

How to Make a Model Aeroplane

A Monoplane Driven by Elastic Rubber Bands Which Will Fly 700 Feet

By Cecil Peoli

AFTER the problems of flight had been so far solved that men could take the air with reasonable safety, it was but natural that boys, who like everything that "goes," should take an interest in the flying machine. It is not too much to say that most boys from twelve to eighteen know more about the actual construction of aeroplanes and the difficulties of building and operating them than their grown-up relatives, who stand open-mouthed in the contemplation of spiral dips, figure-of-eight curves, and other antics.

The interest of boys in aeroplanes has led them to build small models of their own. With these, remarkable results are obtained, so remarkable indeed that in the hands of a skillful scientific experimenter, they might be used for the purpose of clearing up some of those mysteries of dynamic flight which are still concealed. Although the results obtained with small models are not always directly transferable to the full-sized machine, there can be no doubt that they will serve the useful purpose of performing at a small expense, in a rough yet sufficiently accurate way, the work which is now being done by costly aerodynamic institutions.

Feats Accomplished With Small Models.

The rivalry among boys in the building of safe, stable models is so keen that model-flying contests are held from time to time in various parts of the country, notably at Van Cortlandt Park, New York city. The amount of interest that is aroused is impressive to the man who is unfamiliar with the spread of the model-making movement among boys. The feats accomplished by the models are indeed remarkable. One of them, devised by the writer of this article, has flown for a distance of 1,691 feet, driven only by rubber bands. The model which is here illustrated, is built along somewhat similar lines, and will fly for about 700 feet. A boy of an experimental turn of mind can supply it with supporting surfaces of different size and shape, and probably increase its flying range considerably. At all events, the possibilities for experimenting, if the boy who makes this aeroplane is of an inquiring turn, are almost unlimited.

Aeroplane models are sold in stores throughout the country. They undoubtedly fly—some better than others. Their cost ranges from two to five dollars, and upward. The model here shown can be made for much less and will outfly almost any bought model.

The Main Frame.

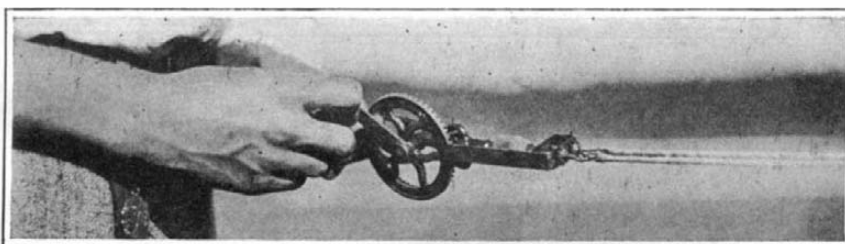
The main frame of the model monoplane consists of two strips *a* of spruce, each 28 inches long, and measuring in cross section $\frac{1}{4}$ by $\frac{3}{8}$ of an inch. As shown in Fig. 1, the two strips *a* are tied together at the front and with strong thread and are then glued, the glue being spread over and between the windings of the thread. (Figs. 1 and 5.) The rear ends of the two strips *a* are spread apart $4\frac{1}{4}$ inches to form a stout triangular frame, and are tied together by cross bars of bamboo *b* and *c*, which are secured to the main strips *a* by strong thread and glue.

The Propellers.

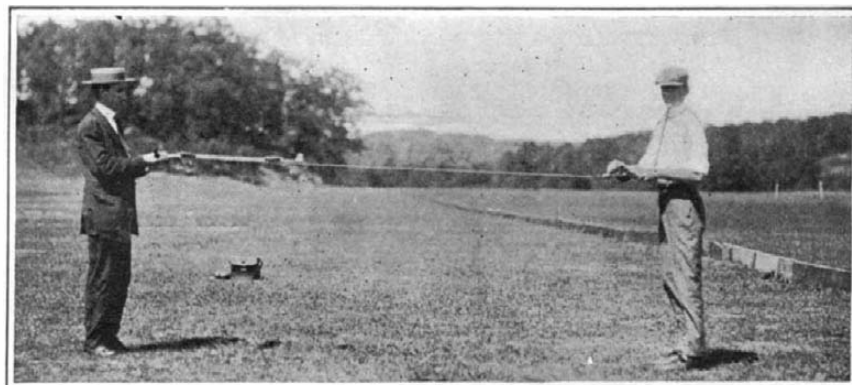
The propellers *d* are two in number and are carried by the two long strips *a*. Each propeller is five inches in diameter, and is whittled out of a single block of white pine. The propellers have a pitch of about ten inches. After the whittling is done they are sand-papered and coated with varnish. The thickness of the wood at the hub (*e'*, Fig. 7) of the propeller



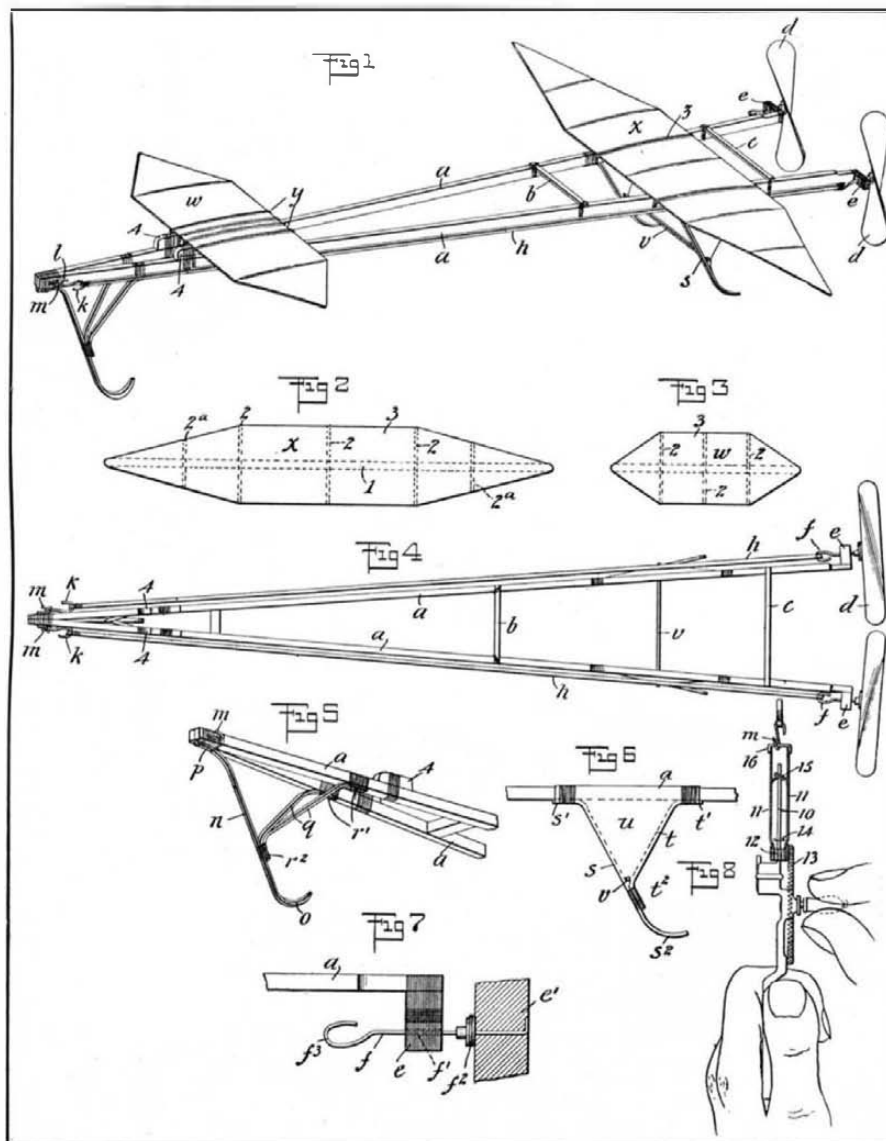
A group of boys at Van Cortlandt Park, all of whom have made their own model aeroplanes.



A hand-drill modified so as to wind up two rubber bands at once.



Winding up the rubber bands by which the model is driven.



Details of the model aeroplane.

HOW TO BUILD AND FLY A MODEL AEROPLANE

should be about $\frac{5}{8}$ of an inch. At the rear ends of the strips *a* bearing blocks *e* are secured. These bearing blocks are simply small pieces of wood projecting about $\frac{5}{8}$ of an inch laterally from the strips *a*. They are drilled to receive a small metal tube *f'* (steel, brass or copper), through which tube the propeller shaft *f* passes.

The propeller shaft itself consists of a piece of steel wire passing through the propeller hub and bent over the wood, so that it cannot turn independently of the propeller. Any other expedient for causing the propeller to turn with the shaft may obviously be employed. Small metal washers *f'*, at least three in number, are slipped over the propeller shaft so as to lie between the propeller and the bearing block.

That portion of the propeller shaft which projects forwardly through the bearing block *e* is bent to form a hook *f'*. To the hook *f'* rubber strips *h*, by which the propellers are driven, are secured. The rubber strips are nearly as long as the main strips *a*. At their forward ends they are secured to a fastening consisting of a double hook *k* *l*. The hook *k* lies in a horizontal plane, the hook *l* in a vertical plane. The hook *k* holds the rubber strips, as shown in Figs. 1 and 4, while the hook *l* engages a hook *m*. This hook *m* is easily made by passing a strip of steel wire through the meeting ends of the main strips *a*, the portions projecting from each side of the strips being bent into the hooks *m*.

The Skids.

Three skids are provided, on which the model slides, one at the forward end, and two near the rear end. All are made of bamboo. As shown in Fig. 5, the front skid may be of any length that seems desirable. A 6-inch piece of bamboo will probably answer most requirements. This piece *n* is bent in opposite directions at the ends to form arms *o* and *p*. The arm *o* is secured to the forward ends of the two strips *a* constituting the main frame, by means of thread and glue. The strips and skid are not held together by the same thread, but the skid is attached to the two strips after they have been wound. Hence there are two sets of windings of thread, one for the two strips *a* themselves, and another for the skid and the strips. Strong thread and glue should be used, as before. In order to stiffen the skid, two bamboo struts *q* will be found necessary. These are bent over at the ends to form arms *r*¹ and *r*² (Fig. 5). Each of the arms *r* is secured to the under side of a strip *a* by strong thread and glue. The arms *r*² are superimposed and tied to the bamboo skid *n* with strong thread and glue.

The two rear skids, of which one is shown in Fig. 6, consist each of two 5-inch strips of bamboo *s*, likewise bent at either end in opposite directions to form arms *s*¹ and *s*². The arms *s*¹ are fastened to the strips *a* by strong thread and glue. To stiffen the skids a strut *t* is provided for each skid. Each strut *t* consists of a 3-inch strip of bamboo bent over so as to form arms *t*¹ and *t*². The arm *t*¹ fits the under side of the main strip *a*, the arm *t*² the skid *s*. Strong thread and glue are employed to fasten each strut in position on the strip *a* and the skid *s*. In the crotch of the triangular space *u*, formed by the skid *s* and the strut *t*, a tie bar *v* (Figs. 4 and 6) is secured by means of thread and glue. This tie bar *v* connects the two skids, as shown in Figs. 1 and 4, and serves to stiffen them. The triangular space *u* is covered with paper, preferably bamboo

paper. If bamboo paper is not available, parchment or stiff light paper of some kind may be used. It does not need to be waterproof. Thus triangular fins are formed which act as stabilizing surfaces.

The Main Planes.

The main planes are two in number, but are different in size. Contrary to the practice followed in large man-carrying monoplanes, the front supporting surface is comparatively small in area and the rear supporting surface comparatively large. These supporting surfaces w and x are shown in detail in Figs. 2 and 3. It has been found that a surface of considerable area is required at the rear of the machine to support it. Hence the discrepancy in size. Although the two supporting surfaces differ in size, they are made in exactly the same manner. Each consists of a thin longitudinal piece of spruce 1, to which cross pieces of bamboo 2 are attached. In the smaller plane (Fig. 3) all the cross pieces 2 are of the same size. In the larger plane (Fig. 2) the outer strips 2a are somewhat shorter than the others. Their length is $2\frac{1}{2}$ inches, whereas the length of the strips 2 is $3\frac{1}{2}$ inches. In order to allow for the more gradual tapering of the plane, around the outer ends of the longitudinal strips 1 and the ribs 2, a strip of bamboo 3 is tied. The frame, composed of the longitudinal strip 1 and cross strips 2 and 2a, is then covered with bamboo paper, parchment paper, or any other stiff light paper, which is glued in place.

The forward or smaller plane has a spread of $8\frac{1}{2}$ inches and a depth of $3\frac{1}{4}$ inches. The main plane has a spread of 20 inches and a depth of $3\frac{1}{2}$ inches at

the widest portion. The author has made experiments which lead him to believe that the tapering form given to the outer edge of the plane improves both the stability and endurance of the machine.

The planes are slightly arched, although it will be found that flat planes will also give good results. The rear edge of the main plane should be placed $4\frac{1}{4}$ inches distant from the forward edge of the propeller block e .

The front plane must have a slight angle of incidence, just how much depends upon the weight of the machine, the manner in which it is made, and various other factors. This angle of incidence is obtained by resting the front portion of the plane on two small blocks 4 (Figs. 1 and 5) which are fastened to the top of the main strip a by strong thread and glue.

The height of the blocks 4 should be about $\frac{1}{4}$ of an inch, although this will necessarily vary with the machine. The blocks should be placed approximately four inches from the forward end of the machine. The front end of the forward plane should be elevated about one-fourth of an inch above the rear end, which rests directly on the main strips a .

Both the front and rear planes w and x are removably lashed to the frame by means of ordinary rubber bands, which may be obtained at any stationery store. These rubber bands are lettered y and z in Fig. 1.

Winding the Rubber Strips.

The rubber strips can be most conveniently wound up by means of an egg beater, slightly changed for the purpose. The beater and the frame in which it is

carried are entirely removed, leaving only the main rod 10, which is cut off at the lower end so that the total length is not more than two or three inches. The two brass strips 11 on either side of the rod, which are attached to the pinion 12, meshing with the large driving wheel 13, are likewise retained. A washer 14 is soldered to the rod near its upper end, so as to limit the motion of the small pinion 12 and the brass strips 11 attached to the pinion. Next a wire 15 is bent in the form of a loop, through which loop the central rod passes. The ends of the wire are soldered to the side strips 11. Lastly, a piece of wire 16 is bent and soldered to the lower ends of the side strips. In order to wind up a rubber strip, the strip is detached from the forward end of the model, and the hook m slipped over the wire 16. The opposite end of the rubber band is held in any convenient manner. Naturally the two strips must be wound in opposite directions, so that the two propellers will turn in opposite directions. By stretching the rubber while it is being wound, more revolutions can be obtained. It is not safe to have the propeller revolve more than 700 times. The ratio of the gears of the egg-beater winder can be figured out so that the requisite number of twists can be given to the rubber bands for that particular number of revolutions.

Instead of an egg beater, a hand drill can be used, as shown in one of our photographs. This, however, will have to be also modified for the purpose, a wire hook being inserted in the jaws. In the modified drill here presented, an extra gear has been provided so that the two rubber bands may be wound up at the same time in opposite directions.

Rules Governing the Competition for the \$15,000 Flying Machine Prize Offered by Mr. Edwin Gould

1. A prize of \$15,000 has been offered by Mr. Edwin Gould for the most perfect and practicable heavier-than-air flying machine, designed and demonstrated in this country, and equipped with two or more complete power plants (separate motors and propellers), so connected that any power plant may be operated independently, or that they may be used together.

CONDITIONS OF ENTRY.

2. Competitors for the prize must file with the Contest Committee complete drawings and specifications of their machines, in which the arrangement of the engines and propellers is clearly shown, with the mechanism for throwing into or out of gear one or all of the engines and propellers. Such entry should be addressed to the Contest Committee of the GOULD-SCIENTIFIC AMERICAN Prize, 361 Broadway, New York city. Each contestant, in formally entering his machine, must specify its type (monoplane, biplane, helicopter, etc.), give its principal dimensions, the number and sizes of its motors and propellers, its horse-power, fuel-carrying capacity, and the nature of its steering and controlling devices.

3. Entries must be received at the office of the SCIENTIFIC AMERICAN on or before June 1st, 1912. Contests will take place July 4th, 1912, and following days. At least two machines must be entered in the contest or the prize will not be awarded.

CONTEST COMMITTEE.

4. The committee will consist of a representative of the SCIENTIFIC AMERICAN, a representative of the Aero Club of America, and the representative of some technical institute. This committee shall pass upon the practicability and efficiency of all the machines entered in competition, and they shall also act as judges in determining which machine has made the best flights and complied with the tests upon which the winning of the prize is conditional. The decision of this committee shall be final.

CONDITIONS OF THE TEST.

5. Before making a flight each contestant or his agent must prove to the satisfaction of the Contest Committee that he is able to drive each engine and propeller independently of the other or others, and that he is able to couple up all engines and propellers and drive them in unison. No machine will be allowed to compete unless it can fulfill these requirements to the satisfaction of the Contest Committee. The prize shall not be awarded unless the competitor can demonstrate that he is able to drive his machine in a continuous flight, over a designated course; and for a period of at least one hour he must run with one of his power plants disconnected; also he must drive his engines during said flight alternately and together. Recording tachometers attached to the motors can probably be used to prove such performance.

In the judging of the performances of the various machines, the questions of stability, ease of control and safety will also be taken into consideration by the judges. The machine best fulfilling these conditions shall be awarded the prize.

6. All heavier-than-air machines of any type whatever—aeroplanes, helicopters, ornithopters, etc.—shall be entitled to compete for the prize, but all machines carrying a balloon or gas-containing envelope for purposes of support are excluded from the competition.

7. The flights will be made under reasonable conditions of weather. The judges will, at their discretion, order the flights to begin at any time they may see fit, provided they consider the weather conditions sufficiently favorable.

8. No entry fee will be charged, but the contestant must pay for the transportation of his machine to and from the field of trial.

9. The place of holding the trial shall be determined by the Contest Committee, and the location of such place of trial shall be announced on or about June 1st, 1912.

10. Mr. Edwin Gould, Munn & Co., Inc., publishers of the SCIENTIFIC AMERICAN, and the judges who will be selected to pass upon machines, are not to be held responsible for any accident which may occur in storing or demonstrating the machines on the testing ground.

A Weather Forecasting Competition

THE Société Française de Navigation Aérienne has decided to organize a competition in weather forecasting, which will extend over a period of two weeks about the time of the vernal equinox of next year. This season was selected because it is supposed to be characterized by generally unsettled weather, and therefore likely to afford a severe test to the competitors. An elimination contest, the particulars of which have not yet been announced, will precede the principal competition, its object being to shut out the cranks and charlatans who might be disposed to participate in such an event.

The idea of a public contest in weather forecasting is not new. In the autumn of 1905 a competition of this sort was held by the Société Belge d'Astronomie for a prize of 5,000 francs. The competitors were first required to make daily forecasts based on the current weather maps published at the various meteorological centers of Europe; these were submitted by telegraph and registered mail to the jury assembled in Belgium, the members of which were all well-known meteorologists, viz., Messrs. Teisserenc de Bort, Rotch, Polis, Brunhes, and Vincent. From the twenty-four contestants the seven who submitted the most accurate forecasts were summoned to Liège to take part in a further test. Each of them was required to make a series of forecasts for a twenty-four hour

period based upon seven weather maps selected at random from those published by the French meteorological service between the years 1880 and 1902. The jury, having at hand the maps for the days succeeding those selected, was able immediately to verify the accuracy of the predictions.

This second test resulted in the further elimination of four competitors, and the remaining three were then required to furnish a statement of their methods of forecasting. The jury unanimously awarded the prize to M. Gabriel Guilbert, of Caen, France, both for his successful forecasts and for his method, which was then first made known to the scientific world, and attracted wide attention.

M. Guilbert has since published a book on weather forecasting.¹

The Mine-safety Demonstration

A NATIONAL mine-safety demonstration will be held at Pittsburg, Pa., on October 30th and 31st, 1911, under the auspices of the Bureau of Mines. The first day will be devoted to demonstrations at the Bureau of Mines Building in the Arsenal grounds, Fortieth and Butler streets, including exhibits of explosives, safety lamps, fuel testing, etc., and actual explosions. On the same day demonstrations and explosions will be given in the experimental mine near Bruceton, ten

¹ Nouvelle méthode de prévision du temps. Paris, 1909.

miles south of Pittsburg. On the second day the demonstrations will be held at Forbes Field, the National League baseball grounds. This programme will include a first aid exhibit, rescue work and mine gas. President Taft will be present and award the prizes, and will afterward be entertained at luncheon at the Hotel Schenley. It is expected that the Bureau of Mines will run a special car from Washington to accommodate the officials of the Federal government. There is at present prevailing a deep interest in the subject of mine safety appliances and many heads of bureaus and departments will grasp this opportunity of having ocular demonstration of the excellent work being accomplished by the Bureau of Mines. Dr. Holmes, the Chief of the Bureau, will, of course, be in charge of the demonstrations.

A Stabilizer for Aeroplanes

A FLYING machine having stabilizing means arranged longitudinally and both in front and rear of the vertical turning center of the machine is shown in a patent, No. 1,001,120, to Joseph A. Blondin of Los Angeles, Cal. The stabilizing means include a plurality of members which may be moved laterally to varying degrees which are connected to a movable aviator's seat, thus permitting the convenient operation of the stabilizing members.