CHAPTER 12

RUBBER MOTORS AND MOTOR STICKS

MANY different means of motive power have been suggested for model airplanes, but none has proved as efficient as rubber.

Every model enthusiast should understand a few of the basic facts concerning rubber and its action. In the first place, rubber has life. There is live rubber and dead rubber. The former allows more energy to be stored in it than in any other source of power of equal weight, while the latter is useless. Through constant use, rubber becomes tired, and it must be rested before it will regain its energy. Sunlight, oil, grease, certain metals, and the stretching of it beyond its elastic limit will quickly affect rubber, and it becomes hardened, cracked, and dead.

Every model supply house carries rubber for model airplanes. The finest is pure Para rubber. It comes in various sizes, the most common being $\frac{1}{32}$" and $\frac{3}{64}$" in the square, and $\frac{1}{8}$" and $\frac{3}{16}$" in the flat rubber.

The $\frac{1}{32}$" square rubber is best adaptable to very light indoor and R.O.G. flying models, while the $\frac{3}{64}$" square is suitable for heavier models of the same type. The $\frac{1}{8}$" flat rubber is by far the most popular size, being the best suited for indoor and outdoor endurance models. Such rubber is usually used on championship models found at most national meets. The $\frac{3}{16}$" flat rubber can be used on all outdoor models and is especially good for large high-speed ones.

The builder should make actual flying experiments, using various sizes of rubber, noting the performance of each, and then choosing the best size for the model being tested. The number of strands is governed chiefly by trial and error. Baby tractors and pushers usually give the best results on one or two strands; larger models require from four to twelve strands, depending on the strength of the motor stick, the size of the propeller, and the weight of the model. If the model is heavy, more rubber will be required.

Rubber always should be applied to a model with a certain amount of slack allowed. In other words, it should never be taut between the propeller shaft and the rear hook. Builders have their pet ideas on the amount of

this slack that is necessary, but for a beginner, here is a simple way of calculating it until definite decisions are reached through trials:

If using the average length propeller shaft and rear hook, each strand of the rubber should be just the length of the motor stick. When the rubber is attached, it will have a slack equal to the combined lengths of the rear hook and propeller shaft. For example, the motor stick of the model is 12″ long and is to be fitted with one strand of rubber for the motor. The rubber strand is then cut 12″ long, plus whatever surplus is necessary for binding the rubber in place to the end hook and propeller shaft. Further, let us assume that the end hook of this particular model extends from the end of the motor stick forward for a length of ¼″. On the other end, the propeller shaft extends over the motor stick for a distance of ¾″. The combined length of these hook extensions over the motor stick is 1″. In other words, the distance between them is 1″ less than the length of the 12″ motor stick, or 11″. By cutting the rubber 12″, a slack of 1″ is obtained.

Various kinds of rubber will stretch in different degrees, but good Para rubber will elongate about seven times its length. The purchaser can test the rubber by stretching a measured piece about seven times its original length, releasing it, and then measuring it again. If the rubber returns to its original length, it is "live" and good for use in a motor; if it remains longer than it was before the test, it is not first-class rubber. Any rubber, however, can be distorted by stretching it past its "live length," so care must be taken not to stretch it past this point.

Dr. William F. Tuley, of the research laboratories of a leading rubber company, gives this hint to model builders concerning the purchase of rubber: "Chemical substances known as 'antioxidants' have been discovered which greatly increase the life of rubber when compounded with it. These substances retard the destructive action of air and sunlight on rubber. They are being extensively used in tires, bathing caps, raincoats, and other rubber articles, and purchasers of rubber strands for model airplanes might find it advantageous to specify that they be included in the composition of the rubber. There are a number of good commercial antioxidants on the market."

Another point to watch when purchasing your rubber is that you specify and obtain pure Para rubber. This contains a minimum of nonrubber ingredients, making it the finest of all grades for model work. See that the rubber you purchase has been kept in a dark place. Do not buy rubber from an open shelf where the destructive elements of sunlight may harden and crack it. See that it has not been under tension.

The safest way to keep rubber when not in use is in a bottle which

has been painted black, so that sunlight and air cannot reach it. A Mason jar is excellent. Obtain one, pour a little black paint in it, shake it around until thoroughly covered, and then empty out the balance. When the paint is dry, rubber can be kept in the jar without fear of damage from light.

When more than one strand is used for a motor, the winding tends to cause the strands to stick together. Lubricants are used to prevent this on the theory that they make it easier for the strands to slip over each other when unwinding. Wound lubricated rubber contains a greater amount of energy than rubber not lubricated, and the author recommends it.

There are a number of commercial lubricants on the market, or plain glycerine will be found excellent for this purpose. Another splendid lubricant, but one requiring a little more attention, is made of soap, water, and glycerine. Cut Ivory soap into small shavings and boil it in a little water to make a thick liquid, then add a like amount of the glycerine, making a fifty percent glycerine and fifty percent soap and water solution.

The above lubricant is used by an expert model builder, who claims that he lubricates his rubber the day before it is to be used in a contest. He then packs it away in a dark receptacle well coated with talc. After it has been used, he replaces it in the same manner and keeps it this way.

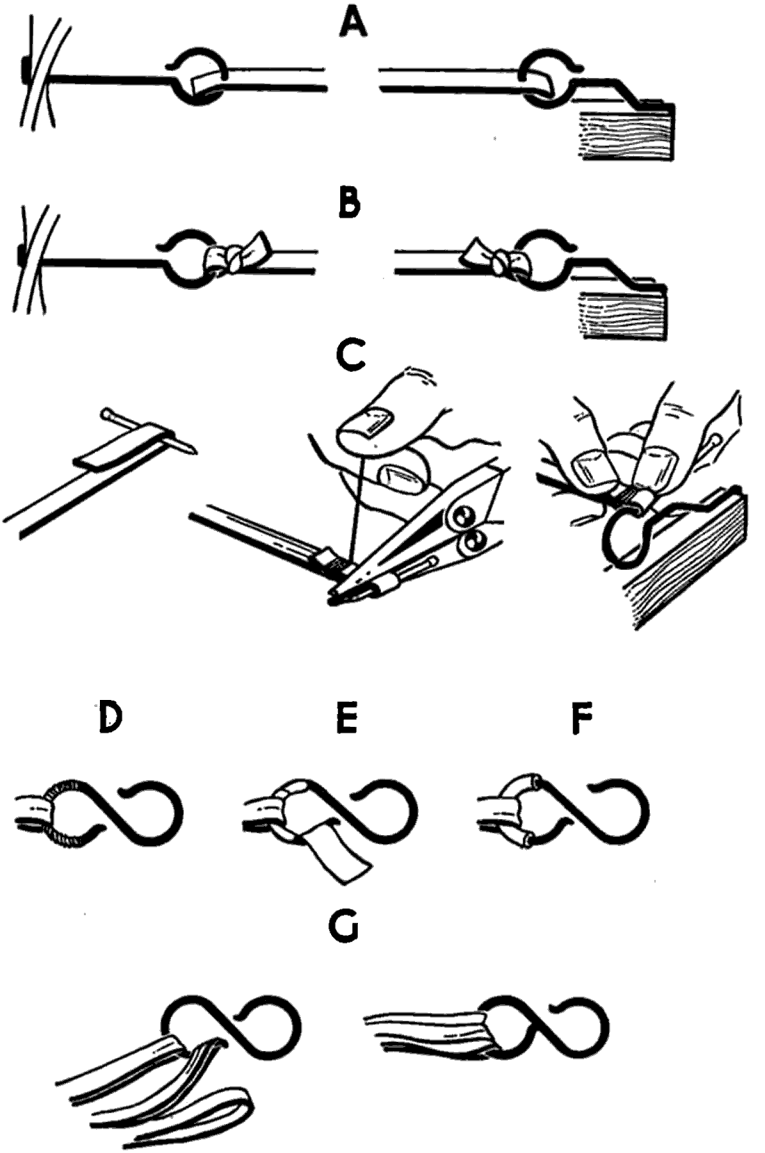
Others prefer to wash the rubber after it has been used. This is done in warm water with a pinch of soda added. After washing and removing all lubricant, the rubber is carefully dried before being packed away. When placed in the jar, it should be sprinkled with either common talc or cornstarch, after making sure that all strands are separated.

Never use oil or grease as lubricants, as these weaken and soften the finest of rubber. Tests should be made by the amateur with lubricated and unlubricated rubber. Various lubricants should be thoroughly tested to obtain the best, and the two methods of packing away and keeping rubber should be tried to determine which is preferred.

Experiments show that the best winding results can be obtained by stretching the rubber three or four times its length before starting to wind. Two should do this operation together, especially on large models: one holds the rubber while the other does the winding. Full instructions are given in Chapter 16 under "Winding."

There are several popular methods of connecting rubber to hooks. When a single strand is used, the rubber can be pierced, as in Fig. 75 A. However, the rubber will take many more turns if it is tied about the hook, as in Fig. 75 B.

As single strands are used only on small models with correspondingly small fittings, it is often difficult to make the knot. Fig. 75 C shows an easy



RUBBER MOTOR ATTACHMENTS

FIGURE 75

way to accomplish this. Fold the strand over a nail, hold the fold together with small-nose pliers, tightly wrap with silk thread, and tie. The nail is then held next to the hook, the rubber slipped off it on the hook, and the nail removed. The deterioration of rubber is accelerated by certain metals, the most common of which are copper and brass. If these should be used for propeller shafts, can hooks, "S" hooks, or end hooks, which come in contact with the motor, they should be wound with silk thread, Fig. 75 D, adhesive tape, E, or covered with spectacle tubing as shown in F.

When using "S" hooks, closing the hook, as shown in G, will keep the strands together on the hook. For motors having a number of strands, "election" bands are used on both ends to keep the strands of equal length. These are small rubber bands tied around the strands, just in front of the "S" hook or end hook at the rear of the motor stick, and just behind the propeller shaft hook at the front end of the stick.

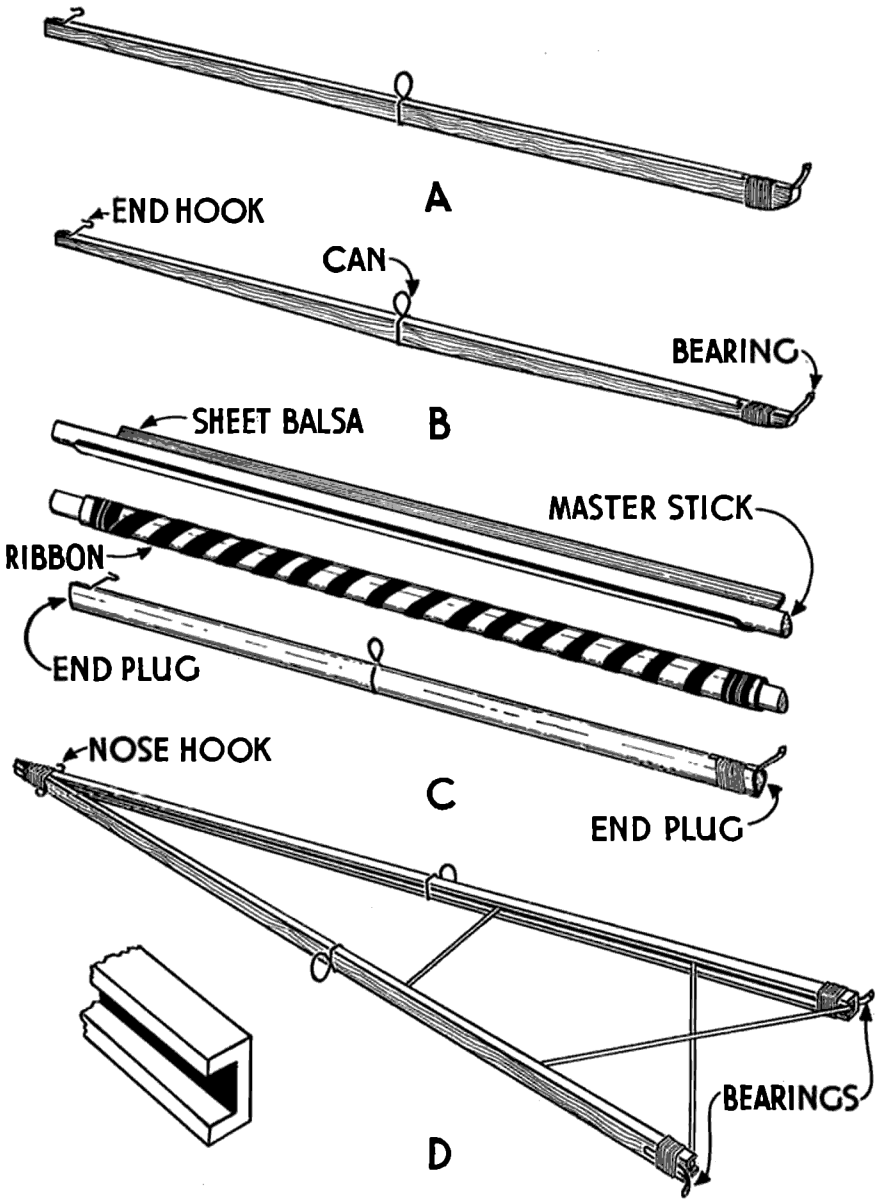
MOTOR STICKS. On stick models, the motor stick serves as a fuselage to which are attached the wing, elevator, rudder, propeller, motor, and landing gear if one is used. For this reason, these models are known as "stick models."

Flying fuselage models have the usual built-up fuselages with or without motor sticks. Some fuselages are so strengthened in their structural framework as to require no motor sticks, in which cases their rubbor motors are attached directly to the members of the fuselages. When this type of fuselage first became popular, it was considered a great asset to save the weight of a motor stick, but close study soon revealed the fact that such a fuselage required heavier construction, which often weighed more than the stick it eliminated. Another great disadvantage to this type of motor asbly was the danger of twisting the entire fuselage frame through winding.

For these reasons, the author recommends the use of a motor stick on all flying scale models. Such a stick allows the motor to be removed from the fuselage, so that the rubber can be stretched before winding. It permits more turns to be made in the rubber, which gives longer endurance, and allows motor repairs to be made easily.

While all scale models should be equipped with motor sticks, commercial models seldom need them. On such models, the construction can be so designed as to give the necessary strength with little added weight. They are usually left uncovered at the end hook, while the propeller bearing consists of a removable plug, which allows the rubber to be removed, as shown in Chapter 35.

Fig. 76 shows a number of the most important types and forms of motor sticks. In A is shown the most common form of motor stick, which is usually



MOTOR STICKS

FIGURE 76

twice as wide as it is thick. Such sticks usually are cut 1/16" x 1/8", 1/8" x 1/4", and 1/4" x 1/2". Occasionally we find a stick cut square, as on the tractor in Chapter 21, but these are unusual. The nose, or propeller end, of the stick is usually beveled, allowing the propeller free motion without danger of striking the stick.

B shows the tapered stick, which is the same as A except that it is slightly tapered toward both ends to eliminate excess weight. Such a stick is usually twice as wide as it is thick at its center and then tapers toward both ends until square. For example, a stick 1/8" x 1/4" at the center would taper to 1/8" x 1/8" at both ends.

C shows the three steps for making a hollow stick. On extremely light, endurance stick models, these sticks are very popular. Some builders make their sticks large enough to hold the rubber motor inside the stick, but weight tests made by the author seem to prove that such sticks weigh too much for any advantage gained.

For such hollow sticks, 1/64" or 1/32" sheet balsa is used. A master stick of pine is shaped as desired and cut about 1" longer than the required motor stick. Some make their motor sticks perfectly round, which can be done by forming the sheet balsa around a dowel stick. The shape given here is for the tractor in Chapter 33.

After the master stick has been prepared, the sheet balsa is cut to size. Its length must equal the required length of the finished stick, and its width must equal its desired circumference. A quick way to determine this is to tie a string around the master stick, remove the string while still knotted, cut it, and measure its length. This will represent the width required for the stick.

When the sheet balsa has been cut to size, it must be thoroughly soaked in hot water. Remove it from the water, place it on a flat table, and lay the master stick on it, so that the side of the stick and the edges of the sheet are parallel with each other. The balsa sheet is then bent up around the stick and tied in place with ribbon. Do not use string, rubber bands, or wire for this work, as any of these will quickly cut into the soft wood. Use a wide ribbon, and wrap it carefully around the entire length of the stick, as shown.

When the balsa has dried, the ribbon is removed and the edges of the sheet balsa cemented together. Some prefer to leave the master stick in position while doing this work. If this is done, it must be pulled back and forth while the cement is drying, so that the cement will not fasten it and the sheet balsa together.

The ribbon may be replaced until the cement has dried, but if this is

done, a thin coat of vaseline should be given the ribbon to keep it from adhering to the crack of the sheeting. After the cement has become thoroughly hard, two small end plugs are shaped to fit the inside form of the stick. These are cemented into the ends of the motor stick. When dry, the entire stick is sandpapered smooth and fitted with the usual end hook, can hook, if used, and propeller bearing.

On twin stick pusher models, the A-frame is often made of two U-beams, so named because they resemble a U in form. Note this type of construction in Fig. 76 D. The open side of the beam faces toward the inside of the A-frame, as shown. Such a beam is used on the model in Chapter 28. Note that the braces of the A-frame fit between the sides of the U-beams, where they are cemented into small holes cut for them. Such beams can be made by cementing three pieces of sheet balsa together, or they can usually be purchased from supply dealers.

CHAPTER 13

PAINTING

ENDURANCE CONTEST MODELS. Endurance models for contest purposes should never be painted. There are no exceptions to this rule, whether the model is a single-stick, twin-stick, commercial, or flying scale plane. All endurance models depend greatly on their lightness, and paint has weight. In fact, during tests to determine the effect of paint on models, one model so tested had its endurance cut in half. While this was not true with all the models so tested, each showed a decided drop in flying time when painted, which should give an idea of the harm paint can do to a flying model when its endurance is counted in seconds.

Many experts refuse even to give their wing surfaces a water-spray because of this danger and that of warping. When $\frac{1}{32}$" balsa is used on such parts as wing tips, it is not hard to realize the effect paint has on such models.

SPEED FLYING MODELS. Paint makes little difference on speed models, as they are of sturdy construction in which weight is not an important item. A close study of the speed twin pusher in Chapter 34 will prove this fact. With solid balsa wing and elevator, heavy balsa propellers, pine A-frame, and considerable weight from its two rubber motors alone, paint would have practically no effect on its flying ability.

The sole question of such a model is, "How fast will it cover the course?" Built to fly only a comparatively short distance, its action is more that of a bullet than the slow, steady, soaring flight of an endurance model. Such planes may safely be painted any color you wish. Give the A-frame, wing, elevator, and propellers two coats of banana oil, a careful sandpapering, and then apply any paint, lacquer, or enamel desired. However, few such models are ever painted, because their appearance counts nothing in a contest.

EXHIBITION FLYING MODELS. There are occasions when the appearance of flying models should be taken into consideration. If you intend to sell your model, give it as a present, or display it to a public which knows nothing about such models, its appearance will count for as much if not more than its flying ability. For such flying models, the author recommends the use of colored dope, which is now carried by practically all model sup-

ply houses. It comes in a number of bright colors and is applied with a soft camel hair brush. It requires no undercoating.

However, before applying any dope to wing sections, the builder should make sure that the construction of his model is strong enough to withstand the strain of shrinkage. Otherwise, he may find his wing sections warped beyond repair.

If the model is a stick type, sandpaper the wood parts and leave them without any finish, unless they are given a single coat of dope and finished with another sandpapering. The wing, rudder, and elevator covering can then be given a coat of colored dope, after each has been water-sprayed.

Models finished in this manner have a "professional" appearance, and while they will not be championship flyers, they seldom lose enough flying ability to be noticed.

SOLID SCALE MODELS. Solid scale models should always be painted. The sole purpose of such models is appearance. They are replicas of real planes and must therefore be finished like the planes they represent.

Such models usually require a certain amount of filling. This is done with a wood filler, of which various makes can be found in hardware stores or model supply houses. The author can recommend Plastic Wood as a splendid filler. This is used to fill all cracks, construction errors, wood defects, or to make streamline wings, cowlings, fuselages, etc. Wings are often tapered into fuselages, and for this purpose, a wood filler is excellent. After such a filler has become perfectly dry, it can be cut, planed, or sandpapered like wood, and will take paint splendidly.

Whether the model is of balsa, pine, or another wood, it should be given an undercoating to prevent the paint, enamel, or lacquer from seeping into the surface. For this purpose, use clear banana oil. The number of coats necessary depends on the hardness of the wood. For balsa, from four to seven coats of banana oil are usually necessary. The surface should be lightly sandpapered after each coat, which will give a splendid base for painting.

There are a number of paints, enamels, and lacquers for finishing work. Lacquer or enamel proves the best, although many builders use ordinary gloss paint. Model supply houses carry such finishers, and lacquer may be bought at the five-and-ten-cent store. Rogers lacquer has proved the best, but the beginner should try both lacquers and enamels to determine which give the best results.

After one or two coats of enamel or lacquer have been applied and allowed to dry thoroughly, a final coat of Valspar varnish will provide an

increased luster. After this finish, the proper insignia should be added to the model. (See Chapter 14.)

The wings are then given their proper numbers, which should be the same as those of the real plane being copied. If a manufacturer's plane is being made, any numbers you wish may be used. (See Chapter 3, "Emblems and License Numbers.")

Propellers are finished with aluminum paint if metal, or if they represent wood propellers, they should be stained oak or mahogany and then given two coats of varnish. All wires, cables, cockpit seats, steps, etc., should also be finished to represent metal.

Cockpits should be finished as shown in Chapter 15.

If the solid wood has been covered with tissue or silk, as shown in Chapter 8 under "Solid Fuselage Covering," this is doped and finished as explained under "Built-up, Non-flying Scale Models" in this chapter.

BUILT-UP, NON-FLYING SCALE MODELS. The object of these models is the same as that of solid scale models. Their framework construction, however, gives them a closer resemblance to real planes than solid models, because the methods employed to build them come very close to actual airplane construction.

If tissue has been used for covering, this should be given the usual water-spray. (See Chapter 7, "Wing Covering.") This is followed by clear dope slightly thinned with acetone. All wood parts, such as cowlings, cockpit formers, landing gears, etc., that have been left uncovered should be given two or more coats of clear dope and sandpapered between each.

Lacquer, enamel, or gloss paint is then applied as described under "Solid Scale Models." The tissue will take these coats quite as well as wood parts. When the last coat has dried, Valspar varnish should be applied. Propellers, wires, instrument boards, insignia, license numbers, seats, etc., are finished in the same way as solid scale models.

If the model has been covered with silk, the entire process is exactly the same, except that the undercoating should be clear banana oil without any thinner. This should be carefully applied with a camel hair brush. Use it sparingly, brush it well, and a perfect painting surface will result. If applied too thickly, the oil will penetrate the silk and deposit on its under side.

Silk covering treated in this manner will take enamel, lacquer, or paint splendidly. However, the silk must be water-sprayed before the banana oil is applied.

FLYING SCALE MODELS. Scale models entering endurance contests should not be painted, but as most flying scale model contests are judged by appearance alone, a perfect paint job is usually essential. If the contest

should be one judged on appearance and flying ability, the model should be water-sprayed and finished with colored dope, as this treatment will seldom harm the flying ability of the model. If, however, the model must merely prove that it can fly and then is judged on appearance alone, it should be finished completely. To paint a flying scale model, follow all the instructions given for built-up, non-flying scale models in this chapter. Proof of the flying ability of a scale model simply means it must fly on its own power a few feet, so the builder should test his model, as his finishing job progresses, for such flying ability. One builder known to the author finishes all insignia, license numbers, cockpits, etc., after giving his covering a color doping. The model is then tested. If it flies more than he thinks necessary to prove its ability at the meet, he gives his covering a coat of lacquer, and retests his model. In this way, he obtains a maximum of finish, and his successes at meets indicate the worth of his plan.

Some meets do not require flying scale models to prove their flying ability, and a close study of the rules governing the meet will show the builder such facts. If models are not required actually to fly, all that is necessary is to have the model carry a rubber motor. When this is the case, the model can be finished in the same way as any built-up, non-flying scale model.

Care of detail is most important when giving an exhibition model its final touches. Do not spoil an otherwise splendid building job by stinting work in finishing it. Remember that the paint on a model is the thing that is usually judged, as it has thoroughly covered all construction work.

CHAPTER 14

AIRPLANE INSIGNIA

WHEN building models for exhibition purposes, the painting of names, license numbers or insignia on them is of the utmost importance. Such models are usually judged solely for their resemblance to the real planes they represent, and such details often decide the success or failure of a model. The general painting of models has been covered in Chapter 13, and the painting of license numbers is explained in Chapter 3.

When building any model of a real plane, the builder should do so with the aid of photographs of the plane which show the proper positions of all insignia. As these locations often differ among planes, it would be impossible to give individual data on each one. Photographs can usually be found in aviation magazines or newspapers. Others can be obtained direct from the manufacturers.

Unfortunately, while such photographs show the location of the insignia, they seldom appear large enough to give detail. For this reason 120 of the most popular and interesting insignia are reproduced here. Each is an exact copy of the one appearing on the real plane, and they represent manufacturers, transport lines, individuals, and countries, as well as war and peace fighting squadrons.

It must be remembered that many planes carry insignia of the manufacturer as well as that of the transport company, squadron, or individual owner.

Two methods are used for transferring such designs to models. The experienced expert with a steady hand can paint them directly on the model, but the beginner should not attempt to do so, as he might ruin an otherwise perfect model. An easier method is to make an exact copy of the insignia on paper, using light pencil lines for its outline. This is then filled in and completed with colored inks or paints. When dry, cut out the design and glue it in position on the fuselage of the model. Its edges should then be touched up with paint the color of the surrounding area. As the majority of insignia are in black and white, much of the work can be done with black ink or paint.

The illustrations have been numbered, and are listed alphabetically under "Aircraft Manufacturers," "Transport Lines," "Miscellaneous" and "Military." Under the latter will be found such divisions as "Attack Groups," "Bombardment Groups," "Pursuit Groups," "Aero Squadrons," "Navy Squadrons," etc.

AIRCRAFT MANUFACTURERS

TRANSPORT LINES

MISCELLANEOUS

AMERICAN MILITARY INSIGNIA

MODERN ARMY INSIGNIA

MODERN NAVY INSIGNIA

AIRPLANE INSIGNIA

WAR-TIME INSIGNIA

BRITISH MILITARY INSIGNIA

GERMAN MILITARY INSIGNIA

FIGURE 77. AIRPLANE INSIGNIA, 1

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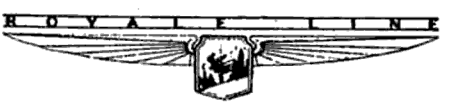

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FIGURE 78. AIRPLANE INSIGNIA, 2

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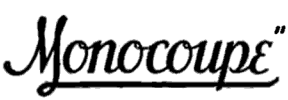

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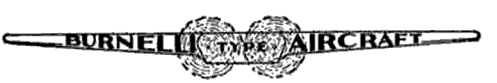

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FIGURE 79. AIRPLANE INSIGNIA, 3

FIGURE 80. AIRPLANE INSIGNIA, 4

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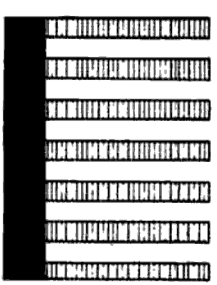

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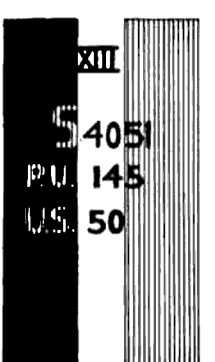

63 LOCKHEED SIRIUS

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FIGURE 81. AIRPLANE INSIGNIA, 5

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FIGURE 82. AIRPLANE INSIGNIA, 6

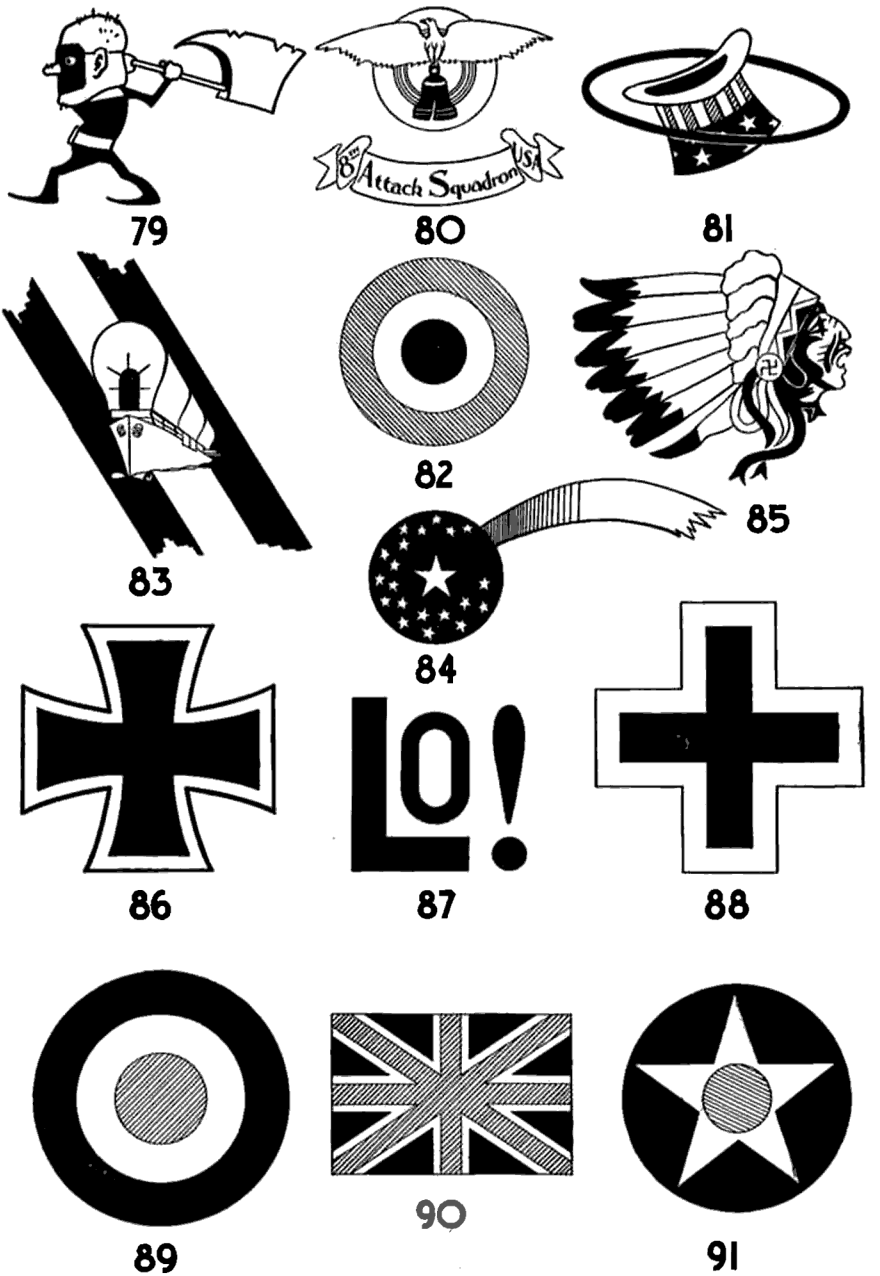

FIGURE 83. AIRPLANE INSIGNIA, 7

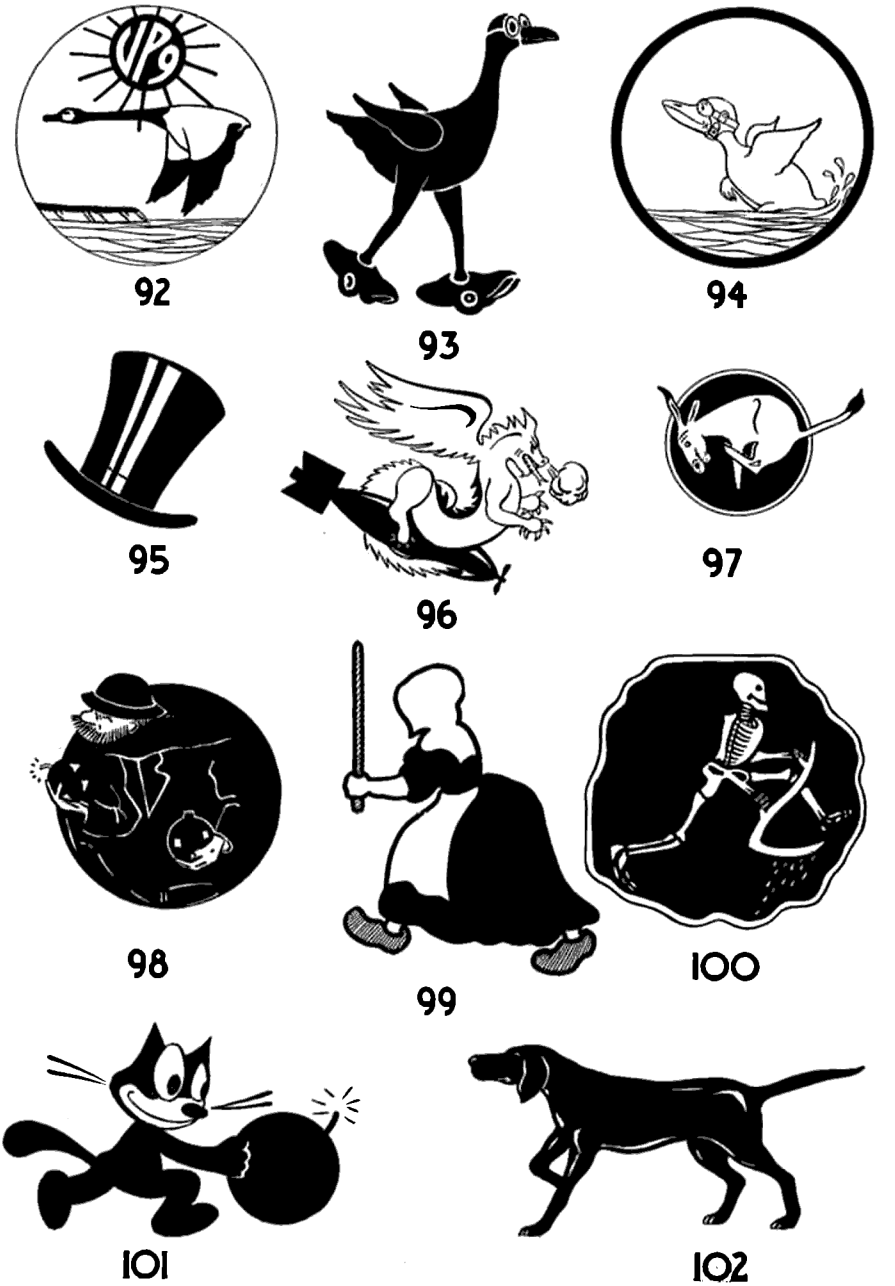

FIGURE 84. AIRPLANE INSIGNIA, 8

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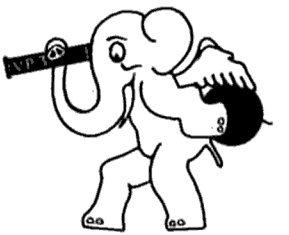

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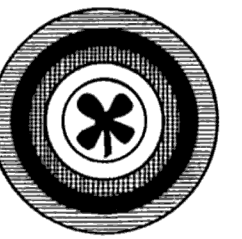

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FIGURE 85. AIRPLANE INSIGNIA, 9

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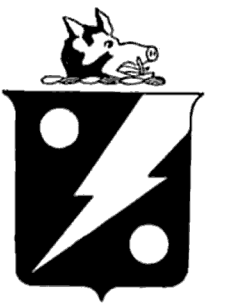

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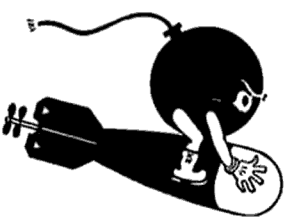

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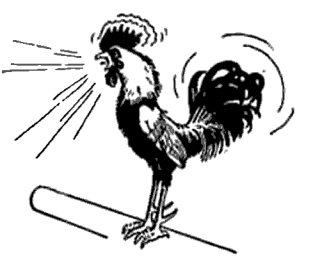

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FIGURE 86. AIRPLANE INSIGNIA, 10