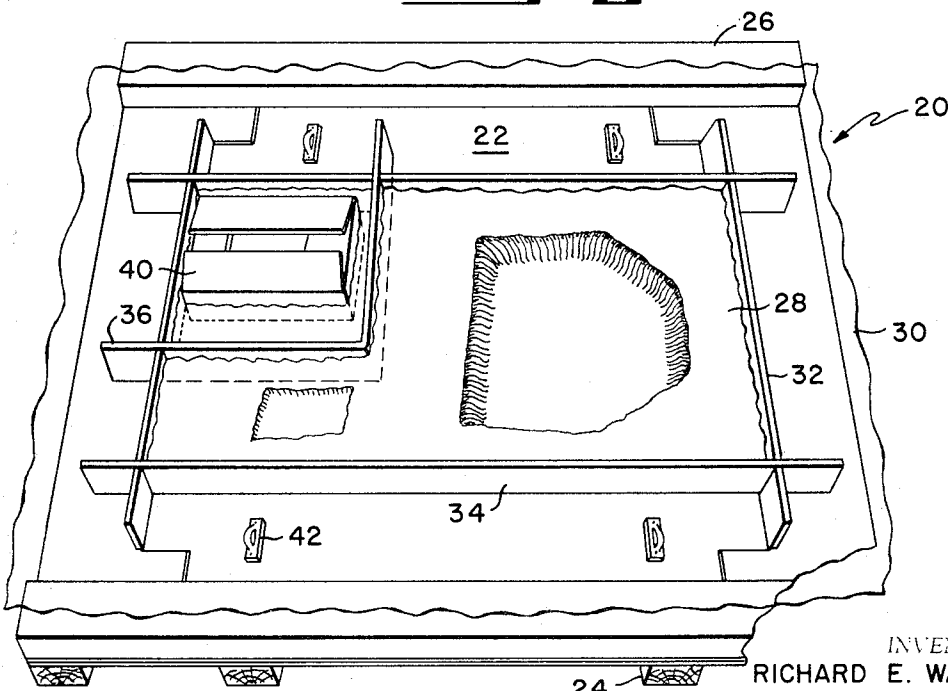


Fig 4

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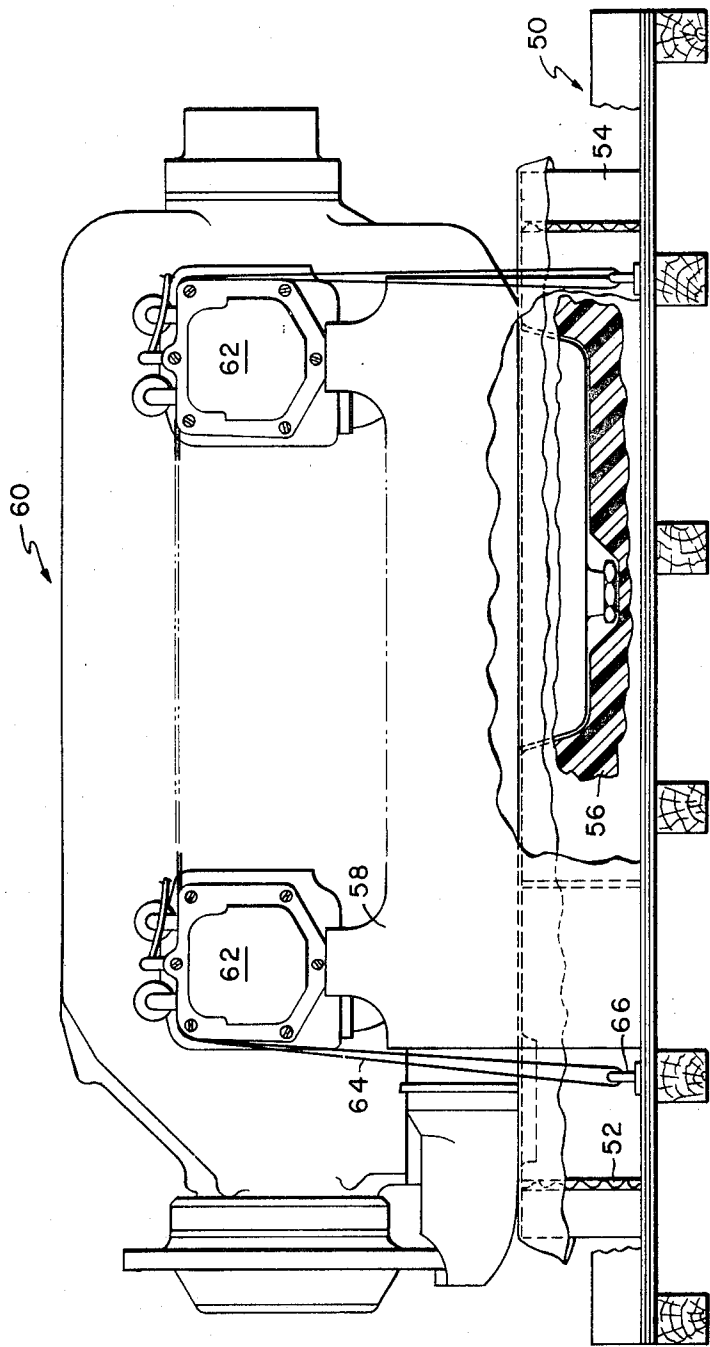


Fig. 7

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3,478,869

SHIPPING APPARATUS

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12 Claims

ABSTRACT OF THE DISCLOSURE

The disclosure illustrates shipping apparatus for an opposed cylinder aircraft engine. The central portion of the engine rests on a rigid foam plastic material that conforms to the irregular contours of the engine and overlies a relatively rigid base member. Straps, secured to the base member, extend over the outer ends of the engine cylinders to hold the engine against the rigid foam material which supports the engine with a sufficient degree of resiliency to minimize effects of adverse handling.

The present invention relates to shipping apparatus and more particularly to shipping apparatus for irregularly shaped objects.

A typical example of an irregularly shaped object required to be supported for shipping is the reciprocating aircraft engine. For a number of years aircraft engines have been mounted for shipping on a rigid plywood pallet by means of precut plywood support members. The engine is generally held on to the support members by straps or other means. While this arrangement generally provides an effective mount for the engine, it is undesirably complex and requires redesign of the support members for even minor variations in engine configuration. Furthermore, the shipping pallet and supports add substantially to the shipping weight and cost of shipping the engine. The initial cost of such a shipping pallet is generally high enough to warrant return of the shipping platform for reuse, thereby introducing an additional shipping cost. All of these factors add substantially to the delivered cost of an engine.

Some of the problems associated with the above arrangement may be solved by completely encasing the engine in rigid polyurethane foam. With this type of arrangement the shipping weight is reduced and the initial cost of the packaging apparatus is also reduced. However, the initial cost is still sufficiently great to warrant the reuse of the container, thus detracting from the savings resulting by the use of the lighter weight, rigid polyurethane foam package.

Accordingly, it is an object of the present invention to support an irregularly shaped object for shipping with an extremely low-cost apparatus which can protect the object against vibration and other stresses during shipment.

The above ends may be achieved according to the present invention by a shipping device comprising a relatively rigid base member having a rigid plastic foam material overlying a portion of the base. The foam material conforms to the contours of one side of an irregularly shaped object to be supported by the packaging apparatus. The irregularly shaped object is held against the base member by a suitable holding means whereby the rigid plastic foam supports the object with a sufficient degree of resiliency to insulate against vibration.

The above and other related objects and features of the present invention will be apparent from a reading of the description of the disclosure found in the accompanying drawings and the novelty thereof pointed out in the appended claims.

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In the drawings:

FIGURE 1 is a side elevation of a shipping apparatus embodying the present invention and used in connection with an internal combustion aircraft engine;

FIGURE 2 is a front elevation of the shipping apparatus shown in FIGURE 1;

FIGURE 3 is a perspective view of the shipping apparatus shown in FIGURES 1 and 2 in a partially assembled state;

FIGURE 4 is a perspective view of the shipping apparatus shown in FIGURES 1 and 2 in a completely assembled state but without the engine to be supported thereby;

FIGURE 5 is a side elevation of a shipping apparatus showing an alternate embodiment of the present invention which is particularly suitable for use with a heavy weight engine.

Reference is now had to FIGURES 1 and 2 which illustrate the shipping apparatus embodying the present invention, together with an internal combustion engine 10 which may be supported thereby. The engine 10 is of the opposed cylinder type having a plurality of cylinders 12 extending from a central crankcase 14. The underside of the engine crankcase 14 has an oil sump 16 which usually is irregularly shaped. Additionally, a starter motor 18 and a starter housing 19 are mounted adjacent the underside of the crankcase 14.

The shipping apparatus for the engine 10 includes a relatively rigid base platform 20 comprised of a multilayer corrugated sheet 22 and reinforced by a series of longitudinal wooden runners 24. The runners 24 are positioned on the underside of the corrugated sheet 22 and extend in a direction parallel to the axis of the engine cylinders. A pair of wooden runners 26 reinforce the topside of the corrugated sheet 22 and extend in a direction normal to that of the underside runners 24. The runners 24, 26 may be suitably secured to the corrugated sheet 22, as by nails or heavy staples.

As will later be described in detail, a rigid foam material 28, such as polyurethane, having sufficient density to support the distributed weight of the central portion of the engine, overlies the cardboard sheet 22. The polyurethane foam has a sufficient density to support the engine 10. As an example, a polyurethane foam having a density of 2 p.s.i. is capable of supporting an engine of the type illustrated with an overall weight of approximately 300 lbs. A polyethylene sheet 30 provides a barrier between the underside of the engine crankcase 14 and the upper side of the foam material 28. This prevents the foam material 28 from adhering to the underside of the engine while permitting the foam to conform to the shape of the engine sump 16 and the starter motor 18. Slotted forward and aft corrugated material tabs 32, integral with the multilayer corrugated material sheet 22, interfit with a pair of slotted corrugated material sheets 34 to form a rectangular wall around the foam material 28. This retains the foam in an area substantially underneath the central portion of the engine 10.

Frequently, engines are shipped with a group of loose accessory parts. A compartment for containing these parts is formed within the corrugated walls by a bent corrugated material sheet 36. A suitable corrugated box 40 is partially immersed in the rigid urethane foam filling the compartment. The polyethylene sheet extends over the top of the box 40 so that the box 40 adheres to the foam and is supported thereby.

The underside portion of the engine 10 is held against the polyurethane foam 28 overlying the base member 20 by straps 38 which loop through strap eyes 42. The strap eyes 42 are secured to the base platform 20 in line with the outer ends of the center runners 24 so that the runners 24 and the straps 38 cooperate to hold the engine

10 against the foam material 28. The straps 38 may be formed from steel or other suitable material. It has been found that plastic straps prevent scratching of the engine while providing a high degree of resiliency in the support of the engine on the foamed material. A suitable strap for this purpose is Dymax strapping manufactured by the Signode Corporation, Chicago, Ill.

The shipping apparatus may be assembled in the manner described below with reference to FIGURES 3 and 4. As shown in FIGURE 3, the base platform 20 is reinforced by the runners 24 and 26 and the corrugated tabs 32 are bent upward to form a wall for foamed material. The corrugated sheets 34 and the bent sheet 36 have been secured in place. The area bounded by the walls 32, 34, 36 is then filled with a predetermined amount of prepolymer and a cross-linking agent which combine to produce, when cured, a rigid polyurethane foam. It will be apparent to those skilled in the art that various combinations of particular prepolymer and cross-linking agents may be selected to provide the foam material, having a sufficient density to support the engine 10.

Immediately upon the application of the components, the corrugated box 40 is immersed in the compartment bounded by the sheet 36 and the polyethylene sheet 30 is placed over the box. A form representing the contours of the bottom of the engine is placed at a predetermined distance from the rigid base platform. The form is held in that position for several minutes to allow the components to foam and expand around the contours of the form. During this time it may also be necessary to support the corrugated side walls to prevent undue expansion of the foam in a lateral direction.

When the foam material has achieved a set state, as shown in FIGURE 4, it is allowed to cure for a longer period of time, in some cases twenty-four hours. After the foam material 28 has cured, the engine 10 is placed on the polyethylene sheet 30 so that the contours of the engine crankcase 14 fit into the contours of the outer surface of the foam material. The engine is then held to the base by looping the metal or plastic tape 38 through the strap eyes 42 and suitably securing it in tension. While the form representing the bottom contours of the engine 10 may be the engine itself, suitably supported above the base platform, it is advantageous to use a dummy form. The dummy form may be used with an assembly jig which permits the form to be positioned a predetermined distance from the base and retracted when the foam material has set.

The above shipping device is highly effective in protecting the engine against the adverse effects of vibration and other stresses encountered during shipping. The engine may be easily mounted in a transportation vehicle by rigidly attaching the base platform 20 to a suitable platform in the vehicle, while the rigidly mounted base 20 and the contoured foam material prevent the engine from shifting during shipment.

It has been found that this type of shipping apparatus provides a significant reduction in shipping costs. The simplicity of the apparatus results in a manufacturing cost of under \$10. In addition, the nature of the foam material enables a high degree of flexibility in accommodating changes in engine configuration. All that is necessary to provide the changed contours in the foam material is to either substitute the new engine itself or a dummy form representing the new engine contours.

Furthermore, the weight of this apparatus is so low that it is quite feasible from an economic standpoint to dispose of the apparatus when the engine has reached its destination. However, the foam material and rigid base are quite re-useable for subsequent use. The foam material, however, provides a highly effective and resilient support of the central portion of the engine besides forming a support for the loose accessory components that are transported with the engine. While the metal strap is effective in holding the engine against the rigid foam,

the plastic tape described is highly effective, not only in providing a degree of resiliency in holding the engine against the foam but it has less of a tendency to scratch the surfaces of the engine over which it passes.

As described previously, the foam material 28 has a density sufficient to provide a support for the central portion of the engine 10. For larger engines having a weight that may be higher than the maximum which a foam material can support, it is desirable to utilize the shipping apparatus in FIGURE 5. In this arrangement there is a rigid base platform 50 substantially similar to the base platform of FIGURE 3, including corrugated material wall members 52 and 54 which contain a foam material 56. In this case relatively rigid vertical posts 58 are positioned underneath the outer portions of the cylinders 62 of an engine 60 to hold the engine a predetermined level above the base platform 50. The engine 60 is then strapped against the outer rigid supports and the foamed plastic material 56 by straps 64 which loop through strap eyes 66. Thus the engine is supported not only by the cured rigid foam material 56 in its central section but also by the rigid vertical support posts 58. In this manner engines of much higher weight can be easily packaged and protected against damage in shipping.

While the preferred embodiments of the present invention have been particularly described, it should be apparent to those skilled in the art that modifications may be performed without departing from the spirit of the present invention. In particular, many types of rigid plastic foam materials may be used to support an irregularly shaped object with equally advantageous results.

Having described the invention, what is claimed as novel and desired to be secured by Letters Patent of the United States is:

1. Shipping apparatus for an irregularly shaped object, said packaging apparatus comprising:
 - a relatively rigid base member;
 - a rigid plastic foam material overlying a portion of said base member and conforming to the contours of only one side of said irregularly shaped object;
 - tension means secured to said base member and said irregularly shaped object for holding the one side of said irregularly shaped object against said material, whereby said rigid plastic foam supports said object.
2. Shipping apparatus as in claim 1 wherein said foamed plastic material has the property of adhering to contacted surfaces and said apparatus further comprises:
 - barrier means positioned between said irregularly shaped component and said foamed plastic for preventing adherence to said irregularly shaped object.
3. Apparatus as in claim 2 wherein said barrier means comprises a flexible polyethylene sheet.
4. Shipping apparatus as in claim 1 further comprising:
 - wall means extending upward from said base member and surrounding said foamed plastic material for retaining said rigid plastic foamed material substantially underneath the one side of said irregularly shaped object.
5. Shipping apparatus as in claim 1 wherein said irregularly shaped component is sufficiently heavy to prevent support solely by said foamed plastic material and wherein said apparatus further comprises:
 - means positioned on either side of said rigid foamed plastic material for supporting said irregularly shaped object a predetermined distance above said rigid base member;
 - whereby said irregularly shaped component is supported by said rigid support members and said foamed plastic material.
6. Shipping apparatus as in claim 1 wherein said tension means comprises:
 - means for resiliently holding said irregularly shaped object against said rigid foamed plastic material, thereby substantially insulating said component against vibration.

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7. Shipping apparatus as in claim 6 wherein said resilient tension means comprises:

plastic tape secured to said rigid base member adjacent said irregularly shaped object and extending thereover.

8. Shipping apparatus as in claim 1 wherein said irregularly shaped object is an engine having a series of cylinders extending from opposite sides of a central crankcase in a plane generally parallel to said rigid base member and wherein:

said foamed plastic material generally supports the central crankcase of said engine;

said tension means comprises strap means for holding the outer ends of said opposed cylinders against said rigid base;

whereby said foamed plastic material supports the mid-section of said engine.

9. Apparatus as in claim 8 wherein said engine includes loose accessory parts and wherein:

said foamed plastic material has the property of adhering to contacted surfaces;

said packaging apparatus further comprises barrier means between said foamed plastic material and the central portion of said engine for preventing adherence of said foamed plastic to the engine;

said packaging apparatus further comprises a receptacle partially immersed in said foamed plastic material for containing said accessory parts.

10. Apparatus as in claim 8 wherein said base member includes a multilayer corrugated sheet and wherein said packaging apparatus further comprises:

wall means extending upward from said base member and including a pair of corrugated tabs integrally formed with said multilayer corrugated sheet and a second pair of sheets interfitting with said corrugated tabs to form a rectangular barrier for confining said foamed plastic material substantially underneath said engine.

11. Apparatus as in claim 10 wherein said base member further includes:

a plurality of longitudinal rigid members extending across the underside of said multilayer corrugated sheet and oriented in a direction parallel to the longitudinal axis of said cylinders;

said strap means is anchored to said base member in line with the outer ends of said rigid longitudinal members so that the strap means and the longitudinal members cooperate to hold said engine against said foamed plastic material.

12. Apparatus as in claim 8 wherein said strap means comprises:

a plastic tape for resiliently holding said engine against said rigid base member.

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