May 3, 1949. L. H. CARGILL 2,469,156

PACKAGING

Filed Aug. 14, 1947 2 Sheets-Sheet 1

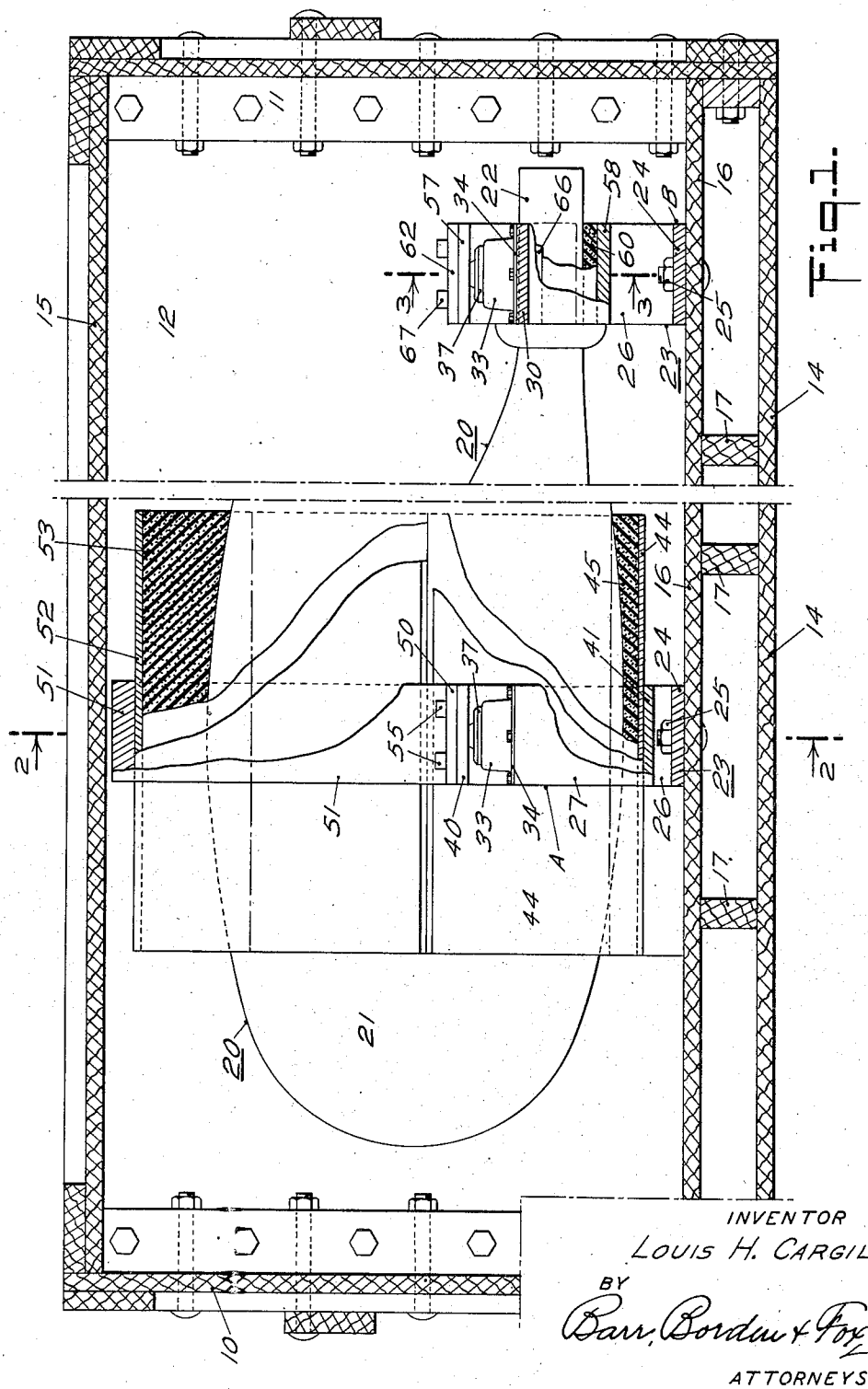


Fig. 1.

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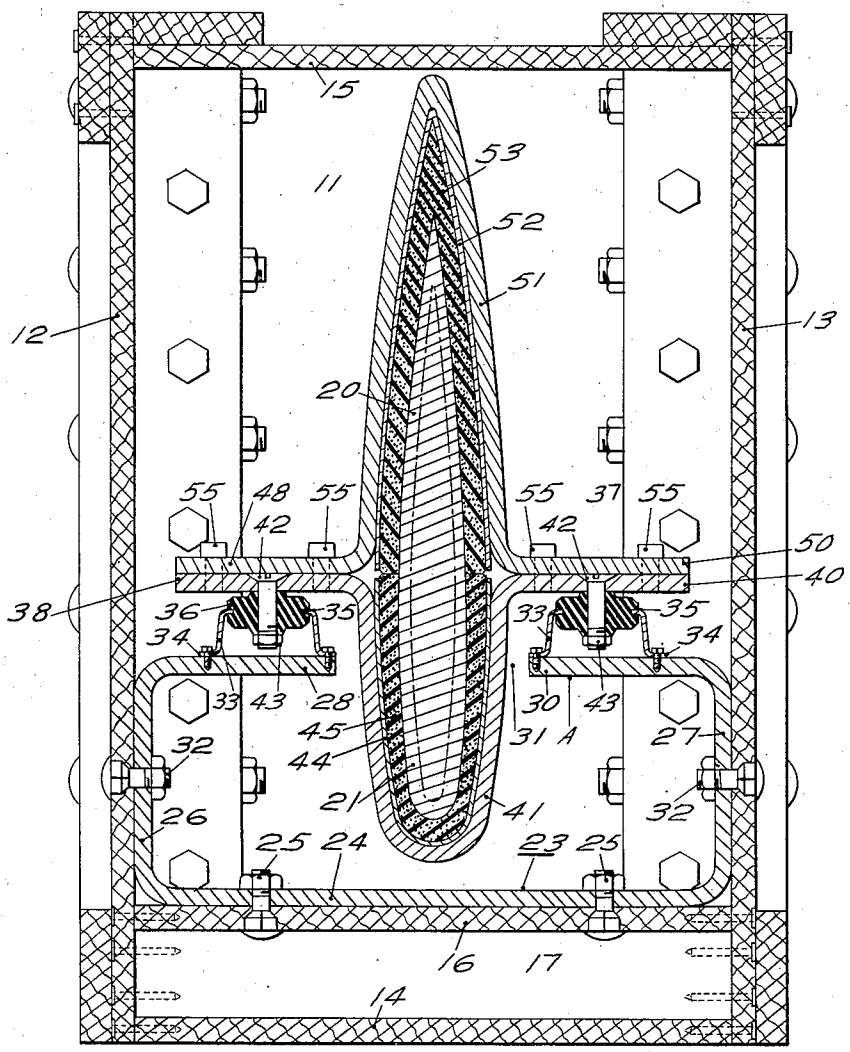


Fig. 2.

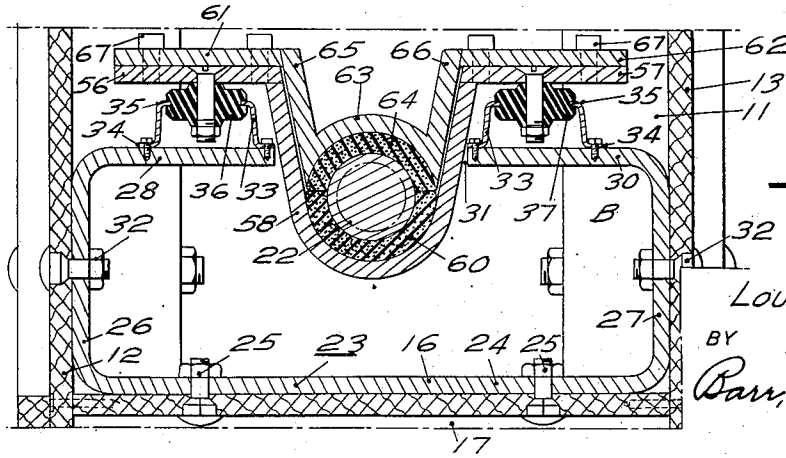


Fig. 3.

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Patented May 3, 1949

2,469,156

UNITED STATES PATENT OFFICE

2,469,156

PACKAGING

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Application August 14, 1947, Serial No. 768,698

1 Claim. (Cl. 206—46)

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This invention relates to packages.

Considerable difficulty has been experienced in packaging articles which are long and thin, such as rotor blades for rotary wing aircraft. Such articles are critical as to maintenance of a predetermined angularity and alignment, balance and superficial contours under all storage, shipping and service conditions, and the packages must, therefore, be capable of passing various dropping and analogous tests, with substantially complete isolation of the packaged blade from such shocks. Such rotor blades usually must be assembled in sets of packages for storage or shipment, after a carefully matched set for a given rotor installation has ben assembled, with each blade packaged in its own individual container.

It is among the objects of this invention: to improve the art of packaging; to improve the art of packaging blades for propellers and rotors and the like; to provide a simplified and economical package for long, thin articles such as rotor blades in which the article is thoroughly isolated and protected against shocks and impacts with a simplified form of package assembly; and to provide other improvements as will become apparent as the description proceeds.

In the accompanying drawings forming a part of this description:

Fig. 1 represents a fragmentary vertical longitudinal section through the assembled package of this invention, with a packaged rotor blade illustrated as mounted therein;

Fig. 2 represents a transverse vertical section through the blade-supporting portion of the assembly taken on line 2—2 of Fig. 1;

Fig. 3 represents a transverse vertical section through the blade root-supporting portion of the assembly taken on line 3—3 of Fig. 1.

The container comprises an external box structure formed of end walls 10 and 11, elongated lateral or side walls respectively 12 and 13, a lowermost or real floor 14, elongated to form the external bottom of the container, and an elongated relatively removable lid 15. The word "elongated" is used as these containers are frequently of the order of twenty-one feet or more in length, although the actual length will be only that necessary to house or enclose the particular rotor blade in question. For this purpose the walls, bottom, and lid will be formed of laminated or multi-ply sheets of the proper length or of short sheets of laminated board notched or cut back at the ends to form overlapping mutual extensions, so as in total extent to form the necessary

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length of siding or boarding required. These shorter lengths, if used, are suitably secured together and all of the side and bottom strips and end pieces are secured together and to suitable corner and reinforcing strips as to form a rigid sheet as desired, according to conventional box constructions.

The first change from a standard box of general formation and for general purposes, is to provide a false floor 16 formed similarly to the other sheets, and held in spaced relation to the real floor by suitable transverse cross strips, battens or joists, such as 2 x 4'' strips, or the like, 17, and the latter are provided in parallel spaced relation at intervals for the full length of the box.

The article to be packaged is comprised, illustratively, of a rotor or propeller or like blade 20, which is of airfoil contour 21 adjacent the tip end of the blade and for the major spanwise extent thereof, and at the root end is reduced into and terminates in a generally cylindrical usually asymmetrical blade root portion 22. The characteristics of the supports for the extreme ends of the blade are therefore radically different. To simplify the problem of mounting such a rotor blade 20 in isolated support in the box, two metallic open-topped generally C-shaped metal bands or frames 23 are provided, respectively towards the ends of the box described, and extending transversely thereof. Each C frame faces upwardly and comprises a lower supporting portion 24, bolted to the false floor 16 in any suitable manner, as by bolts 25, and leading by vertical side walls 26 and 27, juxtaposed to and reinforcing side walls 12 and 13, into the upper horizontally aligned spaced terminal supporting ends 28 and 30, generally parallel with the lower supporting portion 24. There is a transverse clearance 31 between the spaced terminal ends of the supporting portions 28 and 30 of the straps or bands. The side wall frame portions 26 and 27 are preferably bolted to the side walls 12 and 13, as by bolts 32. It is a preferred form of the invention to locate the relatively rigid supporting frames 23 longitudinally at such points on the false floor so that each is disposed substantially medially between a pair of the parallel supporting stringers or cross-strips 17 for the false floor, so as to utilize the flexibility and resilience of the false floor for the absorption of vibrations and shocks, in addition to the insulating properties of the isolating supports to be described. The supporting frame 23 may be formed of relatively heavy stock of relatively narrow material so as to have a rather restricted longitudinal extent,

in order to save both weight and expense, although obviously the precise sizes of the frames will be a matter to be determined in accordance with the weight and size of the articles to be packaged. In order to distinguish between the two supporting frames 23, for purposes of this description, the airfoil section-supporting element will be characterized as the element A, while the root-supporting element will be identified as element B.

It is prefered according to this invention, that the blades be supported and mounted in the box with the chord of the blade extending vertically, generally parallel with the side walls 12 and 13 of the container. To accomplish this expeditiously, the blade-contacting and root or blade mount contacting portions are each respectively arranged in two halves or two complemental portions, one of which is permanently mounted on the respective supporting frames or bands 23, and the other of which is removable on a line of separation transverse of the box. Consideration will first be given to the portions of the airfoil section and root-supporting portions associated with the frames A and B which are common to both.

An annular metallic supporting cup 33 or tapered sleeve, or analogous support, having a wide lower supporting flange 34, is bolted by the latter to the upper surface of each of the short upper supporting portions 28 and 30 of both frames A and B, and the open upper end of each cup is received and permanently mounted in a peripheral central groove 35, in a rubber or like isolating plug 36 on frame arm 28, and in a similar isolating plug 37 on frame arm or support 30 of the frames 23.

Referring now only to frame A, a lower bracket airfoil section supporting portion is provided, comprising spaced oppositely extending aligned planar supporting wings, respectively 38 and 40, joined by an intermediate reentrant looped portion 41, and the wings respectively rest upon the upper edges of and are isolated from vibrations by the isolating blocks 36 and 37. Anchorage of the wings 38 and 40 to the isolating blocks, out of metal-to-metal contact with the lower supporting frame or with the metallic cups or sleeves, is secured by providing bolts 42 passing downwardly through the respective wings and through the respective isolating blocks 36 and 37, to which they are secured by suitable nuts or the like 43. The looped portion 41, which is generally of the same profile or contour as the leading edge portion of the blade to be packaged, and is preferably of the same width as the frame, longitudinally of the box, has a wide sheet metal trough 44 of similar profile welded or otherwise secured rigidly to and extending longitudinally of the box beyond the edges of the looped portion 41 in both directions for an appreciable interval as shown in Fig. 1. The elongated trough has bonded or otherwise anchored to it a layer of sponge rubber or the like 45, which terminates, with the sheet metal trough 44, substantially in line with the aligned upper surfaces of the wings 38 and 40. The parts so far described may be designated as a permanent mounting in the container or box. It may also be noted that the expanded or unstressed condition of the sponge rubber or the like in the looped portion provides an article-receiving clearance too small for the packaged article. In other words, to receive the blade which is inserted by forcing the leading edge thereof between the confronting walls of the sponge rubber, the rubber must be brought to a condition of considerable compression. Illustratively, the unstressed sponge

rubber mounting element is of the order of one inch in thickness. When the blade 20 has been inserted downwardly from the top to the position of the leading edge thereof in the lower permanent portion of the assembly, the sponge rubber will have been compressed to a thickness of the order of one-half an inch. Whether this is a uniform compression throughout the area, or any approximate average compression depends upon the closeness with which the mounting follows the airfoil contours. Certainly, it is preferred to reduce the thickness of the sponge rubber somewhat throughout its area. It will be noted that the loop portion 41 of the fixed bracket dips downwardly in and through the space 31 toward, but clear of, the lower transverse supporting portion 24 of the bracket or frame.

The upper removable portion of the bracket assembly of the airfoil portion of the assembly comprises two spaced aligned planar wing portions 48 and 50, divided by the upwardly extending reentrant portion 51, having the general profile or outline of the trailing edge of the airfoil blade, of such dimensions as to complement the permanently mounted loop 41 to closely encompass a complete airfoil portion of a blade. The inner surface of the reentrant portion 51 has welded or otherwise permanently secured sheet metal trough 52 also extending longitudinally beyond the portion 51 in both directions to the same extent, preferably, as trough 44. Trough 52 is covered internally by a layer of sponge rubber or the like 53, terminating with the trough 52 in the general line of the lower surfaces of the wings 48 and 50, and arranged for deformation in embracing and enclosing the trailing edge of the rotor blade 20. The upper enclosing supporting portion is forced gently and guidably upon the exposed trailing edge portions of the blade already previously mounted in the lower permanent portion of the support including that for the root end to be described. When the wings 48 and 50 of the removable closure have respectively been brought into confronting juxtaposition to the fixed wings 38 and 40, bolts 55 are mounted suitably in the wings and tightened to draw the entire upper housing down upon the lower fixed portion, to firmly yet isolatingly mount the airfoil section of the blade in cushioned support both internally and externally of the blade housings formed as just described. Internally, because of the sponge rubber, and externally because of the isolating blocks 36 and 37, the resilience, if any, of the free spaced ends 28 and 30 of the frame, and the resilience of the false floor between joists, all of which effect cushioning support.

At the root end of the container, as previously noted, the frame B has similar isolating blocks of rubber 36 and 37, and the mountings thereof are identical with those for frame A. However, there is a change in the profile of the permanent supporting member from that which has been described, in that a pair of wings 56 and 57, extending in transverse planar alignment, are joined in the center by the generally semi-cylindrical loop portion 58, arranged to extend downwardly in the gap 31 between the short upper arms of the frame, but to a smaller extent, usually, than the loop 41 of the blade section support. The inner surface of the loop contains a bonded or otherwise anchored semi-cylinder of sponge rubber or the like 60, arranged to receive and to be compressed by the root or blade-mounting extension 22 of the rotor blade when the latter has been inserted vertically downwardly

upon said lining. The complemental removable portion of the root clamp comprises the transversely aligned spaced wings 61 and 62, connected by the arcuate center section 63, internally carrying the arcuate layer of sponge rubber 64, and the connecting divergent arms 65, and 66. After the cylindrical root or blade mount has been disposed in its permanent supporting portion 58 and 60, the upper portion of the support is moved vertically downwardly until the respective wings of the fixed and movable elements are juxtaposed, then the bolts 67 are tightened to force the upper cap member 61, 65, 63, 66, and 62 into tight firm clamping relation upon the blade root. Thus, the entire blade will be held at the root and the tip in an isolating and cushioned support in which, regardless of the direction of the impact on the external casing or box, the delicately balanced rotor blade will be shielded against all disruptive shocks and strains. The degree of compression of the sponge rubber is indicated by the distance between the dash and dot lines of Figs. 2 and 3 indicating uncompressed sponge rubber, and the solid lines of the compressed sponge rubber.

Having thus described my invention, I claim:

A package for rotor blades having an airfoil section and a reduced mounting portion, comprising a generally oblong box, a pair of generally C-shaped frames mounted in longitudinally spaced relation transversely in the box with the open side of the C-shaped frames extending upwardly to form transversely spaced supporting arms generally parallel with the bottom of the box, a permanent airfoil section-receiving element comprising a pair of generally aligned spaced wing elements connected by a trough of partial airfoil shape bent downwardly out of the line of the wings in the space between the said

supporting arms and toward the closed opposite side of the frame, means for isolatingly mounting the said wings on the said arms in a substantially shock-proof mounting, a yielding layer disposed in said trough in position to receive and to be compressed by an edge of the airfoil section of the blade, a complemental detachable airfoil section engaging element comprising a pair of generally aligned spaced wing elements connected by a trough bent upwardly out of the line of its said wings, a layer of yielding material disposed in the last mentioned trough and arranged to be compressed by the other edge of said airfoil section when the complemental element is pushed upon the blade, means connecting the respective juxtaposed wings to establish clamping of the airfoil section of the blade, means for resiliently clamping the reduced mounting portion of said blade, and means for mounting the last mentioned means isolatingly upon the other of said pair of C-shaped frames.

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