Aug. 1, 1939. H. KLEMM 2,168,280

METHOD AND APPARATUS FOR CONSTRUCTION OF AIRCRAFT AND THE LIKE

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Fig.1

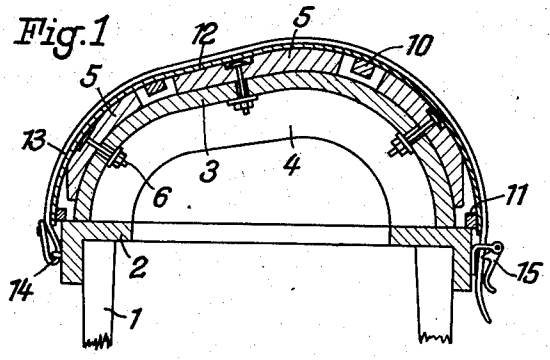


Fig.2

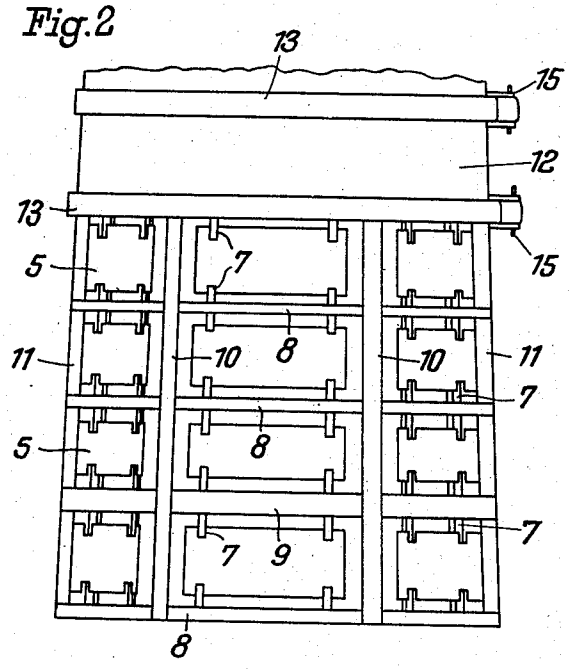
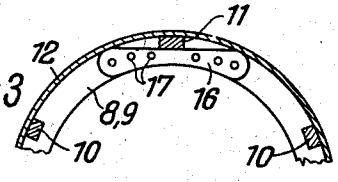


Fig.3



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METHOD AND APPARATUS FOR CONSTRUCTION OF AIRCRAFT AND THE LIKE

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3 Claims. (Cl. 244—120)

Aircraft fuselages and similar light hollow bodies are usually given the form of trellis-work with a superposed covering or, after the style of ships, the said bodies comprise frames and stringers with a skin lying thereon and contributing, at least to some extent, to the strength. In any case the covering skin is stretched, on the frame work, or the covering plates, after having been previously bent as far as possible to the correct shape, are laid upon the framework erected after the manner of a ship built on the stocks, and secured thereto.

According to the invention, a method of construction is used which consists primarily in subdividing the shell body to be constructed into longitudinal shell segments substantially free from intersection, and in producing said segments individually by inserting the longitudinal and transverse stiffening and stabilizing members, which enable the skin to take up higher compression loads into a mold, stretching the skin portions over the whole arrangement and securing the skin to the stiffening members. In contradistinction to the mold of construction used hitherto, in which the result depended to a large extent on the skill of the workers, the new mode of construction permits factory production by substantially unskilled labor. Only the fitter who prepares the mold and, at the most, places the stabilizing members in position must be a skilled worker, while everything else can be left to ordinary unskilled labor. The whole process of inserting the stiffening members is substantially an operation of inserting ready made parts into a fixed mold, nothing further needing to be measured off, so that mistakes can hardly occur. The mounting of the skin, furthermore, consists in simply pressing the same onto the mold, which prevents the skin plates from being bent out of shape, and then in gluing, or otherwise securing it to the stabilizing members. In addition to economical and rapid manufacture, high accuracy and dependability of the product are obtained.

In the case of wooden constructions I provide an advantageous feature according to which wooden stiffening are embedded in the mold and outer skin parts of plywood are stretched over the mold and glued on to stiffenings previously coated with glue. In this process the core-like mold does not need to be accessible at all from the inside, but all structural operations may simply be carried out from the outside.

In an advantageous embodiment of the invention transverse stabilizing members which are inserted in holders in the mold and longitudinal members are inserted into cut-outs of the transverse members. Then, in consequence of the usually quite flat shape and parallel position of the transverse members, less extensive sub-division of the whole structural body into individual sections or shells is possible, without any difficulty arising in removing the shell segments from the mold.

The assembly of the finished sections or shells is advantageously carried out by joining together inner straps or flanges running along the free edges of the segments, thus providing dependable, easily made seam not affecting the outside appearance. Where particularly reliable joints are required, the frames may alternately extend from both sides over the partial joint and thus strengthen the union by overlapping, or they may be joined by a butt joint and strapping.

The building apparatus required for carrying out the new process consists essentially of an uncollapsible core with beddings for the stabilizing members, and with intermediate filling bodies extending to the outer surface of the stiffening members, a gap preferably being left between the filling bodies and the stabilizing members. The filling bodies adjacent the edges of the mold are cut away inwardly from the desired inner shape of the shell segment to permit removal from the mold in radial direction of a shell segment formed on said mold with a stabilizing member secured thereto along or adjacent the edge of the segment. This mold which supports the skin over practically its entire surface, prevents damage to the skin even if the worker lies with his whole body on the workpiece. The gaps between the filling bodies and stabilizing members prevent gluing together of the skin and the filling bodies and also facilitate the removal of the finished segment from the mold.

The filling bodies are advantageously secured slidably or interchangeably to the core; this permits the use of one and the same core for different types of shells, vertical adjustment of the filling bodies enabling the whole shape to be varied substantially.

For the fitting of the skin use is preferably made of belts which are capable of being fastened to one or both edges of the mold by means of quick-fastening devices or, if desired, tension fasteners similar to spring bottle caps, and which are made resilient or are resiliently lined, for example with felt. Owing to the rounded shapes customary for aircraft fuselages, spars of supporting structures and similar bodies, these tension belts provide for a good pressure on all

sides to allow a solid gluing, soldering or other union to be effected.

Referring to the drawing left herewith, the figures represent, as examples only, the rear portion of the fuselage of an aircraft:—

Fig. 1 is a cross-section of the mold with the workpiece enclosed;

Fig. 2 is a view from above of the mold during the work;

Fig. 3 is a partial cross-section of two fuselage sections or shells showing the joint.

As shown in Fig. 1, a support 2, similar to a bench and standing on legs 1, carries a core 3, usually constructed of boards and strengthened where required by ribs 4. Filling pieces 5 of the same height as the stabilizing members to be used, are secured on the core by means of bolts 6 and straps 7 of smaller height (Fig. 2) pushed into the filling bodies, hold the transverse stabilizing members 8, 9 in position; the broader transverse members 9 may serve as a connecting element for the individual transverse sections of the skin, if desired. Longitudinal stabilizing members 10 are inserted into grooves in the transverse members 8, 9, and edge flanges 11 are similarly secured along the free edges of the mold. The filling bodies 5 adjacent these edges are cut away inwardly from the desired inner shape of the segment to permit removal from the mold in radial direction of a shell segment formed on said mold and having said edge flanges 11 secured thereto.

In this stage of construction the surfaces of the transverse members 8, 9 and of the longitudinal members 10, 11 together with the major part of the surfaces of the filling bodies 5 define the shape of the outer skin. Then glue is applied to the members 8, 9, 10, 11, in the case of a wooden construction, and sections of plywood skin 12 are stretched over the mold with the help of felt-lined belts 13, which are held at one end in an eye 14 and are tightened at the other end, by a rapid-fastening device 15.

After the glue has set, the belts 13 are detached and the partial shell complete with its longitudinal and transverse stabilizing members is removed in substantially radial direction from the mold, and made smooth at the edges along the edge spars 11. The assembly is carried out by gluing together the edge flanges 11 and by gluing straps 16 on to the frames 8, 9. The straps 16 may be held together by wooden pins 17 during the gluing, with the aid of additional spring clamps, if necessary. On the other hand, the wooden pins may be replaced by screws, while in the case of metal constructions screws alone may be used to secure the straps.

In the process described the whole fuselage may be built in two half segments of the shell corresponding from the front to the rear. If necessary, each half segment may be sub-divided transversely. Strong wing spars extending from the leading edge of the wing along the line of aerodynamic centres of the wing, which have a cross-section similar to that of a fuselage may be constructed in exactly the same way, or a whole wing may be constructed in this manner in the form of a shell, the shell segments either covering the suction face and pressure face of the wing, respectively, or constituting shell portions which are free from intersection and are joined together in a sectional plane being perpendicular to the chord line of the wing and running along the wing.

Exactly the same type of procedure may be used for metal constructions, the stabilizing members and the skin segments being welded or soldered together.

The field of utility of the invention comprises also, apart from aircraft fuselages and carrying surfaces, struts, supports, fixed planes, control surfaces, wheel fairings and many other light construction hollow bodies.

I claim:

1. A method of building segments of light load-carrying shells for aircraft fuselages, wings and the like, which segments are to be subsequently secured together, said method comprising the steps of inserting a plurality of thin transverse and longitudinal stabilizing members loosely into grooves of a mold having a shape corresponding substantially to that of a longitudinal segment of the shell, allowing for an appreciable clearance between the walls of the grooves and the stabilizing members, stretching a skin of thin, stiff material tightly over said mold and loose stabilizing members while supporting the latter substantially in a position in which the outer surfaces thereof define with the major part of the mold surface the desired inner shape of the shell segment, adhering said skin permanently to the entire outer surface of said longitudinal and transverse stabilizing members without puncturing the skin while allowing the stabilizing members to find their own bearings against the skin, and removing the rigidly stabilized shell segment with the affixed stabilizing members in a substantially radial direction from the mold.

2. A method of building segments of light load-carrying shells for aircraft fuselages, wings, and the like, which segments are to be subsequently secured together, and consist each of a plurality of thin transverse and longitudinal stabilizing members and a skin of thin, stiff material attached to the outer surface of said stabilizing members, said method comprising the steps of inserting the transverse and longitudinal stabilizing members loosely into grooves of a mold having a shape corresponding substantially to that of a longitudinal segment of the shell, allowing for an appreciable clearance between the walls of the grooves and the stabilizing members, applying glue to at least one of the surfaces of said stabilizing members and skin to be brought into contact, stretching the skin of thin stiff material tightly over said mold and loose stabilizing members, while supporting the latter substantially in a position in which the outer surfaces thereof define with the major part of the mold surface the desired inner shape of the shell allowing the loose stabilizing members to find their own bearings against the skin, holding the skin on said mold until a permanent gluing connection has been established between the skin and the stabilizing members, and removing the rigidly stabilized shell segment with the longitudinal and transverse stabilizing members glued thereto in substantially radial direction from the mold.

3. An apparatus for building light load-carrying shells for aircraft and the like, comprising a mold of a shape corresponding substantially to that of a longitudinal segment of such shell, said mold having a core, and filling bodies mounted on said core, said filling bodies being shaped and arranged to substantially define the desired inner shape of the shell segment and to provide a plurality of longitudinal and of transverse grooves for the insertion of thin stabilizing members, subdividing the shell into panels, said grooves having a width sufficiently exceeding that

of the stabilizing members to be inserted therein to allow for self-adjustment of said members to a skin to be applied to said mold, the filling bodies adjacent said mold edges being cut away inwardly from the desired inner shape of the shell segment to permit removal in substantially radial direction from said mold of a shell segment with the stabilizing member permanently adhered thereto without puncturing of the applied skin.

HANS KLEMM.