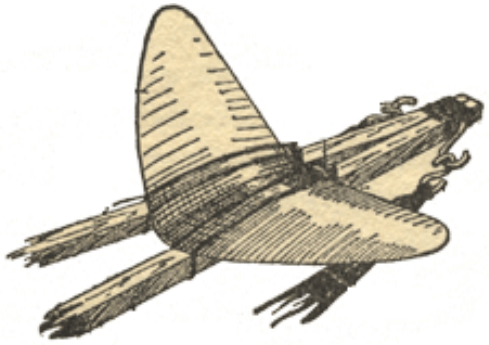
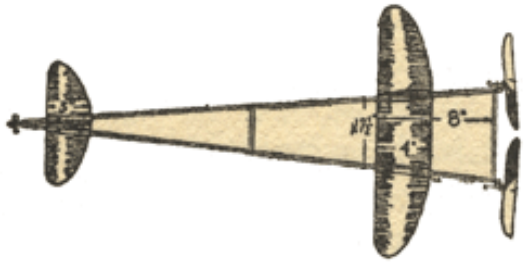
# How to Build a Model Airplane

THE principles of flying are really simple when understood. We always knew that a large piece of paper, or any flat object of considerable area, would present so much surface to the air, if kept in a horizontal position, that it could not fall rapidly. The trick was to make one or more flat surfaces or planes, as they are now called, and balance them so nicely that they would maintain their position parallel to the ground. The Wright brothers accomplished this in some of their earlier models, and were able to glide slowly down from hills, sometimes alighting a half-mile from the starting point. Thus encouraged beyond their fondest hopes, they went further and added devices to their machine that enabled them to tilt the wings or planes to any desired angle, retarding the down-ward motion at will.



As a boat is forced through the water by the screw wheel in the rear, so an air craft may be made to move forward by a similar propeller. The only thing that remained was to provide some force to drive the propeller that would be light enough to be practical. The Wright brothers searched about until they found an engine light enough for their purpose, and their efforts to fly soon became successful.

Soon after the advent of the airplane, the building of model airplanes became a hobby for those old and young alike. These models were not the models we think of today; those which come scripted in a box, require sparse effort and serve no purpose at all except as mere background fodder. The model airplanes of yesteryear actually could fly. They did not contain anything as complicated as a motor, but merely used basic aeronautic principles to fly short distances and short heights. Learn how to build this sort of model airplane.



**How to Build a Good Model Plane**

**Simple Model Airplane #1**

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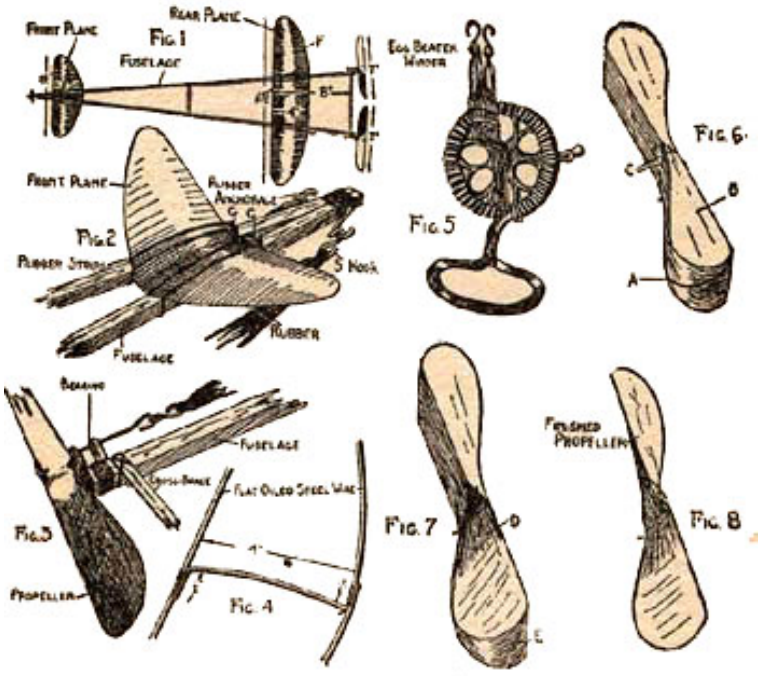
# How to Build a Good Model Plane

The model airplane described here has made flights of from 1000 to 1400 feet in a "straight away" and remained in the air three-quarters of a minute.

The first thing to consider in making this model is what materials are needed. Here they are:

1. Six feet of flat oiled steel wire, for framework of planes and ribs;
2. One sheet of bamboo fibre paper, for covering planes;
3. Two straight-grained spruce sticks three feet long by 1/4x5/16", for fuselage;
4. Two feet of split bamboo, for cross braces;
5. Three feet of one-sixteenth inch steel wire, for hooks, etc.;
6. Two seven-inch propeller blanks, for propellers;
7. Forty-two feet of three-thirty-second inch square rubber, for motors;
8. One egg beater, for winder;
9. One can of glue, for joints;
10. One spool of strong linen thread, for lashing joints;
11. One can of bamboo varnish, for coating planes;
12. One four-inch piece of brass, for bearings;
13. One-half dozen washers, for bearings.




PLANS FOR A MODEL AEROPLANE.

The main frame or fuselage is triangular in shape and is made of straight-grained spruce, each side or member being thirty-

five inches long by 5/16x1/4". One end of each stick is tapered off on the inside, to form an acute angle when fastened together, which is done by gluing and lashing with thread as shown in **Fig. 2**. The other ends are braced six and one-half inches apart by a piece of bamboo fastened on top of the fuselage by lashing with thread and gluing one-half inch from the rear end of each member of the fuselage. The middle cross-brace is also of bamboo and is fastened in the same way as was the rear brace, on top of the fuselage midway between the ends as shown in **Fig. 1**. Now two blocks are cut to form steps and are glued and lashed tightly with thread to the top of the fuselage with the flat sides of the blocks on the sticks, three and one-half inches from the apex (front end). These blocks are for elevating or depressing the front plane. The object of this is explained in the section on Front Plane.

Bore a hole about one-sixteenth inch through the frame from side to side one-half inch from the apex. A piece of one-sixteenth-inch wire, 3 inches long, is inserted and each end bent into a hook to receive the *S* hooks of the rubber motors as shown in **Fig. 2**.

These can be made or bought. To make, get a piece of three-sixty-fourths-inch brass five-sixteenths-inch wide and four inches long. This is enough to make two propeller hangers and should be cut in half and bent with pliers to form two U-shaped pieces (see drawing **Fig. 3**). Or use the same amount of flat metal that you will cut off in making your winder described later on. Now bore a one-sixteenth-inch hole through the ends so that the propeller shafts will turn easily. These are glued and lashed to the rear ends of the fuselage with the ends of the U extending out from the frame as shown in **Fig. 3**. For the shafts use two pieces of wire three and one-half inches long, the same size as the holes, and with pliers bend a hook at one end of each wire to support the rubber motors. Push the shafts through the holes in the brass hangers with the hooked ends toward the front of the fuselage; place a small bead and washer on the disengaged end of the wire shaft. Next slip the propellers on the shafts, with the curved edges of the blades leading. In revolving they should turn out in opposite directions. The straight ends of the shafts are bent back over the propellers to keep them from turning on their shafts. To cut the propellers refer to section on Propellers.

The frame of the plane *F* is made of wire; the best to use is a flat oiled steel, which will stay bent. A piece 43 inches long is required; it is bent with pliers to the shape shown in **Fig. 1**, and the ends lapped one-half inch and fastened by gluing and lashing them four and one-half inches from one end of the wire. This four and one-half inch end is used as a brace or rib; and should cross the plane frame six inches from one end of the frame. It is held by gluing and lashing it to the opposite side of the frame, as shown in **Fig. 4**. A corresponding rib, five inches long, with each end bent one-half inch, is fastened in the same way to each side of the frame or rim six inches from the other end. After the frame is finished, with pliers bend the front middle portions of the rib slightly upward (about one-half inch) as shown in **Fig. 4**. This is to give what is known as camber and increases the lifting power and stability of the flyer considerably. The tips of the plane frame are also bent up slightly, about 30 degrees, to keep the model steady in flight.

Use light, strong paper; bamboo fiber paper is the best. Lay the wire frame upside down on the paper and cut around the frame, allowing about one-quarter inch for turning over. The paper is glued along the edges and turned back over the rim of the plane frame; be sure that it sticks fast. Care must be taken to get the paper as tight as possible, as wrinkled surfaces hinder the flying qualities. The plane is now ready to be painted or sized with a thin varnish; bamboo varnish is the best, spreading it evenly over the paper. This tends to shrink and tighten the fiber, and forms an airtight, strong surface that will give great sustaining power.

This small plane is sometimes called the elevating plane, as by raising or lowering it regulates the upward and downward movement of the model in flight. It is made of the same material and like the main plane, with the exception that it is bent up at the ends to form a dihedral angle of about 45 degrees, as shown in **Fig. 2**. This plane has only one rib and is covered with the paper on the underside instead of on the top. The wire for the rim and single rib is twenty-four inches long and bent, and the rib formed in the way described.

The small plane is fastened on top of the fuselage three inches from the apex, with its straight front edge over the blocks, by wrapping with a strip of rubber tightly around the plane and frame, first over the plane and then under the fuselage as shown in **Fig. 2**. The main (rear) plane is fastened on top of the fuselage in a similar way, with its straight front edge eight inches from the rear brace of the fuselage.

Make four *S* hooks from a piece of one-sixteenth-inch wire and hook them on the front rubber anchorage and propeller shafts to hold the rubber. About forty-two feet of three-thirty-seconds-inch square rubber are needed; twenty-one feet for each motor. Make a loop in both ends of each portion of rubber and hook one over the front *S* hook, then pass the rubber around through the *S* hook at the rear, back and forth, until the second loop is slipped on a hook. Do the same with the other rubber motor.

There are two propellers for this flyer, one a right-hand and the other a left-hand propeller. A right-hand propeller is one of which the uppermost blade turns toward the right as the propeller revolves in traveling forward. Of course, a left-hand propeller turns in the opposite direction.

In making a propeller the best way is to buy what is known as "blanks," which can be had from almost any supply dealer. It is then cut into shape with a knife, which would be a good deal easier than cutting the blank first out of a block of wood.

In making a right-hand propeller, draw a curved diagonal line at each end of the blank at opposite angles as shown in *A*, **Fig. 6**. To carve, hold the blank in the left hand, cut the portion *B* out, starting at the dotted line *C*, as shown in **Fig. 6**, so that the blades will be concave, i.e., curved in as shown in *D*, **Fig. 7**. The blank is then turned over and the portion *E*, **Fig. 7**, is cut to follow the other side. Care must be taken, however, not to get the blade so thin as to weaken it. Observe carefully in the drawing how the propeller is shaped at the middle for a hub. It is at this point the full thickness of the blank. The same process is used for the other blade of the propeller. The leading edge is always the curved edge.

When the four sides are finished, sandpaper the surfaces until they are perfectly smooth. The propeller should now look like **Fig. 8**.

To make a left-hand propeller, the curved diagonal line at the beginning is drawn at an opposite angle, and the opposite cutting operation is carried out.

It would take altogether too long to wind up the rubber motors by turning the propellers. One of the best ways to accomplish the winding is to make a winder from an egg beater, which is shown in **Fig. 5**, although a better one can be made from a hand drill. The two beaters, of flat metal, are each clipped three inches from the gear wheels on one side and one and three-quarters inch on the other. Then slip in the gear wheels with the attached pieces of metal down on the heavy wire on which they revolve and cut the wire off three-quarters inch from the cast iron bracket to which the ends of the wire are bound.

Now put the gear wheels and the attached metal extensions back on these three-quarters-inch wire stubs, and hold them there by soldering on a piece of brass tubing that will just fit on the wire stub or axle, moderately close to the gear wheels. Now bend the flat extensions on a line with the wire stubs, so that the tips of the extensions will meet; the extra one-quarter inch of flat metal on one side is turned over on the other shorter end, and through these three thicknesses of metal a one-sixteenth-inch hole is bored. Make two *S* hooks out of a three-inch piece of one-sixteenth-inch wire (same as used for the *S* hooks of the rubber motors). Insert a hook of the *S* in the one-sixteenth-inch hole and pinch it together with pliers, to keep the hook tightly in place. The winder now looks like **Fig. 5**. Both rubbers can be wound up at the same time by hooking them on the hooks of the winder; one turn of the large wheel means five turns of the rubber.

Put a little oil on the bearings so that the propellers will turn easily.

Have some one hold the model at the rear by the propellers and fuselage. Unhook the *S* hooks with the attached rubber from the front rubber anchorage and hook them on the winder, step back until you have stretched the rubber about twice the length of the machine, and wind it up about 100 turns of the winder for a trial flight. Then hook it back on the front rubber anchorage.

Grasp the rear cross-brace with the right hand in such a way as to prevent the propellers from unwinding, supporting the flyer by the middle cross-brace with the left hand. Push the flyer forward through the air, letting go with both hands at the same time.

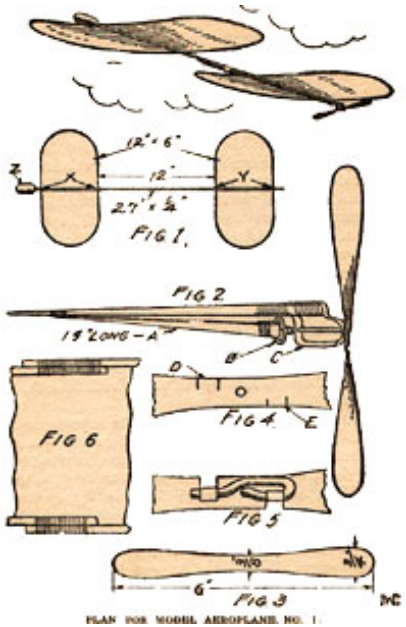
Longer flights can be made by winding the rubber up a greater number of turns: 250 turns of the winder is the limit.

Be patient if things don't go just right; keep trying; you will succeed.

# Simple Model Airplane #1

The airplane pictured here depends for its buoyancy on the same principles that govern all successful airplanes. The planes prevent it from falling quickly, the wheel drives it.

First get the long stick or spine. It should be one-quarter inch square and must be light and straight grained. There is nothing better for the purpose than a piece of white or cork pine. Each plane is twelve inches long and six inches wide. To make them you will need four pieces of rattan each twenty inches long. You can get it at factories where baby carriages and reed chairs are manufactured or you can obtain some from an old piece of furniture. To make on plane you use two pieces bent to a U shape and fastened together at the ends by wrapping with thread, as shown in **Fig. 6**. Nail the planes to the twenty-seven-inch stick with small brads. The planes are covered with light cloth. It may be stitched on or glued. Pull it tight enough to make the planes curve slightly upward at the ends.



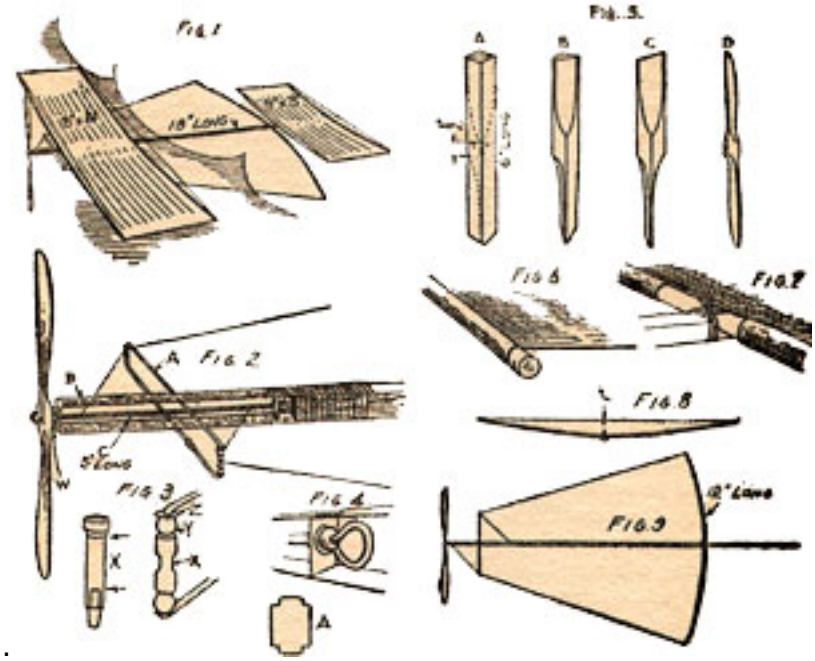

To the rear end of the spine we now attach a strip of tin bent and fixed on, as shown in *C*, **Fig. 2**. Next cut a strip of tin to the shape and size of **Fig. 3**. Slit it as shown in *D* and *E* in **Fig. 4**, bending over to make fast to the wire key as in **Fig. 5**. The rubber band A in **Fig. 2** is fastened to the wire *B* in **Fig. 2**. This cut shows the whole arrangement very clearly. As might be expected, the end that has the fixtures on will be considerably heavier than the other, so to balance up we put a spool or knob on the fore end. The best way to do this is to put a common spool on, and if it proves too light, wrap wire around it until the airplane will balance nicely when suspended from the ceiling with a thread tied to the center.

To use it, you twist the wheel around until you have it as tight as the rubber band will stand and then toss it into the air, releasing the tension at the same time. It will ascend to a good height and then glide gracefully to the ground.

# Simple Model Airplane #2

Here is shown how to make a complete monoplane model, using as power a bow and string which has been drawn tight by twisting the wheel. Upon being released it gives a powerful impetus to the wheel.

First get a stick one-quarter inch square and eighteen inches long. It must be sound and straight grained. Spruce or ash being favorite woods, the main point is to have the backbone light and strong. Put on a piece of hickory or any flexible piece for the bow at about the position shown. The exact distance is best determined by experimenting. Fasten it with wire so that it may be moved till you get the right balance. The plane is made of silk stretched on a rattan frame 18x4". It is curved up by putting tight strings parallel with each other from corner to corner. The amount of curvature (one inch) is shown by **Fig. 8**. The small plane (9 x 3") is made in the same way. Its mission is something like that of the tail of a kite. **Fig. 5** gives a clear idea of cutting a square spruce stick into propeller shape. The planes are fastened to the backbone or spine in the manner shown in **Fig. 7**. Use very fine wire or strong thread for the lashing. Now comes the power plant

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Bend a long strip of tin double and tack or tie it to the long stick or spine as shown in **Fig. 2**. Close to the end of the stick place the small piece A. (See **Fig. 4** for complete view.) For a shaft we use a bicycle spoke. For the cross-arms A in **Fig. 2** use two spokes threaded through slits in the tin and twisted together. The little piece *X* is found on spokes, and use to tighten them. Get two of those and place one on each side of the cross arm, to be used as pulleys. It is well illustrated in **Fig. 3**. *Y*, in this same cut, is a bead used for a bearing. It is a simple thing to understand, but you must work carefully and slowly to get right results. Look the drawing over carefully and study the details. Everything is shown and it will answer any question that might come to your mind.

A bearing is that part of a machine that comes in contact with any other part that turns or moves. Always try to make those parts slippery by using oil, and to further reduce the friction use a bead, in this case at *W*, in **Fig. 2**. Now put your wheel on, use strong fish line for a bow string, simply tying it on; bring each end over a different pulley on the sides of the cross-arms *A* in **Fig. 2**. Twist the propeller until the bow is drawn as much as it will stand, then toss the airplane gently up. It should fly fifty or sixty feet at least, and is not liable to be broken, for the planes will cause it to glide safely to the ground even after the power is spent. The greatest difficulty you will have to overcome is to balance the device properly to make it light enough.