CHAPTER 10

LANDING GEARS

SINGLE-STICK LANDING GEARS. Landing gears for these models serve only one purpose. This is to enable them to take off from or land on ground, water, or snow. They are not added for appearance, nor are they used particularly as a safeguard for the model upon landing.

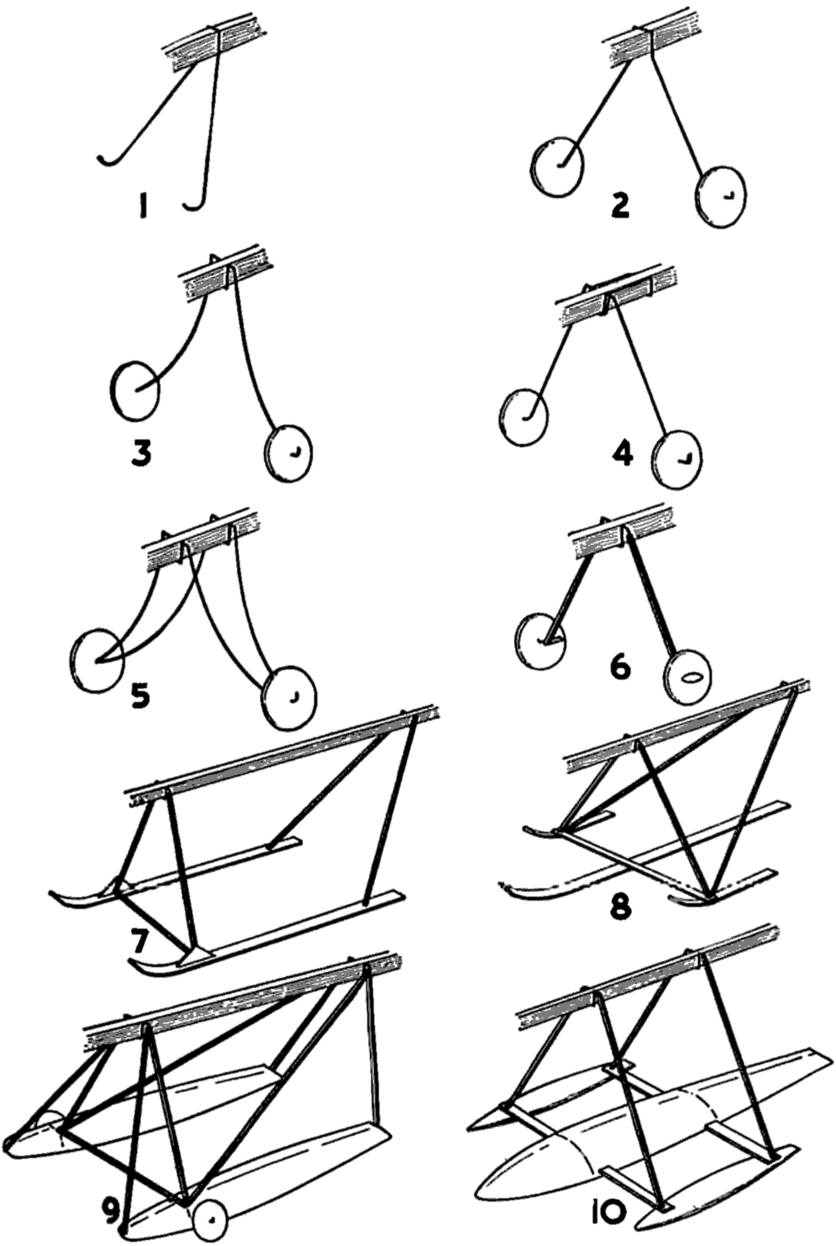
They should be as light as possible in order to keep the weight of the model at a minimum, but at the same time, strong enough to bear that weight, whatever it may be. In Fig. 66 ten popular landing gear types are shown.

No. 1 shows a skid gear used without wheels. At one time, when models weighed considerably, such skids were added to keep the model from breaking on landing. The skid consists of a single length of piano wire, bent to fit the motor stick, and having its ends turned up.

No. 2 shows the most popular type of landing gear used on light R.O.G. single-stick models. A length of piano wire is bent in the middle to fit the motor stick, from which it extends down on both sides. The ends of the wire gear are bent parallel to the ground to act as axles. Wheels are placed on the axles, and the tips of the axles are then bent up to keep them on. Another method of keeping the wheels in place is to apply a drop of cement to the ends of the axles after the wheels are in place. In this way, the ends do not require bending.

No. 3 illustrates another R.O.G. landing gear. This is attached to the under side of the motor stick, and the supporting wire struts have a slight bend. Such a gear has a certain amount of spring on touching the ground. The connection at the motor stick has no particular advantage over that of No. 2. On extremely light models builders prefer No. 2 stick connection, because it requires about ½″ to 1″ less wire, and saves that weight.

No. 4 landing gear is an exact copy of No. 2 except that its motor stick connection has been supplied with a saddle. Single wire connections sometimes allow the gear to fold against the stick when the model receives a sudden forward or backward shock on landing. With the saddle arrangement the gear has two points of contact with the motor stick, which prevent



SINGLE STICK LANDING GEARS

FIGURE 66

it from being folded forward or backward. Note how this saddle is bent, as shown at the right of the illustration.

No. 5 shows another method of obtaining the same effect as the saddle. Here two lengths of piano wire are bent as shown in No. 3 gear. Only one of these is thrust through the wheels, while the second is either twisted around the first one, soldered, or cemented to it. Notice, however, that such a gear requires about twice the amount of wire that is needed for the others. Because of this added weight it is seldom used on endurance models.

No. 6 is constructed of piano wire and balsa or bamboo. A wire clip fits under the motor stick, as in No. 3. Its ends extend down just far enough to be cemented into the ends of the landing gear struts, which are of balsa or bamboo. Short lengths of wire are cut and bent to form axles. These are thrust into the other ends of the upright struts and cemented. Wheels are then fitted on the axles. Small streamlined pieces of balsa wood are shaped and cemented over the ends of the wire.

No. 7 shows an R.O.S. (rise-off-snow) landing gear. It consists of two wire clips as shown for No. 6. These fit into balsa struts and are cemented in place. The distance between these clips on the stick should be great enough to hold the stick above the snow. The leading pair of balsa struts is at right angles to the stick, while the trailing pair extends back from the ends of the skis. Bamboo is usually used for skis, but to cut weight they can be made from $\frac{1}{32}''$ sheet balsa, cut $\frac{1}{4}''$ wide and sandpapered smooth. The ends of the skis should be bent up, as shown. Small triangular braces are used to strengthen the connection of the front struts, as these receive the greatest strain.

No. 8 shows another R.O.S. landing gear which has proved practical. Its motor stick connection is a duplicate of that of No. 7, but in this case only one long center ski is used, while two shorter ones act as balancers.

No. 9 illustrates an amphibian landing gear. It consists of the usual wire motor stick connection clip, balsa struts, and built-up floats. These are made of balsa formers with bamboo stringers forming their outline. This frame is then covered with tissue, water-sprayed, and doped. The latter makes it water-tight, which is of utmost importance. The general construction details of such a float are shown in Fig. 67, No. 1.

Small balsa wheels are used for R.O.G. purposes. These are attached with large-head pins, which are thrust into the sides of the float former. For landing on the water, these wheels need not be removed, as they will not interfere with the action of the floats.

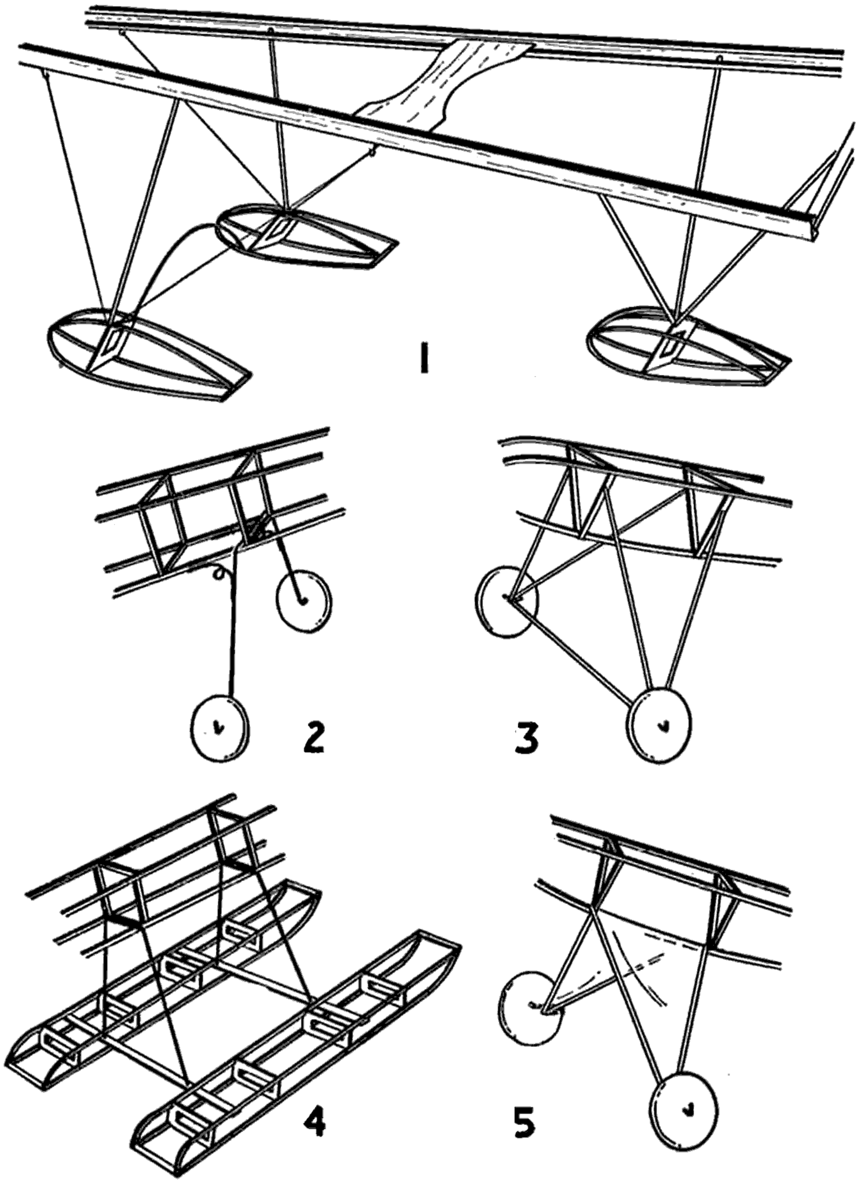
No. 10 is an illustration of the R.O.W. (rise-off-water) type of landing gear. Its construction is much the same as the amphibian gear, except that it has only one large float of the built-up type, while the two small side floats act as balancers. The small floats are of solid balsa, which has been well doped to make them water-tight. The large center float is constructed with two balsa formers and bamboo stringers. The small side floats are connected to the center built-up float by two lengths of balsa wood, which are cemented to the side bamboo stringers as well as to the two formers. Full instructions for making this gear will be found in Chapter 31. Either No. 9 or No. 10 can be made amphibian or just R.O.W. by adding or removing the side wheels.

TWIN-STICK AND COMMERCIAL LANDING GEARS. In Fig. 67, No. 1, is shown an R.O.W. (rise-off-water) landing gear, as applied to a twin-stick pusher. Full instructions for making such a gear will be found in Chapter 28.

No. 2 is designed for commercial models. A length of piano wire is bent in a "U" with its cross portion cemented to the under side of the fuselage and strengthened with silk thread binding. The upright portions are then spread apart about twice the width of the fuselage, and wheels are attached in the usual manner. Small lengths of piano wire are bent in loops, and attached between the fuselage and the upright strut sections of the landing gear. These are cemented in place and strengthened with silk thread binding, as shown. They function as springs, tending to absorb the shock of landing.

No. 3 is an R.O.G. gear especially adaptable to triangular fuselages. No wire is used on this gear, except very short lengths for axles. Bamboo is used in place of the wire, and balsa wood is not recommended, as any severe landing shocks will quickly break it, while bamboo is practically unbreakable.

No. 4 is an R.O.W. landing gear often found on commercial models. The form of the floats, shown in Fig. 66, Nos. 9 and 10, and in Fig. 67, No. 1, gives graceful streamlining, although it is a question as to which construction is the more simple. No. 4 is shown uncovered, so that all details can be seen. It consists of four formers, all square, with a bamboo stringer passing through each corner. These four stringers are united at both ends with a balsa cross brace. The float is covered with Japanese tissue, water-sprayed, and doped. Bent piano wire in the form of an inverted "U" makes the connection to the fuselage. The cross portion of the "U" is cemented and bound with silk thread to a bottom cross brace of the fuselage. The ends of the wire are bent and then cemented to the under side of the two connecting axles of the gear after they pass through each.



TWIN-STICK AND COMMERCIAL MODEL LANDING GEARS

FIGURE 67

No. 5 illustrates another R.O.G. landing gear for triangular fuselages. See building instructions in Chapter 35.

SCALE MODEL LANDING GEARS. In Fig. 68 and Fig. 69, fifteen of the most commonly seen landing gears are shown. These are replicas of the landing gears of various real airplanes, as of course they must be when attached to true scale models. As all of these are fully explained in the text covering the particular model to which each belongs, details will not be repeated here. No. 1 is the landing gear of the S.E.5 in Chapter 49. No. 2 is that of open cockpit Pitcairn Autogiro in Chapter 55. No. 3 is the landing gear of the Curtiss-Wright Sedan in Chapter 51, while No. 4 is the Stearman Mailplane in Chapter 54.

No. 5 shows the landing gear of the Waco Taper Wing in Chapter 47, and No. 6 is the Curtiss-Wright Junior in Chapter 46. In No. 7 we see a landing gear not given in this book. It belongs to the Stinson Monoplane. Such a gear is built up of bamboo lengths. No. 8 is the German Fokker D-7 in Chapter 53.

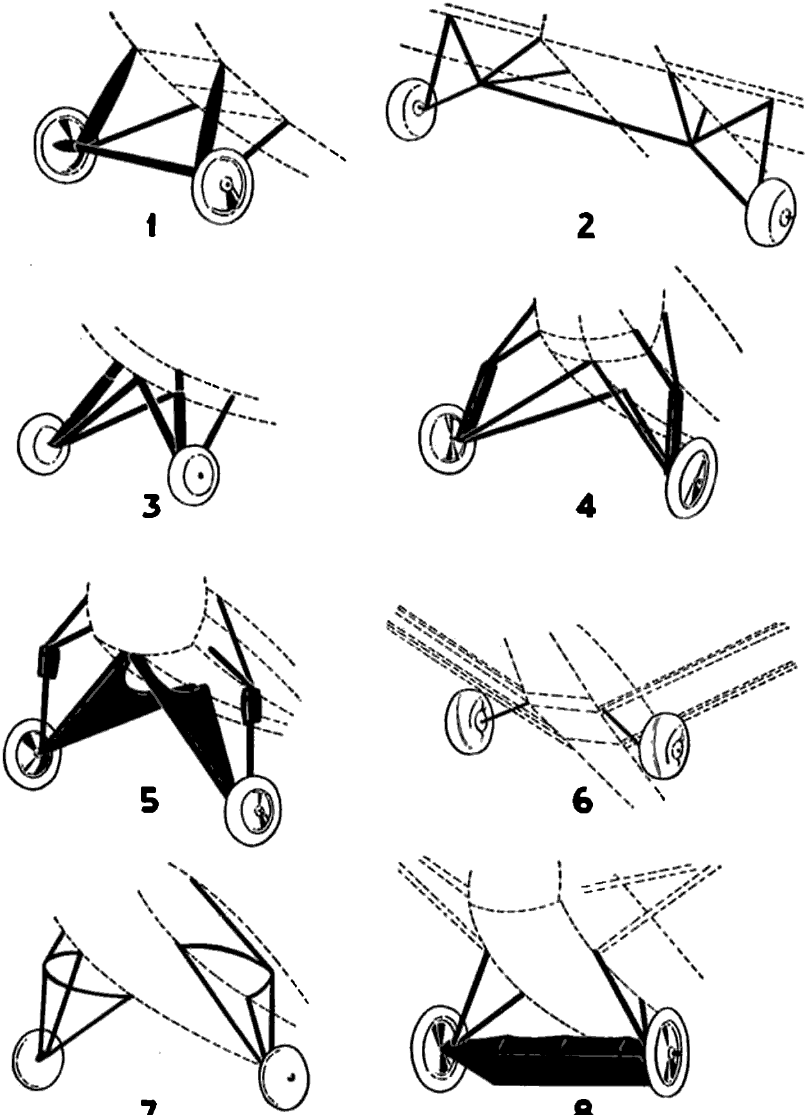
In Fig. 69, seven other popular landing gears are shown. No. 9 is that of the Gee Bee Super-Sportster in Chapter 40. No. 10 shows the landing gear of the Lockheed-Vega "Winnie Mae" in Chapter 42, while No. 11 is that of the Bellanca Pacemaker "Cape Cod" in Chapter 36.

No. 12 shows the landing gear of the Wedell Williams in Chapter 44, while No. 13 is the gear belonging to the Northrop Gamma in Chapter 48.

No. 14 has been added to this group to show the inside framework of the average scale model R.O.W. floats. These are built up of a number of balsa formers, with bamboo stringers connecting them and shaping the structure. While floats gain their forms from those of the real ships being copied, practically all are constructed in the same manner, so the builder can gain a general working knowledge of float construction through studying these. It has been found that bamboo is best for the stringers of such floats, as it is practically unbreakable, resists water splendidly, and has a certain amount of spring which balsa wood lacks. While the weight of the bamboo is slightly greater, the above factors offset this disadvantage.

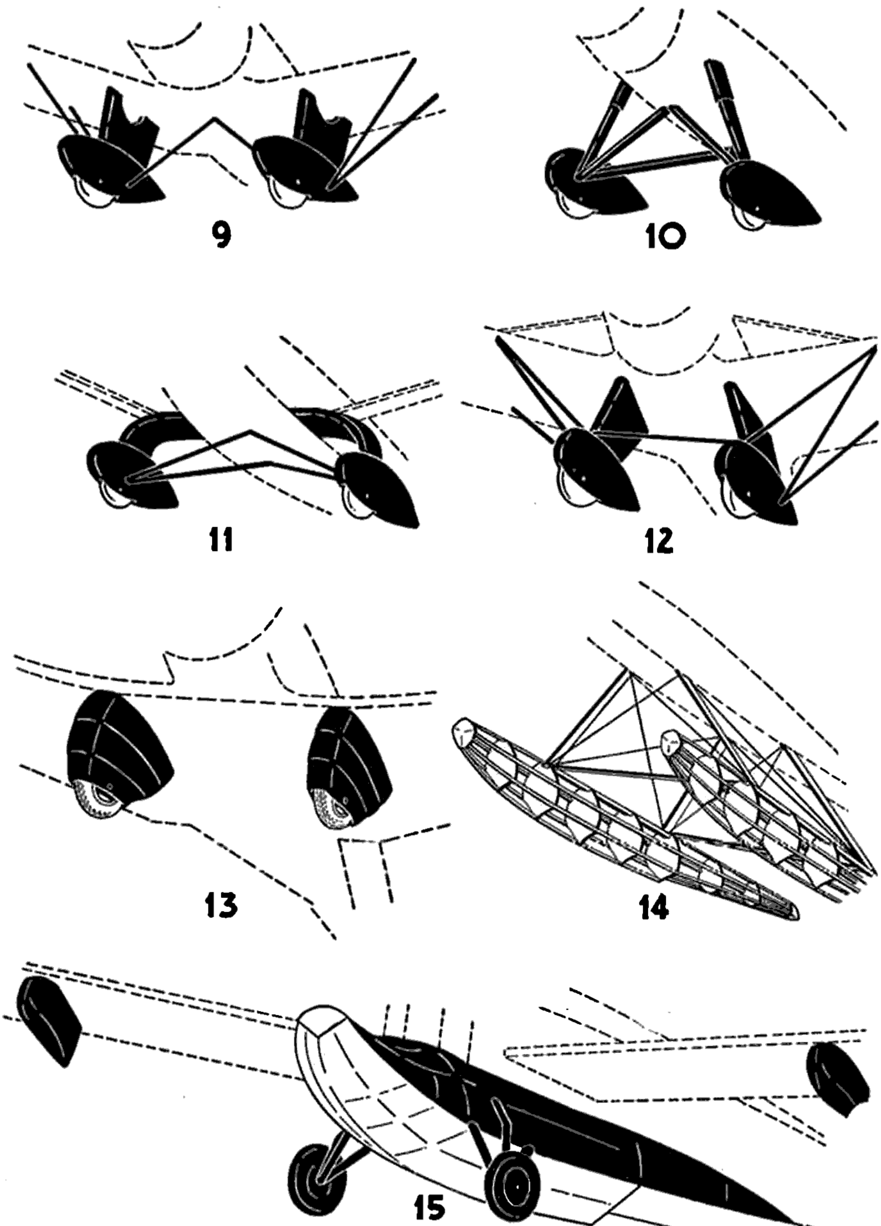
No. 15 shows the hull of the Loening Amphibian in Chapter 50. All of these gears are shown here to acquaint the reader with the various popular forms of landing gears, and a close study of each should prove of great aid when building scale models.

WHEELS. A great assortment of various types of wheels for model airplanes are carried by practically every model supply house. Some builders, when turning out a perfect scale model, prefer to buy the wheels, but for flying models they are usually made.



SCALE MODEL LANDING GEARS

FIGURE 68



SCALE MODEL LANDING GEARS

FIGURE 69

Several methods of building wheels are given here. These not only include flying model wheels, but those for scale models as well. If the builder will master these, he will be able to make wheels quite as good as those he can buy.

SOLID BALSA WHEELS. Fig. 70 shows the three steps in making a solid balsa wheel, the most popular wheel for flying stick models. A piece of $\frac{1}{32}''$, $\frac{1}{16}''$, or $\frac{1}{8}''$ sheet balsa, depending on the size and weight of the model, is cut out to form a disk. In A is shown the laying out of the wheel on the balsa with a pencil compass. B shows the cutting of the circle just drawn. (See Chapter 3, "Balsa Wood.") The edge of the disk is sandpapered perfectly round, and a hole slightly larger than the diameter of the axle wire is made in its center. It is then placed on the wire axle, which is bent up to prevent it from falling off, as shown in C.

SOLID BALSA RUBBER-TIRED WHEELS. These are exactly the same as the solid balsa wheels except for the addition of a rubber tire. Spectacle tubing is used for this purpose. It can be purchased at any optician's shop and most model supply companies now carry it. In A is shown the disk finished as shown in C for the solid balsa wheel. The tubing is split along one side, as shown in B. Cement is applied to the inner surface of the tubing and it is spread on the edge of the wheel, as in C. D shows the finished and mounted wheel. These make splendid wheels for large flying models or scale models. If the model is to be painted, the disk should be sandpapered, given two coats of dope, and painted any desired color. The rubber tubing is then mounted. If you wish to paint the tubing black, it should be done before the tubing is mounted, as the painting of the edge of the rubber will prove difficult if on the disk.

DISK RUBBER-TIRED WHEELS. This wheel should not be used on endurance models, as it is heavier than the others, but for flying scale and exhibition models it gives a splendid appearance. The usual disk of sheet balsa is finished as for the solid balsa wheel. In this case, however, the balsa should be cut from $\frac{1}{32}''$ stock. (Note A.) In B is shown a smaller disk cut in the same manner, but from $\frac{1}{4}''$ stock. The diameter of this second disk should be $\frac{1}{8}''$ less than that of the larger disk. Two of these smaller disks are required for each wheel. When cut out, they are sandpapered to a cone-like form, as in C, with their high point centering at the axle hole. These are then cemented on each side of the larger disk, after being carefully centered, as at D. Rubber tubing is split along one side and cemented in place around the edge of the large center disk, as in E. The finished wheel is shown in F. If the wheel is painted, as such wheels usually are, this is done before the tire is attached in place. (See "Solid Balsa Rubber-tired Wheels.")

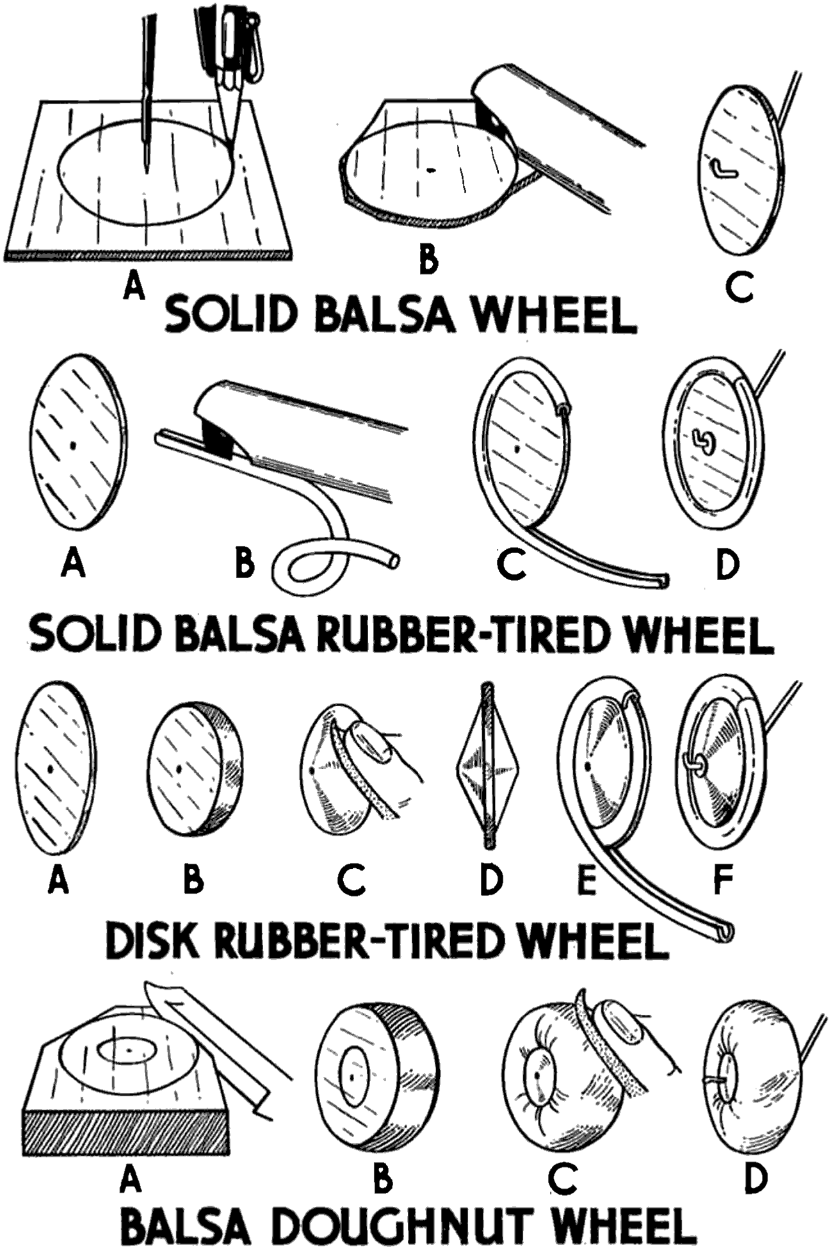


FIGURE 70. WHEELS, 1.

BALSA DOUGHNUT WHEELS. Balloon tires are often called "Doughnut" wheels, and they will be found on such planes as the Curtiss-Wright Junior and the Pitcairn Autogiro. (See Chapters 46 and 55.) For model work, these can be easily cut from a 1/2" or 5/8" thick balsa board. Trace the wheel outline on the balsa, and then cut it out, as in A. The disk is then finished perfectly round by sandpapering, as in B. The tire outline is made with sandpaper, making it round from side to side, and carrying out the shape of the tire to a 1/2" diameter circle at the hub of the wheel, as in C. The mounted and finished wheel is shown in D. Such wheels are usually painted black around the form of the tire, with another color for the hub circle.

PAPER WHEELS. These are very light, quite strong, and give a most realistic appearance. They are splendid for flying models. On fairly stiff paper, a circle is drawn with the compass slightly larger than you wish the finished wheel to be, as in Fig. 71 A. A small section of the circle is then ruled from its center to its edge, as shown. The circle is cut out and from this disk the ruled section is also removed, as in B. Two of these disks, exact copies of each other, are required for each wheel. They should be bent into the form of shallow cones by closing the edges of the cut sections and cementing them together, as in C. The edges of these disks, or cones, are now matched together and cemented.

At the center of each cone, a hole is cut, into which is fitted a small roll of paper, as in D. The length of this strip of paper, after it has been rolled, should be slightly longer than the thickness at the hub center of the joined cones. Cement is applied and the roll of paper is thrust through the holes made in the cones.

With scissors, trim off the ends of the roll until they extend out from both cones about 1/16", as in E. This small roll of paper forms an excellent wheel hub for the axle of the landing gear to turn in. The finished assembly requires two small washers, which should be cemented to the ends of the paper roll, as in F. The cement must not close up the ends of the roll, or the wire axle will not fit into it. Dope can be applied to such a wheel for weatherproofing and stiffening.

BUILT-UP BALSA WHEEL. This makes a light, serviceable, and strong wheel for any model. In A is shown the tracing of the wheel on sheet balsa with a compass, and in B is seen how the wheel is cut out. It is then sandpapered smooth, as in C. A small roll of paper is thrust through a hole made in the center of the disk, and allowed to extend out 1/4" from each side of the balsa disk, as in D. Japanese tissue or Japanese silk is then applied to each side of the disk, passing over the end of the roll, and being

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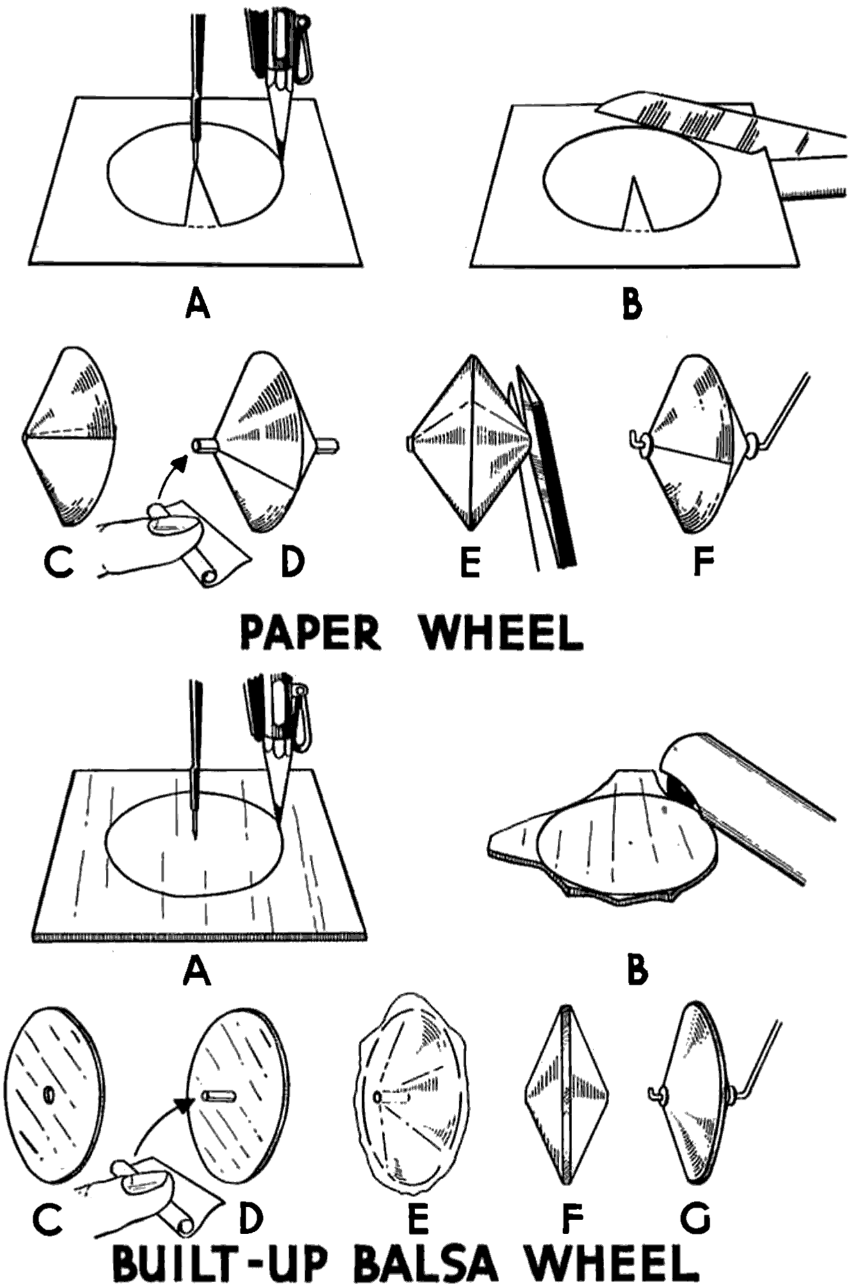
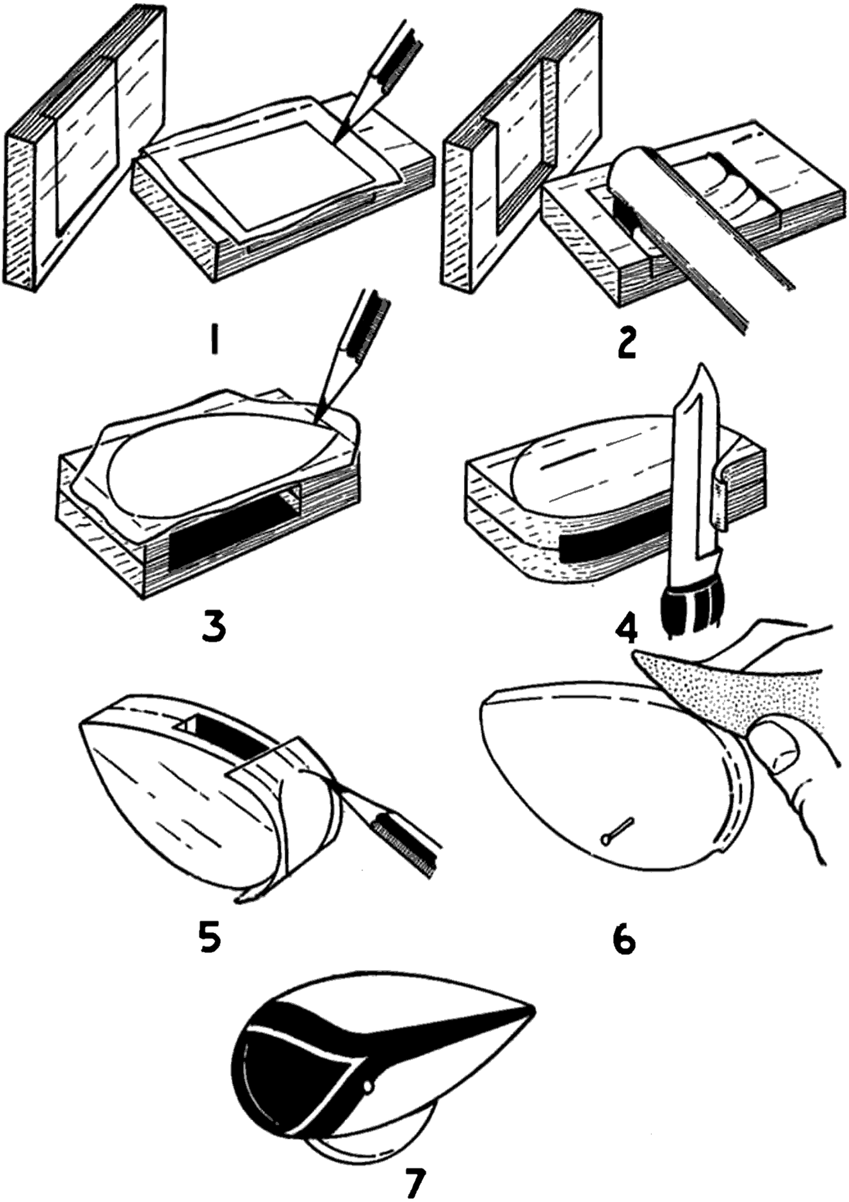


FIGURE 71. WHEELS, 2



WHEEL PANTS

FIGURE 72

cemented to the edge of the wood, as in E. The covering is then trimmed around the edge of the disk, and water-sprayed. The result is shown in F. Two washers are cemented to the ends of the paper roll, the covering pierced at both ends of the roll, and the axle fitted through the hub, as in G, which completes the wheel.

WHEEL PANTS. As the majority of modern airplanes have their wheels equipped with wheel pants, it will be necessary to add them to many solid scale and built-up, non-flying scale models. They are a form of wheel guard which serves to streamline the shape of the wheels, and by so doing to cut down air resistance.

Fig. 72 illustrates the seven steps necessary to make a wheel pant. Step No. 1 shows the laying out of the two blocks which make up one wheel pant. The necessary size of the material used depends on the size of wheels used, the type of pant, etc., all of which must be determined from the plans of the model.

Some pants also serve as landing gear struts, as in the case of the Curtiss Shrike in Chapter 52 and the Northrop Gamma in Chapter 48, but the majority are of the type shown in the illustration.

Sheet balsa of 1/8″ or 1/4″ thickness is used, depending on the thickness called for in the plans. Two duplicate pieces of this stock are squared up to the necessary length and width, as shown in Step 1. The inside cut for the wheel is then traced on each and cut out, as shown in Steps No. 1 and No. 2. These cuts must be large enough to allow the wheel to turn in them freely. Note that these cuts are located on the blocks slightly nearer one end than the other, and that they are made on opposite sides of the blocks, so that when the blocks are fitted together, the cuts in them will also fit, as shown in Step No. 3. The cuts must be a little deeper in each block than half the thickness of the wheel.

The two blocks are then cemented together, as shown in Step No. 3, and their outside shape traced on one face, as in No. 3. This outline is then cut out with a knife, as seen in Step No. 4. Step No. 5 shows the thickness being shaped by first tracing it on the blocks. This is then completed by sandpaper, as in No. 6. The wheel is mounted in the pant by means of a model pin, or a regular pin may be used. Test to see that the wheel moves freely when in place, and then cut off any excess length of the pin flush with the side of the pant. A drop of cement over the cut end will hold it firmly in place. The head of the pin should appear on the outside of the assembled pant, as shown in Step No. 7. It is then painted.

CHAPTER 11

ENGINES AND COWLINGS

ENGINES. All engines are made up of a number of cylinders, and the builder must determine beforehand how many cylinders the engine he is copying requires. On most of those given in this book, nine cylinders are required, with the two exceptions of the Curtiss-Wright Junior, which has only three cylinders, and the Northrop Gamma, which has fourteen.

The height of each cylinder depends on the size of the cowling into which it is to fit. As the cylinders are attached around a center core, they must be long enough to extend from this core to the inner face of the cowling, which fits around them. Some builders prefer to make their cylinders free of all contact with the cowling, which is the proper method of construction, as in real engines the cylinders do not touch the cowling, but if the engine is very small, the safest method is to attach one end of the cylinders to the core and the top of them to the cowling.

In Fig. 73 six steps in the construction of a cylinder are shown. In A is shown a square block of balsa wood cut to proper length. A circle of desired diameter is drawn on both ends, and the block is rounded, as in B. This is then tapered from its original diameter at one end to a slightly smaller one at the other, as in C. This shape should be that of a cork. The block is then shaped as shown in D. This consists of cutting a groove in the top of the block and then rounding the edges. Balsa is the best material for these blocks, although small corks or blocks of pine or other woods are sometimes used. Each block is painted black. A blue ink treatment gives the bluish tinge of steel which is desirable.

The block is wrapped with soft copper wire. No fastening is required, as it will stay in place on the block when it is wrapped. This is shown in E. The two illustrations in F show the final assembly of the cylinder on its core. On some models, this core may be a separate part of the model, but on most of them it is the nose of the fuselage. The cylinder is attached with cement and a pin thrust through its center into the core, as shown in F. The cylinders should be attached to the front portion of the core, so that when assembled in the cowling they will be just inside its front edge.

Two more pins are thrust into the core next to the front side of the

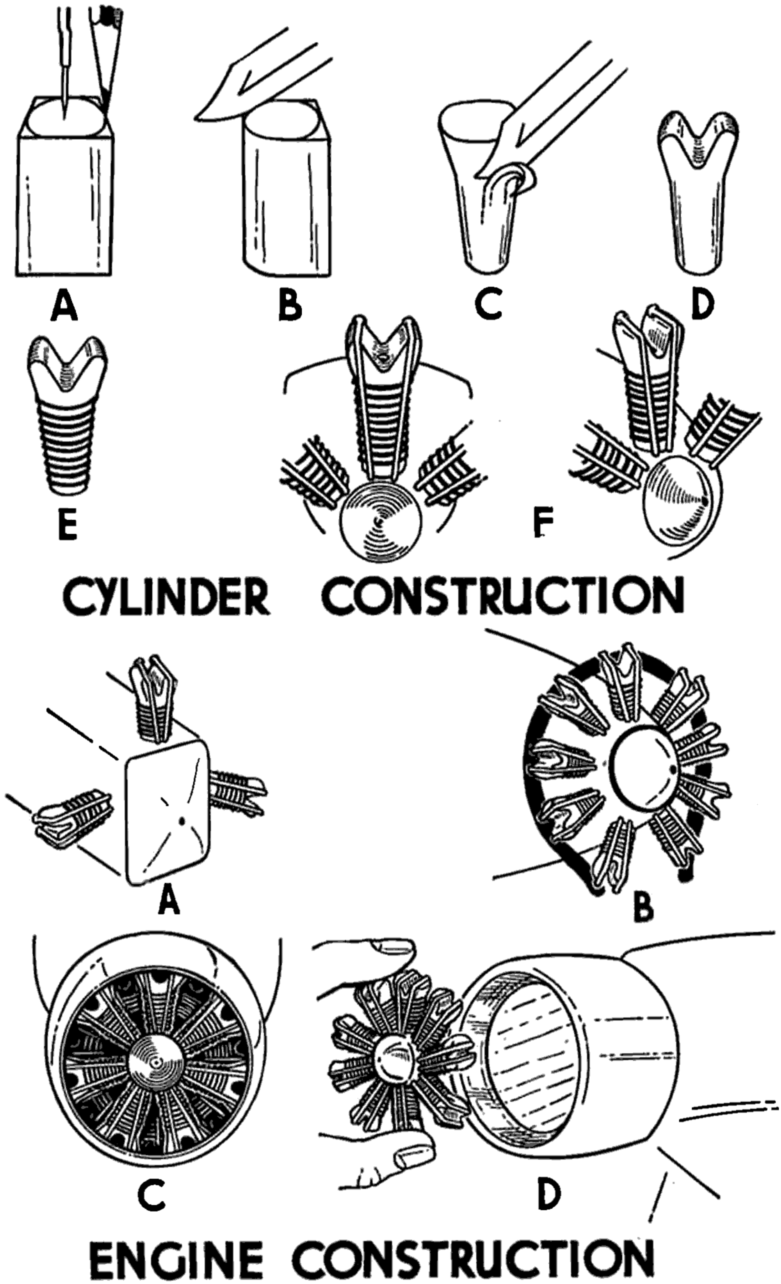


FIGURE 73

cylinder, after their stems have been bent at right angles to fit over the top of the cylinder. To finish the effect, the core of the engine should be colored in the same manner as each cylinder, after which the propeller is attached to the tip of the core with a pin.

The various assemblies of engines most commonly used in exhibition models are also shown in Fig. 73. A shows the assembly of the three-cylinder engine of the Curtiss-Wright Junior. B shows the assembly of an engine without a cowling, as in Chapter 47, while the fourteen-cylinder engine of the Northrop Gamma in Chapter 48 is shown in C.

The nine-cylinder Wright "Whirlwind" engine of the Waco, shown in B, has its pipe made of reed bent to shape and painted black. The fourteen-cylinder engine of the Northrop consists of two seven-cylinder assemblies around the same core, one behind the other, and so staggered that the rear cylinders will show between the front cylinders.

On most solid scale models, the cowling is not a separate part of the fuselage, as the front portion of the block from which the fuselage has been shaped is cut into the form of a cowling. When this is the case, the inside of the cowling must be hollowed out deep enough to accommodate the engine assembly.

When the cowling has been cut out, the cylinders are assembled on a separate core no longer than the cowling is deep. After the assembly has been completed, as in D, cement is applied to the end of the core and it is attached into the hollow of the cowling with its coated end against the inner wall of the cowling. A long pin can be thrust through the center of the core and into the back of the cowling to hold the assembly in place until the cement dries.

COWLINGS. There are only two types of cowlings the model builder will need to consider. These are the N.A.C.A. and ring cowlings.

SOLID N.A.C.A. COWLING. Fig. 74 under "Solid N.A.C.A. Cowling" shows the five steps for making this type of cowling from a solid block. As these cowlings are used on built-up, non-flying scale models, the inside diameter at their back should be just large enough to fit over the leading former of the fuselage, and their front diameter should be the same size.

A shows the first step of the work, after the block has been cut to proper size. A hard grade of balsa should be selected for these cowlings. After the outside diameter has been drawn on the face of the block, an inner circle is made to indicate the inside diameter of the cowling. This should be about 1/4" smaller than the outside diameter, and the exact diameter of the front former.

The square block is now cut round, as in B, which is followed by scooping out the inside of the block, as in C.

The outer side of the block is now given a streamlined form, which is shown in D. The outer circle is tapered down to meet the inner circle at both leading and trailing edges of the block.

The block is now brought to a satin finish with No. 000 sandpaper, as in E. The completed cowling can be seen in F. The engine assembly for such a cowling should be made around a small center core of the same length as the cowling.

RING COWLING. Technically known as an "anti-drag ring," this so-called cowling aids in increasing the speed of the plane. It looks much like an enormous wedding ring. Slightly wider than the tops of the cylinders, it is streamlined in the same manner as the N.A.C.A. cowling.

In Fig. 74 under "Ring Cowling," the five steps for making this are shown, as were those of the N.A.C.A. cowling. Follow each step, as shown, when making this type of engine covering. These are used on engines assembled around the nose of solid fuselages, where they are fitted over the cylinders after these engine units have been attached in place. For this reason, such cowlings must have inside diameters equal to the diameter of the circle formed by the tops of the cylinders, when these are in position around the core.

BUILT-UP N.A.C.A. COWLING. For all flying models, the engine cowling must be of very light construction to keep weight at a minimum. For such models, having no engines, cowlings are used only to complete the general outline of the fuselage, and hold the front motor stick clip. The four necessary steps for building such cowlings are shown in Fig. 74 under "Built-up N.A.C.A. Cowling."

On $1/32''$ sheet balsa, the two circular formers and six or eight former struts are traced with pencil, as seen in A. The next step, B, shows these after they have been cut out. The large former must have a diameter equal to that of the front fuselage former, while the small one need only be large enough to allow the motor stick and rubber motor to be removed through it. The width of these formers, or the distance from the inside to the outside diameters, should be about $3/16''$. These are now assembled, as in C, and a piano wire motor stick clip is cemented to the inside face of the front, or small, former. When it is fully assembled and the cement has dried, the cowling framework is covered with Japanese tissue, silk, or whatever has been used on the fuselage. This can best be done by cutting the paper into strips wide enough to reach from one former strut to the next

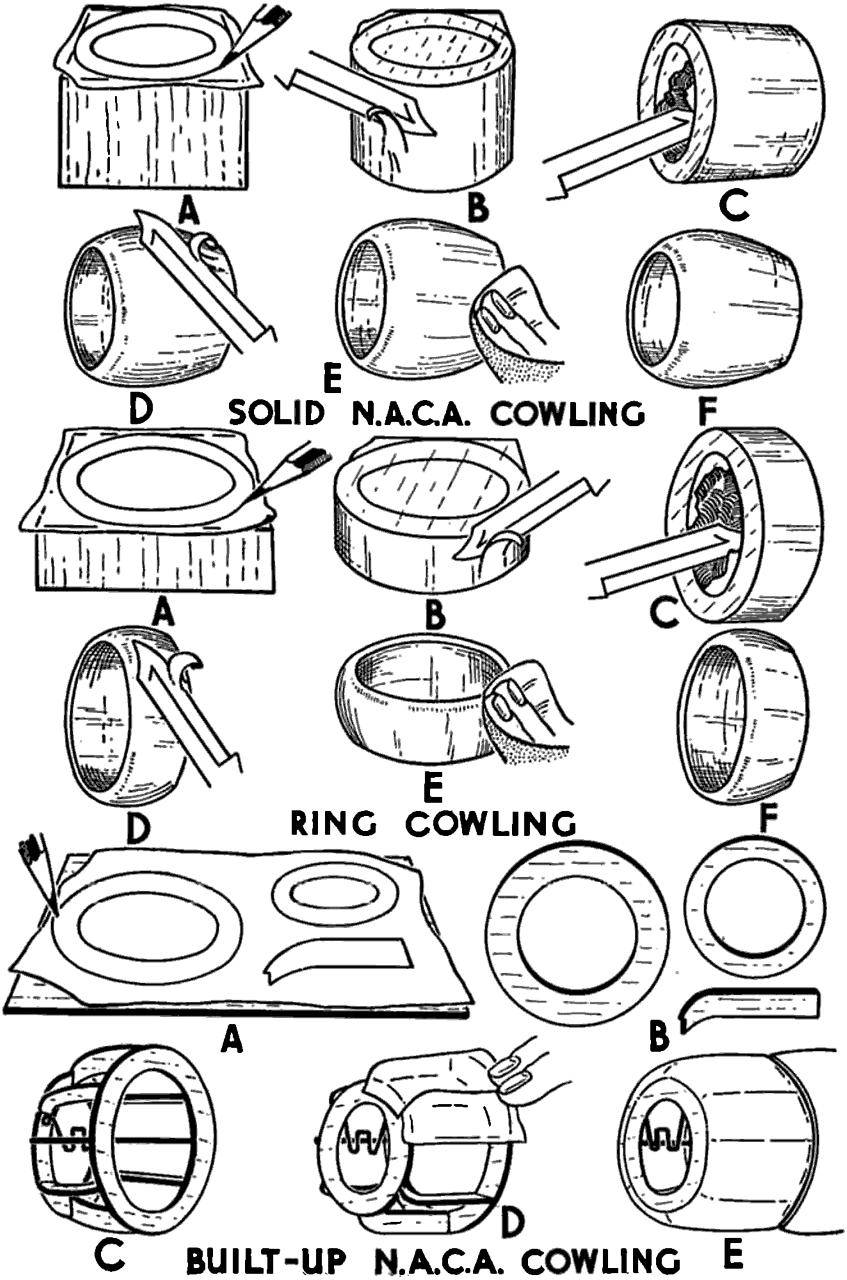


FIGURE 74. ENGINE COWLINGS

one, and long enough to reach from the front to the back former. Attach the covering with clear dope or banana oil, as in D.

When fully covered, the tissue or silk should be water-sprayed to tighten the covering. (See Chapter 7, "Wing Covering.") If the fuselage has been doped, the cowling should be finished in the same manner. When completed, all edges should be trimmed to remove any excess covering. The cowling is then attached to the fuselage. Coat the front former of the fuselage with cement, and press the large former of the cowling in place against it, holding it in position until dry.