R. KEMP AND F. H. JOHNSON.

STRUCTURAL ELEMENT.

APPLICATION FILED JUNE 30, 1916.

1,414,419. Patented May 2, 1922.

Fig. 1

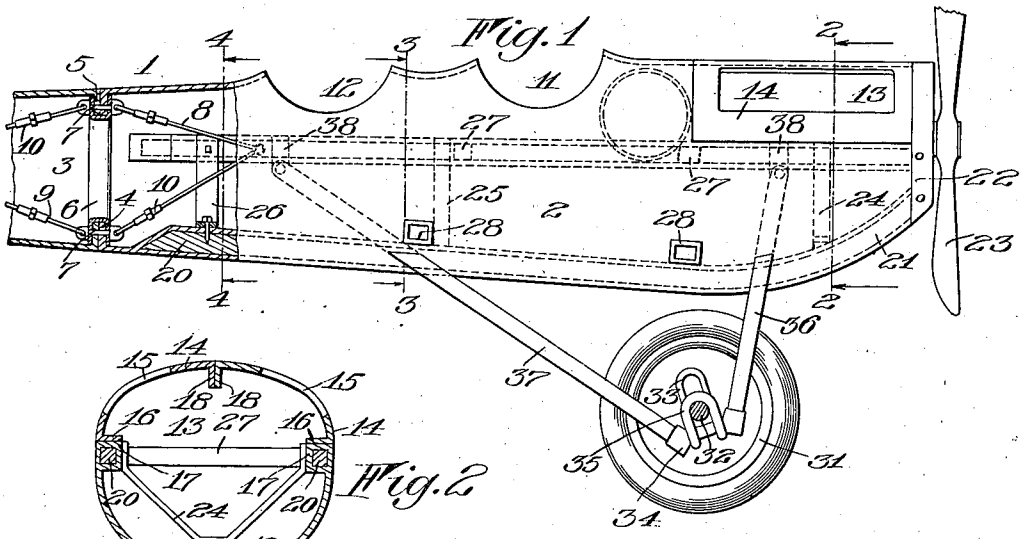


Fig. 2

Fig. 3

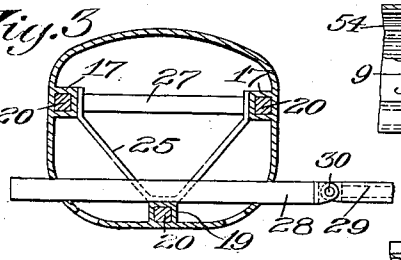


Fig. 8

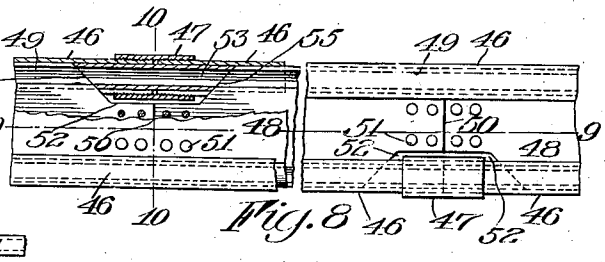


Fig. 9



Fig. 4

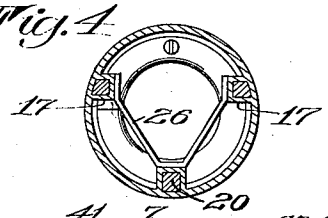


Fig. 10

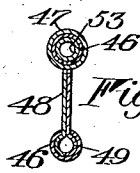


Fig. 6

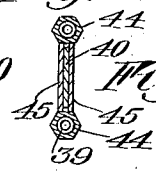


Fig. 5

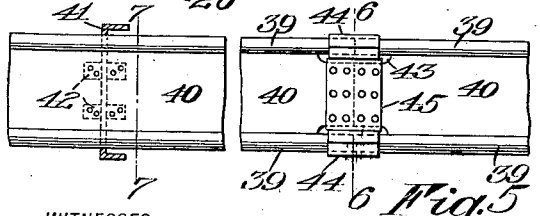
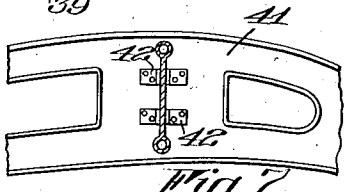


Fig. 7



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STRUCTURAL ELEMENT.

1,414,419. Specification of Letters Patent. Patented May 2, 1922.

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To all whom it may concern:

Be it known that we, ROBERT KEMP and FREDERICK H. JOHNSON, citizens of the United States, of Buffalo, county of Erie, and State of New York, have invented certain new and useful Improvements in Structural Elements; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification and to the reference characters marked thereon.

Our invention relates to improvements in structural elements for various purposes, and more particularly to elements used in aeroplane construction. The invention has for its object the formation of various structural bodies which are light, strong and durable and peculiarly adapted for flying machine construction. Another object of the invention is to simplify the construction and to materially reduce the number of parts of flying machines, and thereby the cost of manufacture and at the same time, provide structural elements possible of cheap and rapid assembly by labor relatively unskilled in the art. A further object of the invention is the formation of structural elements composed essentially of flexible materials made rigid by the addition of a binder capable of being hardened. To these and other ends the invention consists in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Figure 1 is a side elevational view of a portion of a flying machine body shown partly in section;

Figure 2 is a sectional view taken on line 2—2 of Figure 1;

Figure 3 is a sectional view taken on line 3—3 of Figure 1;

Figure 4 is a view in section taken on line 4—4 of Figure 1;

Figure 5 is a side elevational view of a beam and beam splice;

Figure 6 is a sectional view taken on line 6—6 of Figure 5;

Figure 7 is a sectional view taken on line 7—7 of Figure 5;

Figure 8 is a view illustrating a modified form of beam construction;

Figure 9 is a sectional view taken on line 9—9 of Figure 8, and

Figure 10 is a sectional view taken on line 10—10 of Figure 8.

Similar reference characters throughout the several views indicate the same parts.

Heretofore in the formation of structural elements especially those elements entering into the construction of flying machines, builders have been confined principally to the use of wood and steel. In the present instance, however, it is proposed to employ in the formation of various structural members filling materials which are normally flexible and which with a binder may be either molded or laid in laminations or layers, and formed by means of dies or other devices into structural elements of the desired shape and hardened, preferably under pressure and by heating into rigid structural bodies. I prefer, however, as a binder, the use of a comparatively new and peculiarly adaptable material for this purpose, which is composed of phenolic condensation products. The phenolic condensation products may either be products of phenols and formaldehydes, as described in United States Patents Nos. 942,700, 942,809 and others to Leo H. Baekeland, or condensation products of metracresol and formaldehyde, as listed in other United States patents to the same inventor.

Such a combination results in material possessing properties of lightness, durability and strength, being extremely resistant to chemical agents, as well as for all practical purposes, fire and waterproof.

The material is further adaptable for this purpose on account of its toughness, resistance to wear and other physical properties as well as on account of its being both insoluble and infusible. The reduction in cost of manufacture and time required to turn out the completed structural parts of a machine also renders the use of this material far more advantageous for such purposes than any other known material in existence. It has been found as set forth in the patents above cited, that certain condensation products of phenolic bodies and formaldehyde or their equivalents, after being subjected under proper conditions, to the action of heat, become hard, infusible and extremely resistant to chemical agents, as well as to

practically all forms of liquids. The filling materials with which said condensation products are compounded are preferably fibrous in character as for example, wood or asbestos fiber or the like. However, paper pulp, sheets of cardboard, or paper, plates of wood, layers of cloth and other like porous bodies may be impregnated with the liquid or dissolved-partial-condensation products of phenol and formaldehyde and heat treated until hardened into strong and durable homogeneous bodies. When such materials have been consolidated and hardened as described they may be cut into any desired form.

After this material is once hardened it can not be reset, but while in plastic form it may be pressed or stamped by the use of suitable dies for providing various structural shapes or completed sections and then heat treated while under pressure until hardened into permanent bodies. By stamping and pressing prior to hardening, however, large numbers of parts may be turned out in a relatively short time as compared with the time required to shape, assemble, nail and glue together the numerous wooden members at present employed to construct the bodies and other structural portions of a flying machine. Not only is a great saving in time, labor and cost of material effected, but a stronger, more durable and dependable flying machine structure is capable of being produced by the use of the materials described herein than with any other materials now in use for this purpose.

Referring to the drawings by numerals, 1 designates the body of a flying machine constructed preferably of front and rear sections 2 and 3 respectively. The sections at their meeting ends are provided with inwardly extending flanges 4 and 5 which are preferably clamped together by a flanged ring 6, U-shaped in cross section with the flanges of the ring turned outwardly to receive the inwardly extending flanges of the sections as shown. The ring is clamped or held upon the flanges 4 and 5 by means of bolts 7, the heads of which are apertured to receive the forwardly and rearwardly extending wires or cables 8 and 9 respectively, which are suitably connected with the sides of the front and rear sections of the body at any desired points. Turnbuckles 10 are provided upon the cables which may be adjusted to properly tension said cables for bracing the sections. In the cockpit of the front section of the body provision is made in the present instance for front and rear seats as indicated by the openings 11 and 12 respectively in the top wall of said body section. The extreme front end of the body section 2 is designed to carry the motor at 13 for propelling the machine. At this point removable covers 14 are provided with openings 15 therein. The covers are preferably supported by the inwardly extending flanges 16 which rest upon the upper surface of the body reinforcing members 17 formed integral with and extending longitudinally of the front section of the body. At the top of the covers downwardly projecting flanges 18 are positioned back to back, as shown in Figure 2, and may be connected in any preferred manner. At the bottom of the front body section 2 is provided a longitudinally extending reinforcing member 19 similar to the members 17. Inclosed within the walls of the upper and lower reinforcing members 17 and 19 are beams 20, preferably of wood, which serve as strengthening members for the body section as well as attaching means for the braces, ties and other parts of the machine which it may be found desirable to connect therewith. At the front of the body section 2 the lower reinforcing member 19 and beam 20 therein are curved upwardly as indicated at 21 and suitably connected with a nose ring 22 in the rear of the propeller 23. A brace 24 is provided at the front of the body section 2, the upper ends of which are suitably connected with the reinforcing members 17 while the bottom of the brace is carried by the reinforcing member 19. Similar braces 25 and 26 are provided near the central and rear portions respectively of the front body section as shown in Figure 1. Suitable cross ties 27 are provided for tying the sides of the body together, preferably at points between the upper reinforcing members 17. It will be understood that the body sections 2 and 3 are preferably constructed of layers or laminations of fibrous material united by a suitable binder, preferably a binder consisting of the condensation products of phenol and formaldehyde or metracresol and formaldehyde as set forth in the patents above referred to. The reinforcing members 17 and 19, in which the beams 20 are embedded not only strengthen and brace the body section, but serve also as supports upon which the motor and other parts to be positioned on the body, may be carried. Extending through the front body section transversely thereof and preferably upon the reinforcing member 19 are cross beams 28 for supporting the lower planes or wings 29 of the machine as indicated at 30. The wheels 31 of the running gear are mounted upon the axle 32 movable in guide members 33 carried by the support 34. An elastic band 35 is looped over the axle and connected with the support to permit the axle to yieldingly move within the guides for the purpose of absorbing the shocks caused by the striking of the wheels upon the ground in the landing of the machine. Connected with and extending from the support 34 are the forwardly and rearwardly inclined struts or braces 36 and 37

respectively, the upper ends of which are preferably carried through the walls of the body section 2 and connected with the reinforcing members 17 by means of brackets or plates 38 as shown in Figure 1.

In Figures 5 to 7 inclusive is shown an improved form of wing beam and web construction. The beam comprises spaced tubes 39 connected by a plate section 40 as embodied in section in Figure 6. The beams are adapted to pass through the web 41 between the upper and lower flanges thereof and are connected therewith by means of suitable angle brackets 42. When it is desired to splice the beams, the plate sections 40 are cut as indicated at 43 and the ends of the tubes 39 threaded to receive the nuts or couplings 44 which are provided with right and left hand threads. After the ends of the beams have been drawn together by the turning of the nuts, the latter are positioned each with one of its flat sides adjacent the cut out portion 43. The splice plates 45 are then applied with their upper and lower edges engaging the nuts. After the splice plates are riveted or otherwise secured upon the beams, the nuts will be locked against turning. This arrangement affords a very rigidly constructed joint and one which will not work loose.

The beam construction shown in Figures 8 to 10 inclusive comprises the spaced slotted tubes 46, the adjacent ends of which are provided with right and left threads to receive the threaded couplings 47. The web 48 of the beam is preferably formed by placing together two plates, the sides of each of which are provided with outwardly extending semicircular flanges 49 shaped so that when said plates are placed together as shown in Figure 10, they form a section the edges of which are of tubular formation. When the slotted tubes 46 are properly connected by the couplings 47, the web sections are driven therein and held clamped together by said tubes.

In order to build up a beam of any desired length from relatively short sections of material the plates upon one side of the web are adapted to abut and form a joint as indicated at 50 in Figure 8. At the point where said plates abut the plate upon the opposite side of the joint is continuous so that a more effective splice is afforded than would result from merely tying together two beams by the use of short splice plates upon opposite sides thereof.

The abutting ends of the web plates are securely connected with the oppositely disposed web plate by suitable bolts or rivets 51 as shown in Figure 8. At each of the joints 50 both the abutting and continuous web plates are cut away at one side as indicated at 52 to properly clear the couplings 47. Projecting into the adjacent ends of the connected tubes 46 is a short bracing tube 53 cut diagonally at its ends as indicated at 55 to engage the correspondingly cut portions of the web plates. A splice or joint constructed in the manner just described affords a very strong and rigid connection for the meeting ends of the tubes and web plates. These parts as well is the couplings are preferably formed of layers or laminations of fibrous material united by any suitable binder, but preferably one composed of phenolic condensation products or their equivalents. However, said construction may if desired be formed of metal plates and tubes which are also readily adaptable for such purposes.

It will be understood that all of the parts shown in the drawings which are not specifically described as being formed of metal or other materials are preferably formed of fibrous or paper like materials and united and hardened by a suitable binder, preferably a binder composed essentially of condensation products of phenol and formaldehyde, or metracresol and formaldehyde or their equivalents, said materials being hardened by heating.

We claim as our invention:

1. A structural aircraft body formed of a plurality of tubular sections having inwardly extending flanges, and means connecting said flanges, said sections being composed essentially of fibrous material compounded with phenolic condensation products acting as a binder.

2. A structural aircraft body having a plurality of longitudinally extending beams embedded in the walls of the body, said body consisting essentially of a hard, insoluble and non-plastic phenolic condensation product compounded with a fibrous filling material.

3. A structural aircraft tubular body provided with spaced reinforcing hollow ribs extending along its walls, said body consisting essentially of a hard, insoluble and non-plastic phenolic condensation product compounded with a fibrous filling material.

4. A structural aircraft body comprising a plurality of tubular sections in combination with means for connecting the sections, said sections consisting essentially of a hard, insoluble and non-plastic phenolic condensation product compounded with a fibrous filling material.

5. A structural aircraft body comprising a reinforced tubular section in combination with wing supporting beams projecting therethrough, said body consisting essentially of a hard, insoluble and non-plastic phenolic condensation product compounded with a suitable filling material.

6. A structural element comprising a beam, the flanges of which are tubular and threadedly connected upon opposite sides of

the beam, said beam consisting essentially of fibrous material compounded with a binder.

7. A structural element comprising a beam formed of spliced plates having outwardly extending flanges at their sides, tubes secured upon said flanges, and means connecting the tubes upon each side of the beam.

8. A structural body comprising a tubular section having an inwardly positioned longitudinally extending reinforcing rib, transversely arranged beams connected with said rib and extending through said tubular section, and wing supporting members connected with said beams.

9. A structural body comprising a tubular section having a plurality of longitudinally extending ribs, bracing members connecting said ribs, transversely arranged beams connected with one or more of said ribs adapted to extend through said tubular sections, and wing supporting members connected with said beams.

10. A structural aircraft body comprising adjacently mounted tubular sections having inwardly turned opposing flanges and a connecting ring having outwardly turned flanges engaging said opposing flanges on their exposed faces, the parts being formed essentially of fibrous material and a condensation product.

11. A structural body comprising adjacently mounted tubular sections having inwardly turned opposing flanges, a connecting ring having outwardly turned flanges engaging said opposing flanges on their exposed faces and diagonally disposed braces extending from said ring upon opposite sides thereof and anchored upon said tubular sections.

12. A structural element for aircraft comprising slotted tubes and a connecting web, the longitudinal edges of which project through the slots of the tubes for interlocking engagement within the tubes.

13. A structural element for aircraft comprising slotted tubes and a connecting web, the longitudinal edges of which project through the slots of the tubes for interlocking engagement within the tubes, the tubes and web being formed of fibrous material impregnated with a hardened binder.

14. A structural element for aircraft comprising slotted tubes and a connecting web, the longitudinal edges of which project through the slots of the tubes for interlocking engagement with the tubes, the tubes and web being formed of fibrous material impregnated with a hardened phenolic condensation product as a binder.

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