

STICK MODELS

CHAPTER 21

GRANT "MINUTE MAN" TRACTOR

BECAUSE of its simplicity of construction, an all-balsa tractor should be the logical model for the beginner, but as few of them prove exceptional flyers, they are seldom used to introduce model building.

Through the courtesy of Charles Hampson Grant, Editor of "Universal Model Airplane News" and a model designer of national reputation, the author is able to present here an unusually fine all-balsa tractor. Its simplicity of construction, exceptional flying ability, and almost unbreakable sturdiness, have given it a country-wide popularity.

The fact that it has only five balsa parts speaks for its simplicity, while such flights as that made by Thomas W. MacLean of Charlotte, N. C., who flew his "Minute Man" over 1,500 feet for a duration of six minutes and a height of 300 feet, prove its flying ability. Here is a model any beginner can build with ease, and at the same time be assured of many hours of excellent flights and happy landings.

MATERIAL LIST

2 pcs.	$-\frac{1}{32}'' \times 3''$	$\times 10\frac{1}{2}''$	—Sheet balsa for wing
1 pc.	$-\frac{1}{32}'' \times 2\frac{3}{4}''$	$\times 3''$	—Sheet balsa for rudder
1 pc.	$-\frac{1}{32}'' \times 2\frac{3}{8}''$	$\times 7\frac{3}{4}''$	—Sheet balsa for elevator
1 pc.	$-\frac{3}{16}'' \times \frac{3}{16}''$	$\times 18''$	—Balsa for motor stick
1 pc.	$-\frac{3}{8}'' \times 1\frac{1}{8}''$	$\times 8''$	—Balsa propeller block
1 pc.	$-\frac{1}{16}'' \times 2''$	$\times 3\frac{1}{2}''$	—Sheet balsa for wing ribs
1 pc.	$-\frac{3}{16}'' \times \frac{3}{4}''$	$\times 3\frac{1}{2}''$	—Balsa for center wing ribs
1 pc.	$-\frac{1}{8}'' \times 1\frac{1}{2}''$	$\times 3''$	—Sheet balsa for wheels
1 pc.	$-\frac{1}{32}'' \times \frac{1}{8}''$	$\times 64''$	—Pure Para rubber for motor
1 pc.	$-12''$ long		—No. 7 piano wire for wing clips and can hook
1 pc.	$-24''$ long		—No. 12 piano wire for landing gear, "S" hook, shaft, etc.

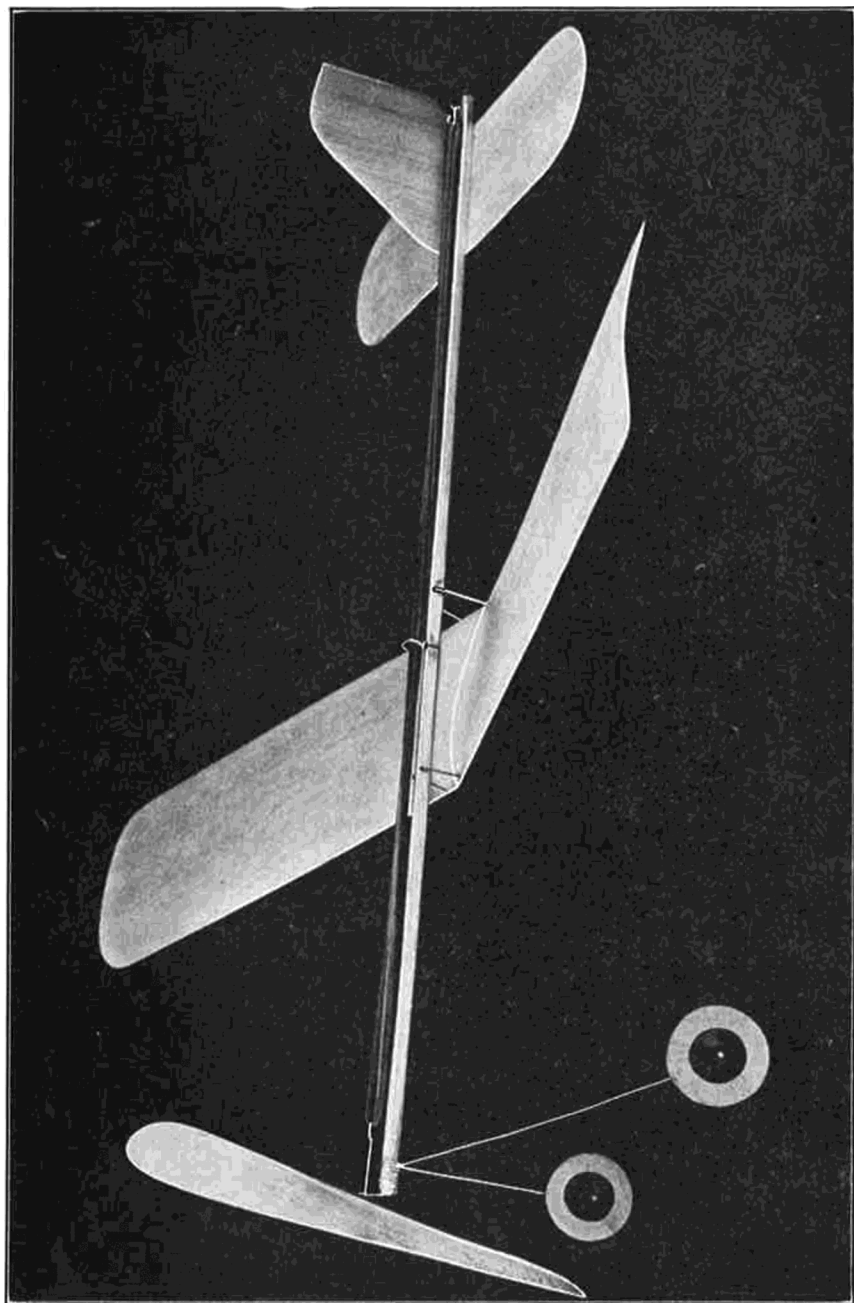
Washers

Propeller bearing

Cement

MOTOR STICK. The motor stick consists of a $\frac{3}{16}'' \times \frac{3}{16}'' \times 18''$ long balsa stick. Its front end is beveled, as shown. Sandpaper the stick until perfectly smooth. On the beveled end, the usual propeller bearing is ce-

GRANT "MINUTE MAN" TRACTOR



GRANT "MINUTE MAN" TRACTOR

mented, but is not bound with silk thread until the landing gear is in place. (See Chapter 6, "Propeller Bearings.") In the center of the stick, a can hook is attached. This is bent from No. 7 piano wire, as shown in the plan under "Can Hook," and cemented in place on the stick with the loop on the same side as the bearing. The trailing end of the stick is equipped with a combination end hook and tail skid, as seen in the plans. Follow the dimensions given for this in the plan, and then cement it over the end of the stick, with the hook on the same side of the stick as the hook of the can. It should then be tightly bound with silk thread over which a thin coat of cement is applied to bind it in place.

RUDDER. Make a full-size drawing of the rudder, as shown. This is then placed on the $2\frac{3}{4}$ " x 3" piece of $\frac{1}{32}$ " sheet balsa and carefully traced. Place the tracing on the wood, so that when the rudder is attached on the motor stick, its grain will run up and down. Cut the rudder out and finish all edges and both faces with sandpaper. It is now cemented to the side of the motor stick, as shown. Note that when looking at the stick held in flying position from the front, the rudder is cemented to its left side. The bottom edge of the rudder and the bottom edge of the motor stick should be flush, while the back, or trailing edge of the rudder, forms right angles with the stick.

ELEVATOR. The elevator is made of a single piece of $\frac{1}{32}$ " sheet balsa. Cut the stock $2\frac{3}{8}$ " wide and $7\frac{3}{4}$ " long, making sure that all corners are square. The rounded tips are formed from a half circle with a radius of $1\frac{3}{16}$ ", as shown under "Elevator."

Lay these out with a compass, and then cut them with a razor blade. Finish the elevator with a careful sandpapering. It can be attached to the stick with cement, which gives a permanent connection, or a single rubber band may be used. Note the position of the elevator on the motor stick. If the former method is used, apply cement along the under side of the stick, and press the elevator tightly against it, making sure that it extends out from the stick evenly on both sides, that its leading and trailing edges form right angles with the stick, and that its trailing edge is $\frac{3}{4}$ " in from the end of the stick.

If the rubber is used, pass one end of the rubber over the stick. Place the elevator in position and bring the band under the elevator, and its loop up and over the end of the stick, which will hold it in position.

LANDING GEAR. This is bent from a single length of No. 12 piano wire. The front view of the landing gear, shown in the plan, illustrates how the wire looks after it is bent. Above this illustration is a top view of the

wire. The small U-shaped section is bent down at right angles with the other sections of the wire.

When bent as shown, apply cement and press the "U" of the wire to the under side of the motor stick on top of the propeller bearing. Both the bearing and this portion of the landing gear wire are now bound with silk thread, which is given a thin coat of cement to strengthen it. As the "U" of the gear was bent at right angles to the rest of the wire, or the wire struts of the landing gear, these will extend straight down and out from the stick. Note in the plans that these struts not only extend out on each side of the stick, but also $1\frac{1}{4}$ " back from the wire "U."

When completed, the wire gear is equipped with two $\frac{1}{8}$ " sheet balsa wheels. (See Chapter 10, "Solid Balsa Wheels.") When these are finished, slip them on the axles of the gear, and bend the wires up to prevent them from falling off.

PROPELLER. The propeller is carved from a $\frac{5}{8}$ " x $1\frac{3}{8}$ " x 8" long balsa propeller block. (See Chapter 9, "Carved Propellers.") A propeller shaft is bent from No. 12 piano wire. (See Chapter 6, "Propeller Shafts.")

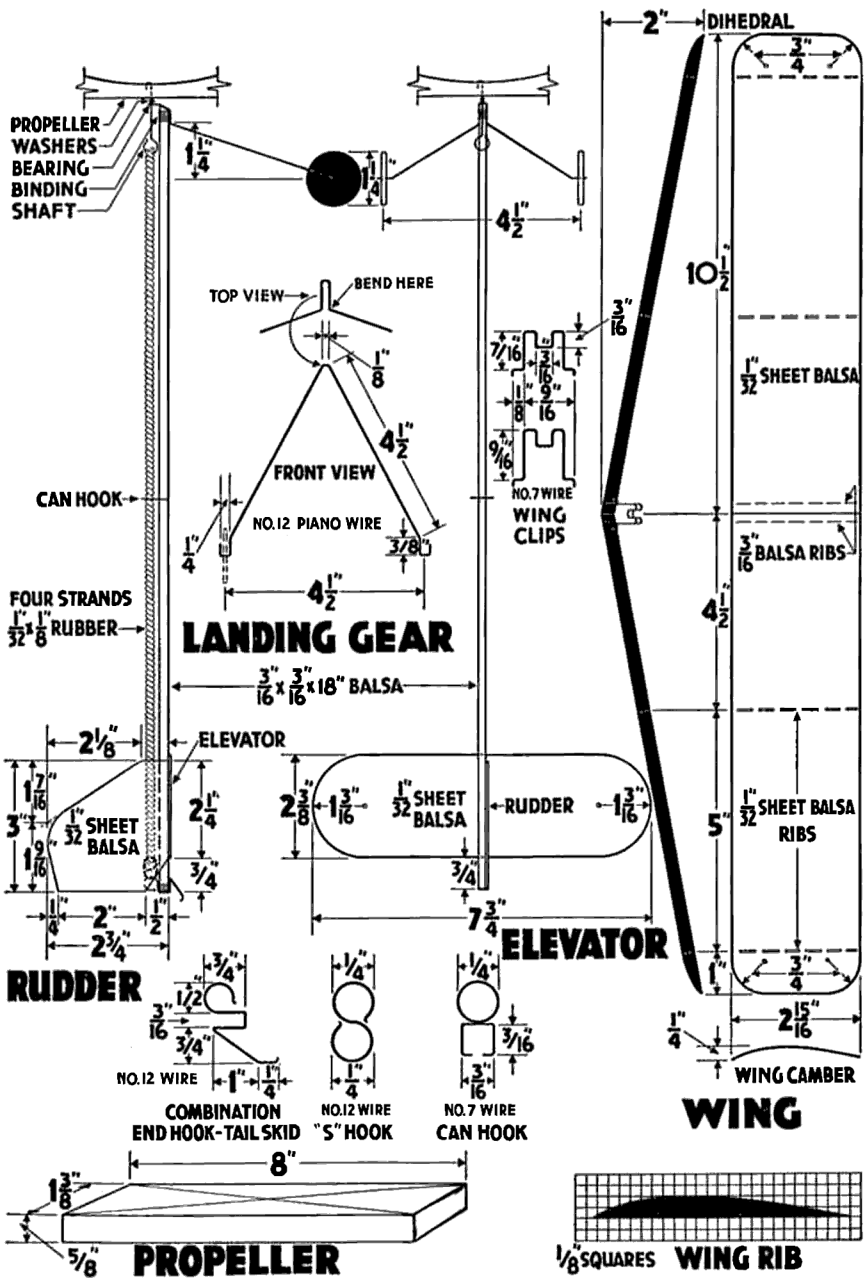
Thread the shaft through the hub, bend it around, and pull it back, allowing its point to bury itself in the hub, and apply cement to the bend.

MOTOR. This consists of a 64" length of $\frac{1}{32}$ " x $\frac{1}{8}$ " pure Para rubber, tied, and looped four times. An "S" hook is bent from No. 12 piano wire, as shown in the plans, and one of its hooks is fastened through the end hook. The rubber strands are then looped around the other end of the "S" hook, threaded through the can hook, and looped over the hook of the propeller shaft, after two washers have been applied to it and it has been passed through the propeller bearing hole.

WING. The wing is made in two parts, each half being $2\frac{5}{16}$ " wide and $10\frac{1}{2}$ " long. It is made of $\frac{1}{32}$ " sheet balsa. Cut these to size, rounding two corners of each half, as shown in the plans, with the arc of a circle having a $\frac{3}{4}$ " radius. Sandpaper all edges and both faces until smooth.

Four $\frac{1}{16}$ " sheet balsa ribs are used to give the wing its necessary camber. Note the size of these in the plans under "Wing Rib." Draw a full-size plan of the rib on $\frac{1}{8}$ " squared paper, as shown. Trace this on the $\frac{1}{16}$ " sheet balsa piece, and cut out each rib. Sandpaper them smooth. To make sure they are alike, the ribs should be placed together with all sides flush, and then sandpapered as a whole.

They are now cemented to the under side of the wing, which must be bent to their top curve. Paper clips can be used to hold the sheet balsa to the ribs until the cement is dry. Slip one clip over the wing and rib at the leading edge and another at the trailing edge. When all four ribs are in



GRANT "MINUTE MAN" TRACTOR PLAN

COMPLETE MODEL AIRCRAFT MANUAL

place and firmly cemented, the wing halves are joined together. Note that the wing has a 2" dihedral. Lay the two halves with their inner ends together on a flat table. Holding one half flat on the table, lift the tip of the other 4" off the surface. Apply cement along their center joint while in this position, and allow the cement to become hard before freeing the wing. (See Chapter 7, "Wing Assembly.")

To give the wing the same camber along its center section and to strengthen its joint, two $\frac{3}{16}$ " thick heavy-duty ribs are used. These are cut from balsa wood, after being traced on it. Use the same tracing as used for the outer ribs. The tops of these ribs must be beveled to fit the angle made by both halves of the wing when they were joined and given the dihedral.

Cement these two ribs together side by side, and then bevel the top in the form of a shallow V to fit the angle of the wing. Cement them in place, so that the cemented crack of the ribs fits directly under the cemented crack of the wing.

Two wing clips are bent from No. 7 piano wire, as shown in the plan. The small clip fits on the leading edge of the wing, while the large one is cemented to the trailing edge. The small prongs of these clips are pressed into the surface of the wing, while cement is added to give further strength to the connection. Both clips are located on the upper side of the wing directly over its center joint.

FLYING. Slip the clips of the wing over the under side of the motor stick to attach the wing to the model. Give the model the gliding test. (See Chapter 16, "Gliding Method of Wing Adjustment.")

If hand winding, the motor may be safely wound about 325 turns, while a winder allows it to be wound 575 turns. Before launching your model, make sure that its wing, elevator, and rudder are perfectly straight and not warped in any manner. For the proper method of launching, see Chapter 16, "Correct Launching of R.O.G. Model."

CHAPTER 22

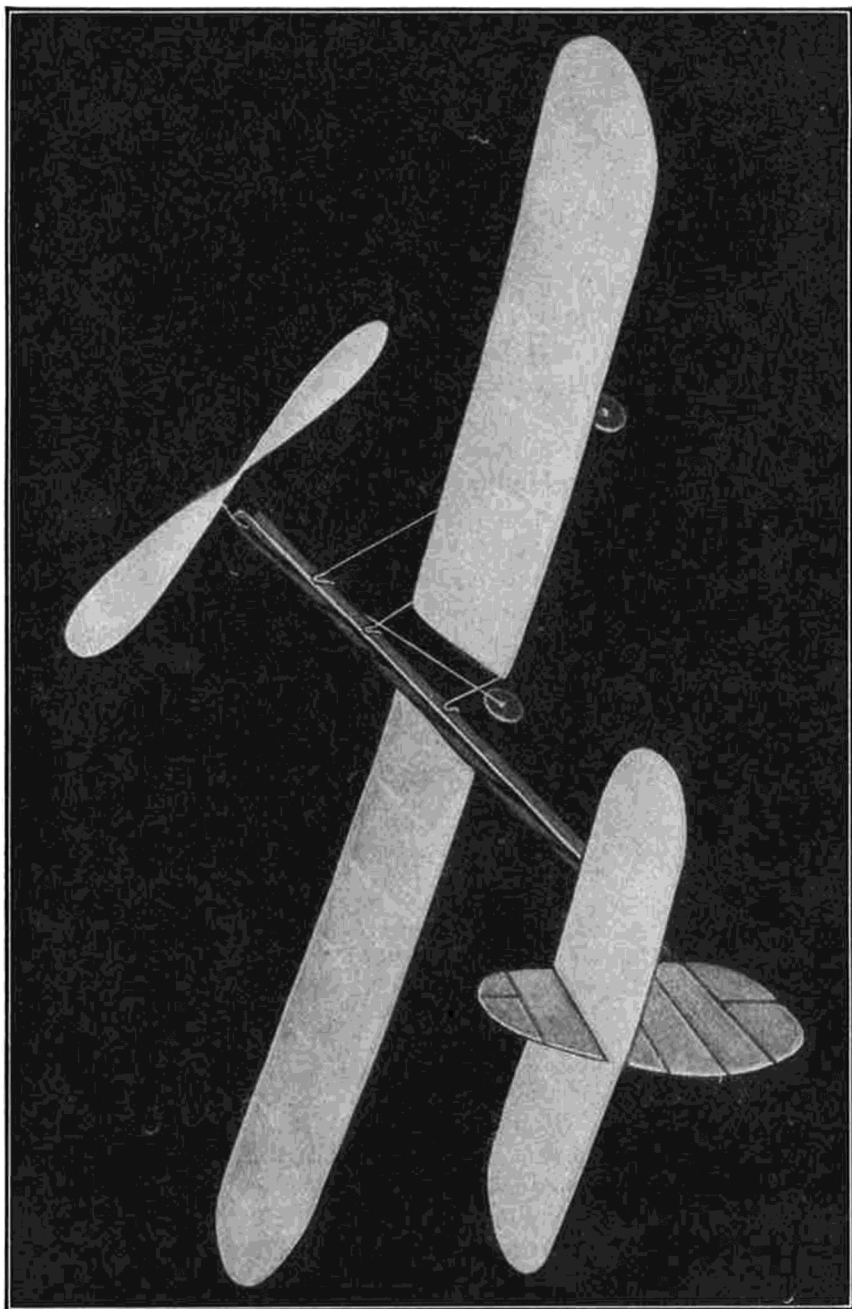
CONDOR TRACTOR

HERE is a splendid model with which the beginner can experiment to his heart's content. When Nick Limber designs and builds a model, he does so for a specific reason and with such great success that today he is considered among the finest designers and builders in this country. The author greatly appreciates the opportunity given him by Mr. Limber to present such a fine example of tractor type model in these pages. The specific reason behind the designing of the "Condor" was a curiosity to discover the effect a high set tail would have on a light model. Results in the air proved that such a tail was a distinct success. Many German light planes have such tails and it was from them that Mr. Limber took his example. The model not only gave a fine endurance and stability performance, but also proved a graceful and smooth flier. When the builder saw this, he immediately called it the "Condor" after that most graceful bird. So get busy and build your own "Condor."

MATERIAL LIST

- 1 pc. — $\frac{1}{8}$ " x $\frac{3}{8}$ " x 13" —Balsa (Motor Stick)
- 2 pcs.— $\frac{1}{16}$ " x $\frac{1}{8}$ " x 10" —Balsa (Leading Edges of Wings)
- 1 pc. — $\frac{3}{16}$ " x $\frac{3}{8}$ " x 15" —Bamboo (Trailing Edge, Tail, etc.)
- 1 pc. — $\frac{1}{16}$ " x 2" x 12" —Balsa (Wing and Tail Ribs)
- 1 pc. — $\frac{1}{16}$ " diameter —Aluminum Tubing (Bearing)
- 1 pc. —.020 x 15" long —Music Wire (All Metal Parts)
- 1 pc. — $\frac{1}{8}$ " x 26" long —Flat Rubber (Motor)
- 1 pc. — $\frac{3}{4}$ " x $1\frac{1}{8}$ " x 8" —Balsa Block (Propeller)
- Japanese Tissue
- Banana Oil
- Copper Washers
- Sandpaper

MOTOR STICK. The fuselage on a stick model is known as the "Motor Stick." It is shown in detail under "Motor Stick" in the plans. It is cut from a $\frac{1}{8}$ " x $\frac{3}{8}$ " x 13" long piece of hard balsa. It is tapered along its bottom edge to $\frac{1}{4}$ " width at the nose and $\frac{3}{16}$ " at the tail. The thickness



CONDOR TRACTOR

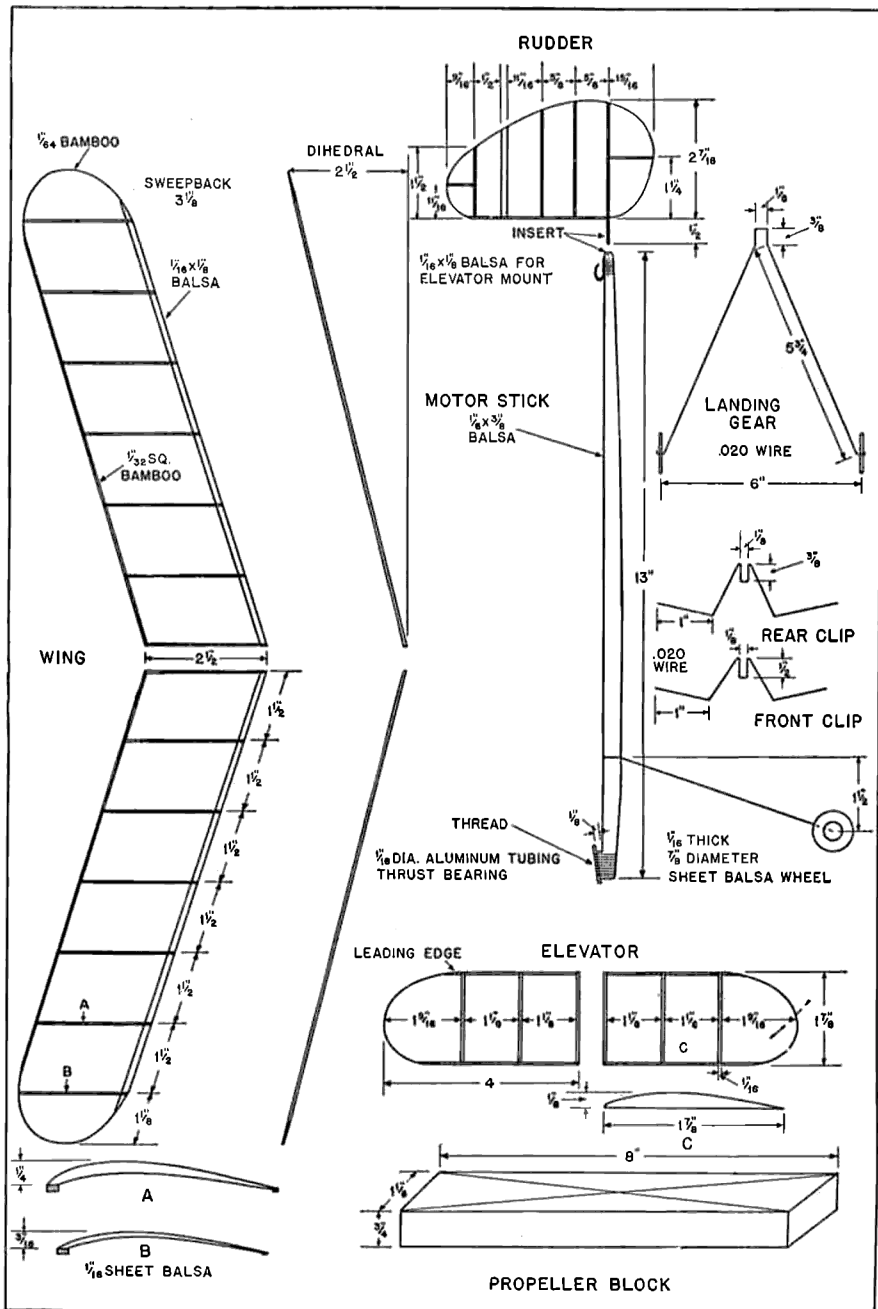
CONDOR TRACTOR

is also tapered along its entire length from its original thickness of $\frac{1}{8}$ " along the top to $\frac{1}{16}$ " along the bottom. Note that the upper edge of the fuselage remains perfectly straight. Carve the stick in this manner and finish smooth with sandpaper. A strip of $\frac{1}{8}$ " square balsa is cemented to the top-front of the stick, which is then shaved at a slant so that it is only $\frac{1}{16}$ " wide at the front, as shown. A $\frac{3}{4}$ " long aluminum tube is then cemented along this strip and bound with silk thread, as shown in the plan. A rear hook is bent from .020 music wire, cemented in place on top of the stick, and then bound with the thread, as shown.

RUDDER. The rudder has a strip of hard balsa measuring $\frac{1}{32}$ " square and 4" long. The trailing edge is made up of a single length of split bamboo making the rounded form of this part. All cross pieces are of $\frac{1}{32}$ " square balsa. Cement the lower brace, which extends out $\frac{1}{2}$ " and is of $\frac{1}{32}$ " square bamboo, in place across the leading edge. Cement the top $1\frac{1}{2}$ " long cross piece in place against the leading edge. The bamboo is then shaped from the leading edge, around these two braces, and then back to the leading edge piece. Cement the other braces in place as shown. The elevator mount is a length of $\frac{1}{16}$ " sheet balsa $\frac{1}{8}$ " wide located $1\frac{1}{16}$ " down from the top of the rudder, as shown. This should be sanded down to match the leading and trailing edges. Cover the rudder with Japanese tissue on one side only using banana oil as an adhesive. When completed, insert the $\frac{1}{2}$ " of projecting bamboo into the end of the stick by making a small hole to take it. Line the rudder up with the motor stick and cement it in place.

LANDING GEAR. This is made of a single length of .020 music wire. Note it in the plan. It is first bent around the stick for a tight fit. Each "leg" is $5\frac{3}{4}$ " long, as shown, and the axles should be $\frac{1}{8}$ " long. In the side view of the motor stick is shown the forward thrust of the landing gear. Bend yours in this manner. The "track," or distance between the wheels, must be 6" long. Two $\frac{1}{16}$ " sheet balsa wheels are cut to $\frac{7}{8}$ " diameter and threaded on the axles which are turned up to hold them in place. The landing gear is now attached in place on the fuselage stick $2\frac{1}{2}$ " back from its nose, as shown.

ELEVATOR. The elevator is made in two halves, as shown in the plan. The leading edge is $\frac{1}{32}$ " strip bamboo $2\frac{3}{4}$ " long. The trailing edge is $\frac{1}{32}$ " strip bamboo cut 3" long. The three ribs are shaped from $\frac{1}{16}$ " sheet balsa, as shown at "C." Each one is $\frac{1}{8}$ " wide at its widest point and all are cut $1\frac{7}{8}$ " long. Cement the ribs in place between the leading and trailing edge spars, and then make the tip of thin bamboo. When complete, make the other half in the same manner. Both halves are covered on the top side only with Japanese tissue using banana oil as an adhesive. If the



CONDOR TRACTOR PLAN

CONDOR TRACTOR

rudder was properly made, the sheet balsa mounting on it should be exactly $1\frac{7}{8}$ " long, which is just the width of the elevator halves. Cement each half on a side of this mount, and check to see that they are in line with each other, perfectly level, and at right angles to the rudder.

WING. The wing is also made in two halves, as shown in the plan. The leading edge spar is $\frac{1}{16}$ " x $\frac{1}{8}$ " x $9\frac{1}{2}$ " long, and is of strip balsa. Note its shape in the plan under "A" and "B." The trailing edge spar is $\frac{1}{32}$ " square bamboo cut $8\frac{1}{2}$ " long. For one half of the wing, you will require seven ribs. These are cut from $\frac{1}{16}$ " sheet balsa. Six "A" ribs are $2\frac{1}{2}$ " long, and the one "B" rib is $2\frac{5}{16}$ " long. The "A" ribs are $\frac{1}{8}$ " at their widest point and the "B" rib is only $\frac{1}{16}$ " at its widest point. Trace these on $\frac{1}{16}$ " sheet balsa and cut them out. Finish with sandpaper. Draw a straight line on paper and place the leading edge spar directly over it. Hold the inner end to the line and move its outer end back $3\frac{1}{8}$ ". Mark this location on the paper. The ribs are now cemented in place to the leading edge while that spar is held on the second line. Each rib, however, must be at right angles to the first line drawn. In this manner the correct sweepback is obtained. The trailing edge spar is then cemented in place. Note that the leading edge spar fits under the entering end of the ribs. A split bamboo wing tip completes the half. The opposite half is made in the same way except that the leading edge is moved back along the other half of the straight line, as it would be when in flying position. While the frame is drying, make the two wing clips of .020 music wire, as shown in the plan under "Front Clip" and "Rear Clip." The wing halves are now covered on their top sides only with Japanese tissue. Use banana oil as an adhesive and stretch the paper as tightly as possible without tearing it. Cement the wing clips to the leading and trailing edge spars, as shown in the photograph. Slip the wings in place under the stick, test each for proper sweepback and bend their clips up to obtain a $2\frac{1}{2}$ " dihedral at each tip. See that both tips are level with each other.

PROPELLER. Carve the propeller from the block shown in the plans as explained on page 91 under "Carved Propellers." Use hard balsa for this, and when finished apply three coats of dope and sand between each coat. Make a shaft from .020 music wire and cement it to the propeller hub. It is then passed through the aluminum tubing and its hook bent properly. Bend two "S" hooks of the same wire, as explained on page 139, attach the rubber motor, and the model is ready for its maiden voyage. Glide without power to obtain the best wing location. When a long even glide has been obtained, wind the motor and let her go.

CHAPTER 23

BABY R.O.G. TRACTOR

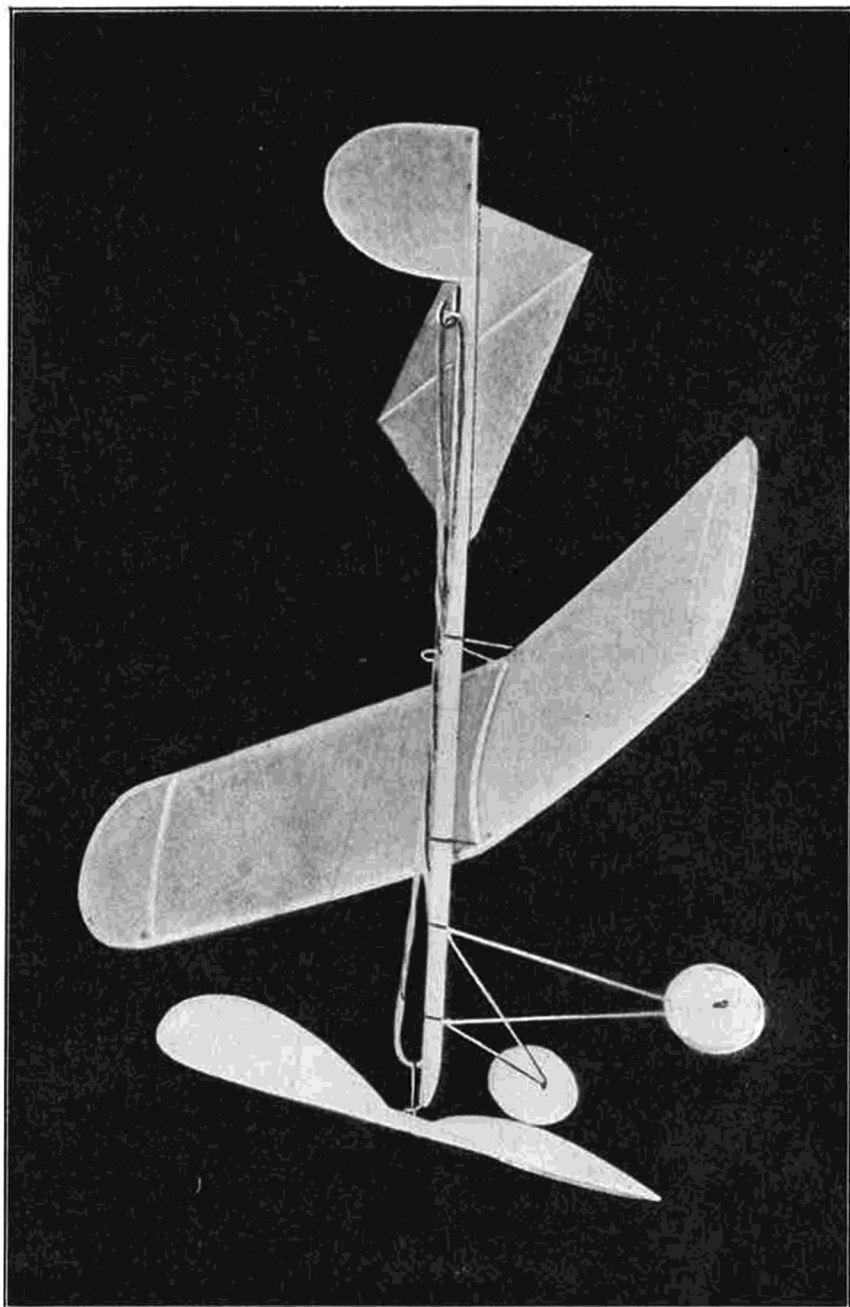
THIS rise-off-ground (R.O.G.) tractor is practically the same size as the indoor tractor of the preceding chapter. Its construction is much the same, except that it is equipped with a landing gear and has a thread outline for the elevator in place of the usual balsa spars and ribs. This model has proved an excellent flyer.

MOTOR STICK. From balsa wood, cut a piece measuring $\frac{1}{16}$ " x $\frac{1}{8}$ " x 8" long. A regulation propeller bearing is cemented to the top edge of the stick at its front end. This can be purchased or made. (See Chapter 6, "Propeller Bearings.") On the rear end of the stick and in the same position, a rear or end hook is cemented in place. This is bent from No. 6 piano wire. (See Chapter 6, "End Hooks.") Note in the plans that the propeller bearing is shown with thread wound around it, which acts as an extra binding for the bearing. On models of this size, such treatment is optional with the builder, but on large models carrying a great amount of rubber, all bearings should be reënforced in this manner.

RUDDER. This is made of two lengths of $\frac{1}{32}$ " x $\frac{1}{32}$ " split bamboo. The base of the rudder is made of one length of this bamboo $1\frac{3}{4}$ " long. The $\frac{1}{4}$ " at the front of this length is allowed to protrude out from the rudder to act as a cementing surface to hold it in position on the motor stick, as shown in the plans. The second length of bamboo is bent over heat to form the outline of the rudder, as shown. (See Chapter 3, "Bamboo.")

Cement the horizontal piece to the under side of the motor stick by applying cement to its forward $\frac{1}{4}$ " portion, and then press it in position. The bent outline length of bamboo is now cemented in place. Apply cement to the end of the motor stick, the front of the horizontal piece and also to its trailing end, and then press the outline piece in position. Make sure that the straight sides of this length are at right angles to the motor stick and that it is also straight up and down.

The rudder is covered with Japanese tissue. Cut the tissue to the exact size and shape of the rudder, coat the outline bamboo with clear dope or banana oil, and press the paper to it. When dry, the paper may be water-



BABY R.O.G. TRACTOR

COMPLETE MODEL AIRCRAFT MANUAL

sprayed to tighten it on the frame. Hold under weights until the paper covering becomes dry.

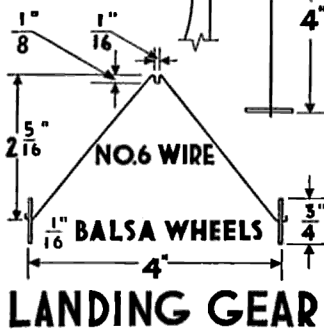
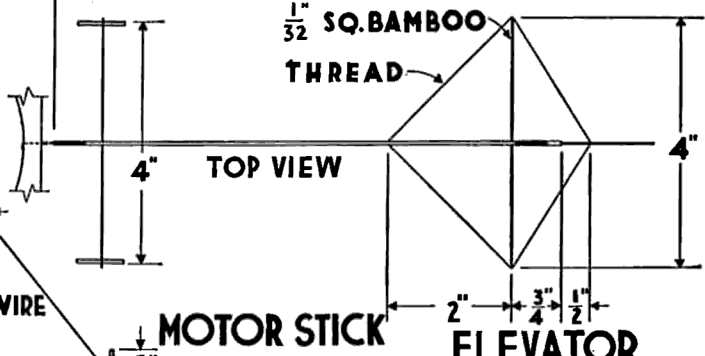
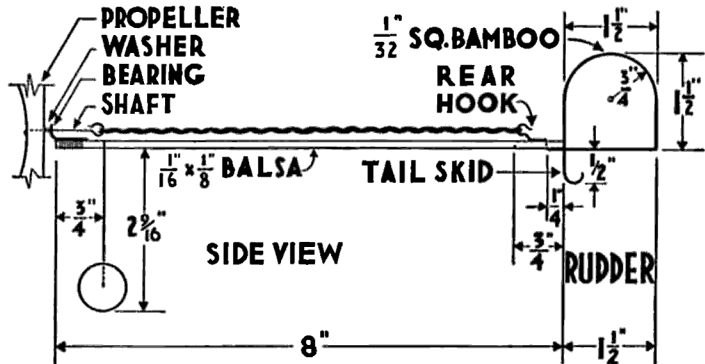
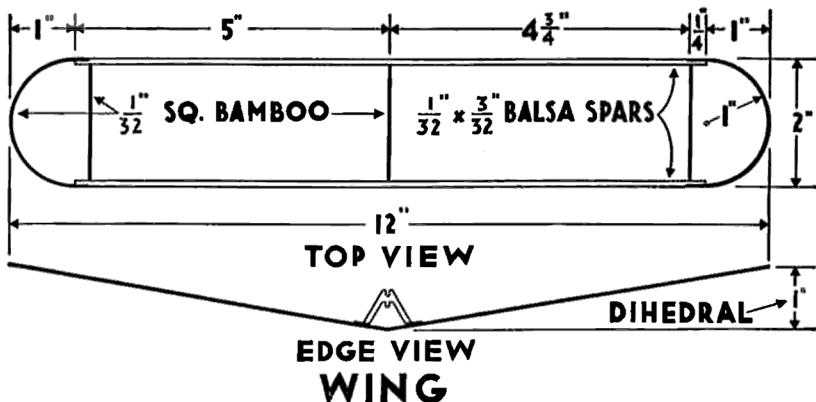
ELEVATOR. The elevator consists of one length of $\frac{1}{32}$ " x $\frac{1}{32}$ " split bamboo and a thread outline. Cut the bamboo piece 4" long, notch the under side of the motor stick $\frac{3}{4}$ " in from its rear end, and fasten the bamboo spar in place in it. When doing this, make sure that the spar is at right angles to the motor stick and that it extends out from both its sides an equal distance. A length of silk thread completes the framework of the elevator. Cement the end of the thread to the under side of the motor stick $2\frac{3}{4}$ " in from its rear end, or 2" in front of the elevator spar. Pass the thread to one end of the spar, and then to a point on the horizontal spar of the rudder $\frac{1}{2}$ " from the rear end of the motor stick. Both these points of contact should be held with cement. The thread is continued to the opposite end of the elevator spar, cemented, and then back to the original point of starting on the motor stick, where it is cemented in place.

When completed, the elevator outline is covered with Japanese tissue. Cut the paper to the exact size and shape of the elevator, coat the elevator spar, under side of the motor stick and rudder spar, and press the paper in place. When hard, the outline thread should be coated in the same manner with clear dope or banana oil, and the edging of the paper pressed on it. The paper should be trimmed if any excess has been left. Water-spraying should not be done on the elevator, because of the delicate framework, so that the paper should be carefully ironed before being applied.

PROPELLER. This is hand carved from a $\frac{3}{8}$ " x $\frac{1}{2}$ " x 5" balsa propeller block. Sandpaper until light will show through the blades. (See Chapter 9, "Carved Propellers.") The propeller is completed by bending a propeller shaft from No. 6 piano wire, as shown. (See Chapter 6, "Propeller Shafts.") Force the end of the shaft through the center of the propeller hub, bend it around, and pull the shaft back until the point buries itself in the wood of the hub. A drop of cement at the bend will hold it securely in place.

MOTOR. Two strands of $\frac{1}{8}$ " flat rubber are used for motive power. Obtain a 15" length of this rubber and tie its ends together to form a loop. Assemble the motor at this time. Place two washers on the propeller shaft and pass it through the hole in the propeller bearing. Loop one end of the rubber over the hook of the propeller bearing and the other end over the end hook, which completes the motor assembly.

WING. Cut two $\frac{1}{32}$ " x $\frac{3}{32}$ " x 10" long balsa pieces for the leading and trailing edge spars. Cut three $\frac{1}{32}$ " x $\frac{1}{32}$ " split bamboo ribs 2" long. Bend these slightly over heat to give the wing a small curve or camber. Lay the spars on a table parallel to each other and 2" apart, and then proceed to



BABY R.O.G. TRACTOR PLAN

COMPLETE MODEL AIRCRAFT MANUAL

cement the ribs in place. Complete the wing structure by cementing two bent bamboo wing tips to the ends of the spars. These are also $\frac{1}{32}$ " x $\frac{1}{32}$ " split bamboo, and should be bent in a 1" diameter circle over a flame. (See Chapter 3, "Bamboo.")

The wing is now given its 1" dihedral angle. Snap the leading and trailing edge spars between the thumb and index finger in their exact center, or at the point where the center rib has been cemented in place. Place the two halves in position on a flat table, with the convex side of the wing facing up, and while holding the broken joints together, lift the tip of one half off the table 2". While in this position, apply cement to the broken joints, and hold until dry. This will give each wing tip the necessary 1" dihedral angle.

The wing is covered with Japanese tissue on its upper side only. Coat all spars, ribs, and wing tips with clear dope or banana oil, and press the paper in place. Trim all edges and give the wing a water-spray treatment to tighten it. Two wing clips are bent from No. 6 piano wire. (See Chapter 6, "Clips.") The large one is cemented to the upper side of the trailing edge, while the small one is located on the leading edge. Note the position of these in the plans.

LANDING GEAR. This is bent from a single length of No. 6 piano wire, as shown in the plans. Two wheels are cut from $\frac{1}{16}$ " sheet balsa. They should be $\frac{3}{4}$ " in diameter. (See Chapter 10, "Wheels.") Thrust the ends of the landing gear wire through the centers of the wheels and bend them up to keep them in place. The small notch at the top of the landing gear wire has been made the same size as the motor stick, so that it can be slipped over the stick. See that this fit is snug enough to hold the landing gear without the aid of cement. Locate it $\frac{3}{4}$ " from the front end of the motor stick. Give the model the usual gliding tests to determine proper location of the wing, which is clipped to the under side of the motor stick. For the proper method of launching, see Chapter 16, "Correct Launching of R.O.G. Model."