June 20, 1939. T. D. WILDON 2,163,075

TOY AIRPLANE

Filed June 16, 1937 2 Sheets-Sheet 1

Fig. 1.

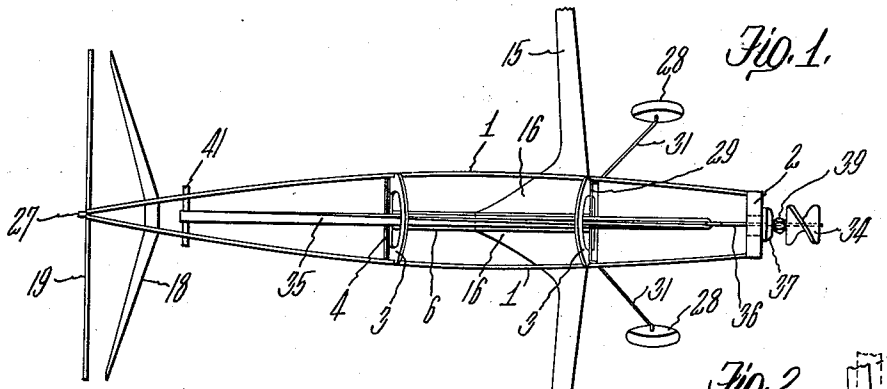


Fig. 2.

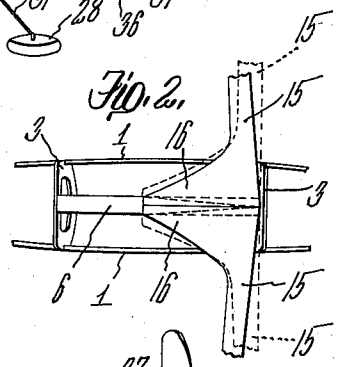


Fig. 3.

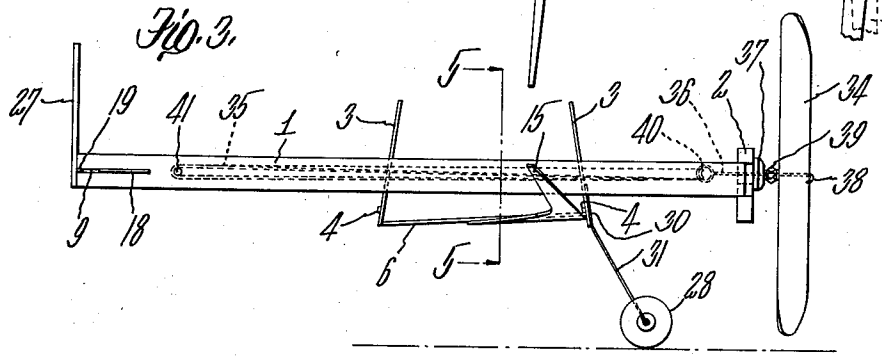


Fig. 4.

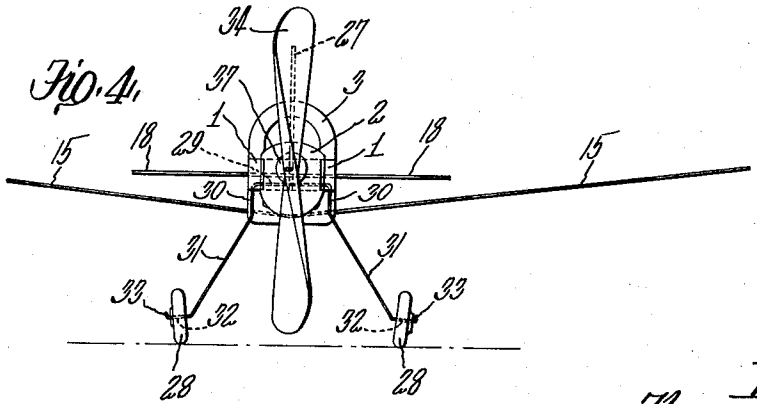
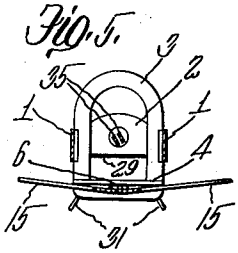


Fig. 5.



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June 20, 1939. T. D. WILDON 2,163,075

TOY AIRPLANE

Filed June 16, 1937 2 Sheets-Sheet 2

Fig. 6.

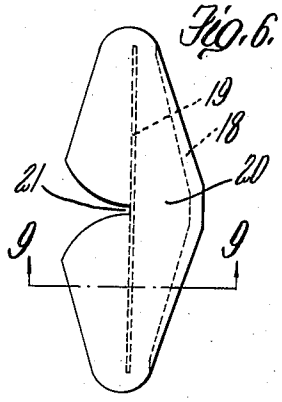


Fig. 7.

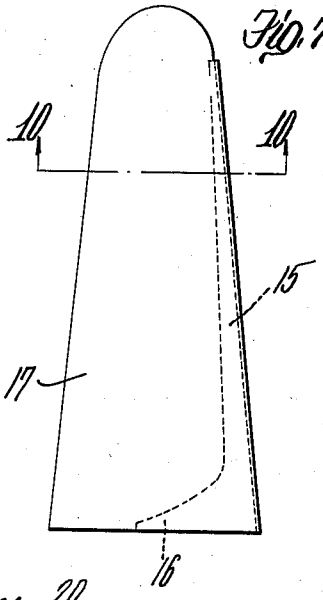


Fig. 8.

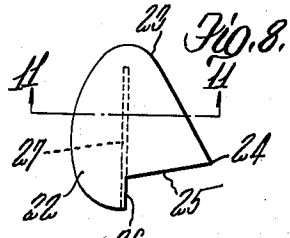


Fig. 9.



Fig. 10.

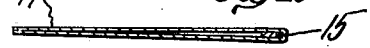


Fig. 11.

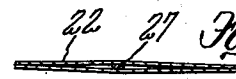


Fig. 12.

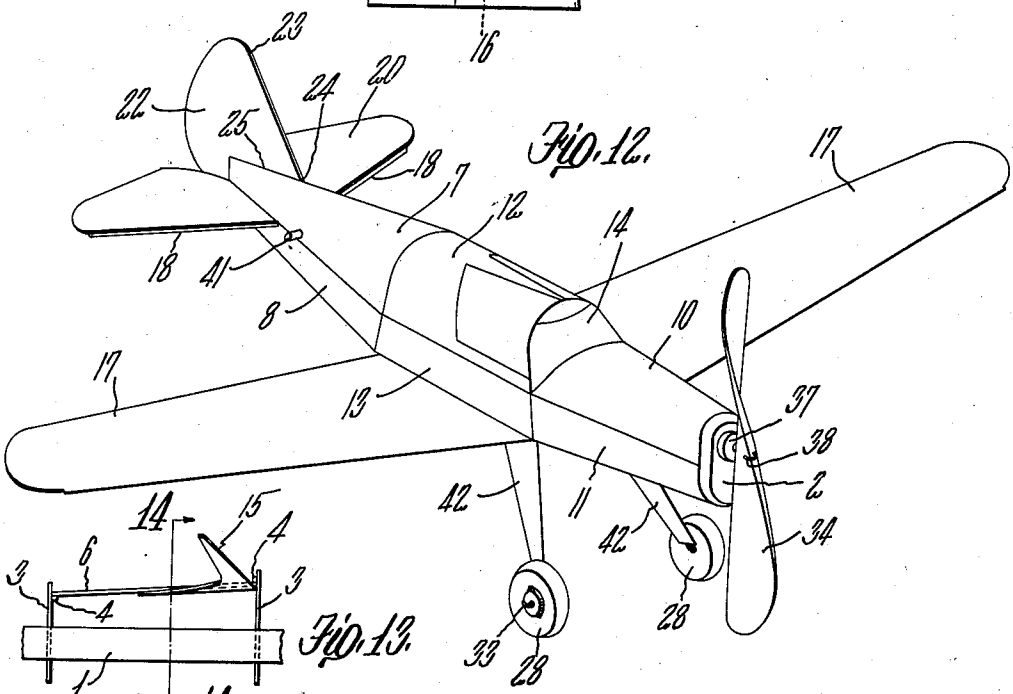
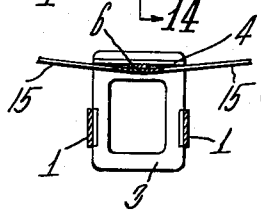


Fig. 13.

Fig. 14.



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Patented June 20, 1939

2,163,075

UNITED STATES PATENT OFFICE

2,163,075

TOY AIRPLANE

Thomas D. Wildon, Reading, Mass., assignor to
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Application June 16, 1937, Serial No. 148,531

14 Claims. (Cl. 46—76)

The object of this invention is to furnish a toy airplane, the parts of which can be sold to purchasers in a knocked down, or wholly disassembled, condition and be quickly and accurately assembled by persons of average intelligence and dexterity, including children of about the age of ten years. A further object is to provide a frame structure having a minimum number of parts, hence great simplicity, and having also sufficient strength, combined with lightness and flexibility, to make a practical model which will fly under its own power and withstand the shock of repeated landings. The invention comprises a structure in which are combined means and elements whereby the foregoing objects are accomplished and in which are embodied also the principles of means whereby the design of the airplane as a whole can be altered without substantial change in the members themselves.

In the drawings illustrating the invention,—

Fig. 1 is a plan view of the frame structure of the airplane;

Fig. 2 is an under plan view of the middle part of the frame structure;

Figs. 3 and 4 are respectively a side elevation and a front elevation of the same structure;

Fig. 5 is a cross section on line 5—5 of Fig. 3;

Fig. 6 is a plan view of the stabilizer vane;

Fig. 7 is a plan view of one of the wings;

Fig. 8 is an elevation of the rudder;

Fig. 9 is a section of the stabilizer vane taken on line 9—9 of Fig. 6;

Fig. 10 is a section of the wing taken on line 10—10 of Fig. 7;

Fig. 11 is a section of the rudder taken on line 11—11 of Fig. 8;

Fig. 12 is a perspective view of the complete airplane including the paper or fabric coverings of the body, wings and wheel struts;

Fig. 13 is a side elevation of the middle part of the frame structure showing a variation of design made with the same structural members;

Fig. 14 is a cross section taken on line 14—14 of Fig. 13.

Like reference characters designate the same parts wherever they occur in all the figures.

The body frame structure of the airplane toy consists of two longerons 1, 1, a nose block 2 and two braces 3, 3 which I call formers because they also have the function of giving form to the covering pieces of paper or fabric in which the frame is enclosed, and an appearance simulating that of regular airplanes. In order to be light in weight, these parts are made of balsa wood, and the longerons and formers are made from thin sheets of the wood, while the nose piece, which needs to have greater strength and rigidity than the other parts, is made of a thick piece of the wood. The formers have height and width suitable for the cabin of the model plane, and are cut out centrally, both for lightness and also to leave space for passage of the elastic band in which energy for driving the propeller is stored. For the purposes of this specification the term "former" may be understood as meaning a brace which has height and width dimensions of substantial extent. Here the height dimension and disposition of the formers are such that they extend both above and below the longerons.

The nose piece and formers are notched in their opposite sides to receive the longerons and establish the positions of these members relatively to one another in the height dimension of the airplane. In assembling the longerons are placed in the notches of these transverse members and cemented to them by suitable adhesive. Their tail ends are brought together and cemented to one another. The flexibility of the longerons, due to their slight thickness, is great enough to permit them to be bent without danger of breakage much further than the distance necessary for this purpose. But at the same time they are so wide as to be very stiff in the plane of their width. The locations of the formers necessary for proper balance of the plane, or at least that of the forward former which establishes the position of the wings, may be shown by marks printed or drawn on the inner faces of the longerons.

The formers are stiffened and reinforced by braces 4 which are rods or bars of a length equal to the width of the formers applied and cemented to the latter in the width dimension thereof and at any desired height between the top and bottom edges of the formers. These braces furnish strength and stiffness normally sufficient to prevent the stresses applied by and through the longerons from either buckling the formers or tearing them apart.

The body frame is completed by a bar 6, called the wing root support, which is preferably a thin strip of the same material as the members previously described, and is cemented to the formers in the longitudinal middle line of the craft. As shown in Figs. 1–5, it is secured to the lower parts of the formers, its forward end being abutted against the rear side of the forward former and the under side of the brace 4 of that former, and its rear end is abutted against the front face at the lower edge of the rear

former. But as will presently appear, this wing root support may be applied in other locations. Its function is to support and anchor the inner ends or roots of the wing spars; and it has a bracing effect on the frame as well.

The frame thus constructed is covered in by pieces of paper or other suitable fabric having such stiffness that, when bent to cylindrical or conical or box-like form it tends to retain such formation and strongly resist deformation. The parts supplied for assemblage of the toy include blanks of such fabric cut to patterns such that, when wrapped around the formers and nose piece, they will give desired external contours to the body of the plane. Pieces 7 and 8 (Fig. 12) are thus bent around the rear former at the upper and lower side respectively of the frame and cemented to the former and longerons, being so shaped in bending as to have generally conical or pyramidal contours with rounded corners, tappering to approximately a vertical edge at the rear end. The rear extremities of the longerons are slotted as shown at 9 in Fig. 3, and the edges of the cover pieces are cut away correspondingly to leave such slots open for insertion of the stabilizer vane. Other blanks 10 and 11 of the cover fabric are wrapped around the upper and lower sides of the frame and cemented to the nose block and longerons, the piece 11 being also cemented to the lower edges of the forward former. A cover piece 12 to form the roof of the cabin is bent around both formers and cemented thereto and to the longerons. Two side pieces, of which one is shown at 13, are cemented to the longerons below the cover piece; although if desired these side pieces and the cover may be made all in one piece. Their lower edges extend to the wings, as shown in Fig. 12, and may be cemented to the latter. Finally a segmental piece 14 to represent the windshield or front window of the cabin is secured on an angle between the nose cover and the upper edge of the front corner. This piece and the cabin roof piece may be decorated with lines representing windows and the figures of occupants within the cabin; and any other desired decoration may be printed on the cover pieces.

The covering of adequately stiff flexible material has substantial mechanical value in the structure. It contributes strength by tying the longerons, formers, nose block, wings and tail assemblage to one another additionally to the direct junctions between these members. It contributes stiffness, not only by its inherent stiffness, but also by virtue of the convex curvature given the blanks of the covering material by bending them around the formers or nose block and the longerons. It absorbs and distributes to a greater or less extent the shocks of repeated impacts when flying or in landing, withstands normal handling without crushing or distortion, holds its shape and reinforces the frame under the torsional effect of the powerful rubber bands installed to drive the propeller. The covering as a whole is in effect a shell, light in weight, which is stiffened and reinforced by the frame members and, in turn stiffens and reinforces the frame. Together, the frame and covering make a structure combining maximum stiffness with minimum weight, most inexpensive in cost of its parts, which can be assembled with ease quickly. The structural parts can be cut so that the assembled model will closely simulate any full size plane, and the cover sheets can be printed to enhance such similitude or obtain other desired ornamental effects.

The wings are made each of a spar 15 and a cover of paper or other suitably stiff and air impervious fabric. The spar is of slender tapering width, as shown best in Fig. 1, and has a wide root or base portion 16 at its inner end. The cover fabric 17 of the wing is made of a blank having the outline of two wings connected together at the leading edge. It is folded around the spar so that the fold forms the leading edge of the wing and the spar is located in it. The trailing edges of the fabric blank are cemented together. Attachment of the wings to the body is made by cementing the root ends of the spars and of the cover fabrics to the wing root support 6, and the adjacent leading edges to the rear side of the forward former. The angle between the forward edge and adjacent end edge of the wing spar and its cover is slightly less than 90°, whereby, when the wings are placed so as to abut squarely against one another, as shown in Fig. 2, their leading edges are inclined slightly backward from the longitudinal middle line of the plane. The angle between the leading edges of the two wings may be changed by placing them with their rear parts more or less separated, as indicated by dotted lines in Fig. 2. The capacity for adjustment in assemblage afforded by the wing root support and the wing root angles thus enables the leading edges of the wings to be at any angle with the longitudinal line of the plane from 90° to that of the base line angle. The dihedral angle of the wings is established by the thickness of the wing root support and the length of the brace 4 on the forward former. That is, with reference to Fig. 5, it will be seen that each wing runs from the under side of the support 6 upward into contact with one end of the brace 4 at the under side of the latter. As the wings are adhesively united to this former and to the brace, they are anchored at points additional to and distant from the attachment at their root extremities, whereby they are braced and stiffened. The brace 4 by overlapping the wings resists the forces tending to fold the wings upwardly about the line of their abutting edges as a hinge, giving rigidity where rigidity is needed and safeguarding the root support from being split along its middle. At the same time the wing spar design is such as to afford a measure of resilient flexibility sufficient to cushion the shock and avoid breakage if the plane lands on a wing after making a flight.

The angles of incidence of the wings to the air when in flight is controlled by the inclination of the wing root support 6. This angle may be varied by raising or lowering the forward former brace before making it fast, and correspondingly raising or lowering the forward end of the wing root support.

The stabilizer vane is made of two spars 18, 19 and a sheet 20 of paper or other suitably stiff fabric. The spar 18 is cemented to the leading edge of the sheet 20 on its under side, and is preferably, although not necessarily, other than straight, substantially as shown. The spar 19 is a reinforce or stiffener and is secured to the sheet 20 between its leading and rear edges. The rear edge of the vane is deeply notched at 21 to accommodate the rudder and rudder spar. The location of the spar 19 is determined by the depth of this notch and the depth of the notch 9 in the longerons. The stabilizer vane with its spars attached is inserted into the slot 9. These parts are preferably so proportioned that when the vane is inserted into the slot 9 until spar 18 arrives at the end of this slot, the spar 19 and

the apex of notch 21 are substantially flush with the rear edge of the longerons.

The rudder 22 is made of a sheet of paper, or other suitably stiff and air impervious fabric, folded on the line 23, 24 (Fig. 8), each half of the original blank having the outline shown in Fig. 8. The lower part of the rudder is cut out to provide an edge 25 to seat on the top cover part 7 of the body and with an upright edge 26 to pass through the notch 21 of the stabilizer vane and extend along the rear edges of the longerons. A spar 27 is placed between the two breadths of the rudder fabric flush with the edge 26 and extending upwardly in alinement therewith, and is cemented to them. These breadths of fabric are likewise cemented together in rear of the spar. Spar 27 is designed to be cemented to the joined rear edges of the longerons.

Wheels 28 are connected to the forward former by means of a piece of thin but stiff spring wire which is bent to wide and shallow U form in its middle, to provide anchor members 29, 30 which are cemented to the forward side of the forward former. Other parts of the wire provide outwardly and forwardly inclined wheel struts 31 while the ends of the wire are bent outward to make wheel axles 32 extending through the wheels, and the extremities 33 are bent up, after placement of the wheels on the axle portions, to lock the wheels on.

The power plant of the plane consists of a propeller 34 and an elastic rubber band 35. The propeller shaft 36, made of a length of wire, passes through a central hole in a plug 37, which is set into a hole in the nose block 2, and through the propeller, its extremity being bent over as a hook 38 arranged to make interlocking engagement with the propeller. The plug 37 is a piece of hard wood fitted to the nose block and having a flange abutting on the forward face of the nose block. A metal separator block or washer 39 is placed on the propeller shaft between the plug 37 and the propeller. I prefer to insert metallic tubes, such as small tubular rivets or eyelets in the plug and propeller at either side of the separator block to reduce friction and wear on the propeller and plug when the propeller is rotated. The elastic band 35 passes through an eye 40 on the inner end of the wire propeller shaft, and passes around an anchorage 41 made of a pin passed through the longerons in the tail part of the plane. This pin is removable to permit substitution of new bands when old ones break.

The illustration of the framing and reinforcing members in Figs. 1, 2 and 3 without the covering fabric is not intended to imply that these members are assembled in this manner before any of the covering fabric is applied. The preferred manner of assembling is to build the body frame consisting of the nose block, longerons and reinforced formers and wing root support in one unit, secure the wheel supports to the forward former, and apply the cover fabric to this frame before the wings, stabilizer vane and rudder are applied. The wing spars and their cover fabrics, the rudder with its stiffening spar, and the stabilizer vane with its spars are separately assembled. Before the rudder is applied the stabilizer vane is inserted in the slot 9 in the longerons and cemented fast, after which the rudder is put in place and its spar cemented in upright position to the rear edges of the longerons. The wings are separately cemented to the wing root support and forward former as previously described. Before the cement used for this purpose has dried, the wings may be adjusted to bring their leading edges square to the longitudinal line of the body or with a rearward inclination in the desired degree within the limits of this adjustment.

The power plant may be mounted after, as well as before, the structure of the plane has been completely assembled. The cover piece 8 which passes under the tail part is left with an opening adjacent to the anchor pin 41, whereby the end of the elastic band is accessible. And the shaft bearing plug 37 is removable readily from the nose block, the hole in the latter which receives the plug being large enough to permit free passage of the elastic band and the eye 40 of the shaft. Thus although the body frame has been completely enclosed by its covering fabric, the elastic band and propeller shaft bearing may be inserted thereafter and the band engaged with the anchor pin. Paper strips 42 of appropriate outline are folded and secured around the wheel strut wires to simulate the wheel struts of full sized airplanes, as represented in Fig. 12.

The particular toy airplane used as the model for the illustration herein has a length from leading edge of the propeller to rear edge of the rudder of 12 inches and a wing spread of 16 inches. The longerons, formers, spars, braces and wing root support are cut from sheets of balsa wood having a thickness of between $\frac{1}{32}$ inch and $\frac{1}{16}$ inch. The nose block and propeller are likewise of balsa but of greater thickness. The nose block plug, wheels and anchor pin for the elastic band are of harder and stronger wood. The airplane thus made, when the elastic band is fully wound up, will take off from the ground under its own power and fly in true and well balanced flight.

The invention is not limited to the specific design and dimensions hereinbefore given. On the contrary, it comprises principles which may be embodied in specifically different designs and in similar designs having different dimensions. The principles include means whereby simplicity and lightness of construction are achieved together with adequate strength and rigidity for propelled flight by power stored in the plane itself, with aero-dynamic balance obtaining straight and level flight, and with flexibility and resilience of wings, guiding vanes and body sufficient to cushion the shock of landing and prevent breakage after falling from a great height.

The illustration of these principles thus far described is a low wing monoplane. But they may equally well be embodied in one having high wings or wings at an intermediate height. Figs. 13 and 14 show a variation in which the wings are mounted at the top of the cabin portion of the body. The only changes here are in the positions of the wings, wing root support, and former braces, and in the shape of the formers, the latter being flat on top instead of arched. In like manner the former braces and wing root support may be positioned at intermediate heights so as to permit placement of the wings directly on the upper edges of the longerons or against the under edges thereof. Any of these designs may be built into toy air ships of other dimensions by making the frame members and spars of correspondingly different dimensions.

An important advantage of this invention as compared with knock down airplane toys heretofore put out commercially is that the plane can be assembled in a small fraction of the time and by persons having small skill, with less dan-

ger of breaking any of the parts in the course of assembling them and practical certainty of having a successful flying machine when assembled.

What I claim and desire to secure by Letters Patent is:

1. A toy airplane having a body frame consisting of a nose block and a plurality of transverse formers spaced apart from one another longitudinally, two longerons secured to respectively opposite sides of the nose block and formers and to one another at the tail end, a longitudinal wing root support extending from one former to the next in the longitudinal middle of the structure, two wings consisting each of a spar at the leading edge of the wing and a cover fabric secured thereto, said wings being fastened at their root ends to the wing root support and abutted against the rear side of the forward former, a horizontal stabilizer vane secured to the rear end of the body frame, and a rudder also secured to the rear end of the body frame.

2. A toy airplane comprising a body structure having transverse formers and a longitudinal wing root support extending between and secured to said formers, guide vanes connected to the tail end of the body structure and wings secured at their root end to the wing root support and forward former.

3. A toy airplane comprising a body structure having transverse formers and a longitudinal wing root support extending between and secured to said formers, guide vanes connected to the tail end of the body structure and wings secured at their root end to the wing root support and forward former, each wing being a self contained structure consisting of a spar at the leading edge and a cover fabric secured to said spar, the spar having a rearwardly extending arm at its root end, and being connectible with the forward former and wing root support with its leading edge at different angles to the longitudinal median line of the body structure.

4. A toy airplane comprising a body structure having transverse formers and a longitudinal wing root support extending between and secured to said formers, guide vanes connected to the tail end of the body structure and wings secured at their root end to the wing root support and forward former, the wing root support being connectible at different inclinations in the longitudinal vertical median plane of the body structure and serving to determine the angle of incidence of the wings in flight.

5. In a toy airplane a body structure consisting of two longerons, one at either side of the structure, a nose block between the forward ends of said longerons, formers disposed transversely between the longerons and spaced rearwardly from the nose block and from one another, the tail ends of the longerons being connected together, and a wing root support midway between the longerons extending from one former to the next and being secured thereto at a desired height and inclination.

6. A toy airplane comprising two longerons connected together at their rear end, transverse braces between the longerons at their forward end and at locations spaced apart longitudinally from one another between the forward and rear ends, the longerons having slots extending forwardly from their rear ends, a stabilizer vane inserted in said slots and a rudder vane including a spar secured upright to the rear extremity of the longerons and a folded sheet of stiff fabric embracing said spar and secured thereto extending in the vertical median plane of the structure.

7. A toy airplane comprising two longerons and transverse formers between the longerons to which the latter are secured, forming a body structure, one of said transverse formers being at the necessary location for the leading edge of monoplane wings to secure balance in flight, a brace secured to the rear side of said former, a wing root support at the rear side of said former beneath the middle of said brace and extending thence in the plane midway between the longerons to the next rearward former, and wings secured at their root extremities to the under side of said wing root support and also secured to the forward former with their leading edges beneath and in braced engagement with the aforesaid brace.

8. A toy airplane comprising two longerons having relatively slight thickness and much greater width, forming the longitudinal side members of a body frame and arranged with their width dimension vertical, transverse formers spaced apart from one another longitudinally between the longerons and secured to them, extending above and below the longerons, a nose block between the forward ends of the longerons and secured to them, the tail ends of the longerons being brought together and having forwardly extending slots in a substantially horizontal plane, a cover fabric wrapped about the longerons and formers and secured thereto, making a closed-in body, a horizontal stabilizer vane consisting of a sheet of fabric and stiffening spars secured thereto, contained in the slots of the longerons, one of said spars being at the forward edge of the stabilizer vane and extending to either side of the body with a rearward slant, the other spar being square to the length of the body at the rear end of said slot, the fabric of the stabilizer vane extending to rear of the second spar and having a notch in its middle of which the apex is at the middle point of the second spar, a rudder vane consisting of an upright spar secured to the rear end of the longerons in the said notch of the stabilizer vane and a fabric secured to said spar extending to front and rear thereof, its forwardly extending portion being above the cover fabric of the body and in union therewith, and wings secured to the body and extending to opposite sides thereof.

9. A knock down airplane toy consisting of two longerons of strip formation having substantial width and relatively slight thickness, the thickness, however, being great enough to provide stiffness to prevent buckling in the plane of the width dimension, two formers and a nose block having notches in their opposite side edges adapted to receive the longerons and adapted to be placed transversely between the longerons and secured thereto with the nose block at the forward end and the formers spaced apart therefrom and from one another toward the tail end, former braces adapted to be secured to the formers on either face thereof at any one of a number of heights between the top and bottom edges of the formers, a wing root support consisting of a strip of material having substantial rigidity adapted to be placed between the formers, midway between the side edges thereof and in connection at opposite ends with one or both of the former braces, and wing spars each having a rearwardly extending base portion of which the base edge makes an angle of slightly less than 90° with the leading edge of the spar, cover pieces folded about the wing spars so that the spars occupy the folds,

the base edges of said cover pieces being adjacent to the base edges of the wing spars, said wings being connectible at their base ends to the under side of the wing root support with their respective base edges abutting against one another or abutting at the leading end and separated in the rear parts, and the leading edges of the wings being beneath and braced by the brace bar of the forward former.

10. In a knock down airplane, a wing comprising a spar of tapering width from its root end to its tip and having a wide root portion, combined with a wing covering consisting of two breadths of suitable fabric folded on a middle line and in embracing engagement with said spar, the fold of the fabric being the leading edge of the wing and the spar being located in said fold and constituting a reinforce for such leading edge.

11. A stabilizer vane consisting of a sheet of fabric with forward and rear edges diverging from one another from each end of the plane toward the longitudinal middle line, a spar having an outline substantially the same as that of the leading edge of the vane secured to the fabric in register with such leading edge, and a second spar connected to the vane approximately midway between the leading and trailing edges thereof, the vane fabric having a notch extending forwardly from its trailing edge substantially up to the second named spar for reception of a rudder vane.

12. In a toy airplane, a rudder vane consisting of a folded sheet of fabric and a spar secured between the breadths of such fabric between the fold and the rear edge, the spar being adapted to be placed vertically when applied to the airplane body and the fold being in a line at an upwardly converging inclination to the spar, the rudder vane having between the lower end of the fold and the spar an edge at a downward and rearward inclination from the fold, the spar and the portion of the fabric in rear thereof extending downwardly beyond the rear end of such edge.

13. In a toy airplane, a body structure comprising longerons and transverse formers connected together to form a frame, of which the formers extend above and below the longerons and have a convex curvature in their upper parts, and a covering of flexible and relatively stiff sheet material extending across and between the formers and curved smoothly around the formers and longerons and secured thereto in contact with the curved edges of the formers, said covering having sufficient strength and stiffness when so curved to reinforce the frame.

14. In a toy airplane, a body structure consisting of a frame and a covering, the frame being composed of longerons at opposite sides, a nose piece and spaced apart transverse formers between the longerons at the forward end and intermediate points respectively of the latter, the longerons being connected to one another at their rear end, the nose piece and formers extending above the longerons and having outlines which are convexedly curved in part, and the covering consisting of flexible sheet material extending across said formers and nose piece and spaces between and adjacent thereto and curved in conformity with the convex curvature and carried outside of the longerons in smooth lines and adhesively secured to the before named members, said covering having strength and stiffness when so curved sufficient to contribute strength and stiffness to the body structure as a whole.

THOMAS D. WILDON.