Driggs, Aeronca and many others use the familiar triangular fuselage aft of the wing. Long has adapted it again in this latest version of what he believes a good lightplane should be, and the beautiful result is apparent in this photo. Note the sweet lines, the apparently rugged undercarriage, and balanced rudder.

THE HENDERSON LONGSTER

The designer of the famous Anzani Longster, one of Modern Mechanix and Inventions' most popular designs, comes through with his promised version of the Longster lightened for Henderson use. The ship is remarkable for stability and flyability.

By LES LONG

After the rather surprising success we had with the Anzani Longster, it was probably only natural that we should turn to the popular little Henderson as the power plant for a still lighter and cheaper Longster. This little engine undoubtedly holds first place in the affections of the lightplane clan, and well may it do so.

The Henderson is undoubtedly a little low in power for the average amateur ship, said ship generally having a tendency to run into pounds. However, we decided to make a try at it and the results were far more than we had hoped for.

This new ship has about everything that could be asked for in a real lightplane. It is reasonably fast, 75 mph at 2,850. It has a good steep climbing angle and keeps right on climbing, seeming to do as well at 4,000 ft. as near the ground. It lands at exactly 25 mph in still air, measured by cars running along beside it.

Its gliding angle is fully 12 to 1. You should hear the pilot talking to his friends on the ground. It rolls, banks, zooms and does wing-overs with such apparent ease it is a joy to watch. As to stability we can only say that it has been flying for two months, most of the flying being done by beginners, and has never made a bad landing nor damaged so much as a bolt or flying wire. Parasol type planes are notoriously easy to land. It will fly for miles with the controls entirely free, and will right itself from any position.

As to power we can say that we fly the ship regularly with the motor turning 2,100 to 2,200. It will actually climb with the engine running 1,900, believe it or not. This is with a propeller of 4 ft. 10 in. diameter and 30 in. pitch. This prop turns 2,950 at full throttle, which certainly leaves plenty of reserve.

As is customary, we shall start out with the wings. The ribs are the usual strut and gusset type, the rib stock being 1/4 square spruce and the gussets 1/16 plywood, birch preferred. Make up the usual rib jig on a smooth board, being careful about accuracy. The curve is the standard Clark Y. Instead of nailing one side at a time it is
best to place gussets with glue applied on both sides of the joint and nail clear through, clinching the nails after removing from the jig. Use casein glue and ¼ by 20 ga. nails. Note that the aileron ribs are slightly different, the little strut to the rear of the rear beam opening being set back is shown by the dotted line. Count your ribs carefully to avoid duplication of effort.

**Spars**

The spars are of the I beam type and are of selected spruce. It is best to have them cut and routed at a planing mill, although they may be built up with 1 in. by 20 ga. nails and glue if desired. In any case be sure the wood is free from all defects, including crooked grain.

When the spars and ribs are ready assemble them, taking care that the aileron ribs are in their proper location. The butt rib is a special one, made up with ½ by ½ caps and one side covered with ¼ plywood. The reinforcing blocks must now be placed. They are all of ⅛ plywood, except at the wing butt. The long ones at the flying wire position are notched as shown and the others are plain blocks, 4 in. long and of the proper height to fit in between the spar flanges. Blocks are placed on both sides of the spar, glue being applied first.

**Butt Blocks**

The blocks at the butt are special and require a little explanation. It will be seen that the wing hinges of one wing straddle the hinges on the other, and must therefore be farther apart. We will choose that the hinges on the left wing have the wider separation, therefore the plywood on the four spars will be as follows:

On the right front spar the plywood is ⅛ thick, one on each side. This separates the straps ⅛ in. On the right rear spar the plywood is ¾, making a spacing of ¾ also. On the left front spar the plywood is ½ thick, and on the left rear spar it is ⅛, which separates the straps on these beams ⅛ in. Therefore, the straps on the left wing will just straddle the straps on the right wing. This sounds worse than it really is, as the drawings will show.

**Bracing**

The drag bracing comes next. The wire is No. 12 hard aircraft wire and the turnbuckles are No. 325. The compression ribs are the regular ribs, but with a ¾ in. by ¾ in. spruce strip nailed and glued on each side. The ends of these strips butt up squarely against the wire pulls. The pulls are slipped in between the rib strut and the reinforcing block on the spar, and are bolted firmly with ¼ in. aircraft bolts. The main compression ribs at the flying wire location are like the others, but have ¾ in. by ⅛ in. strips on the sides and also have an extra cap strip nailed and glued on each...
Spruce spars with cheek girders form the Long idea of built-up spar construction. Light, very strong and good.

Here we see the method in which Long trusses the fuselage. Note placing of fittings and way in which ⅛ in. by ⅛ in. spruce fairing is placed about the turtle back. Fittings for tail skid and stabilizer are shown in the detail at lower right hand corner.
There's nothing radical in the construction of the stabilizer and the rudder. The rudder is of steel, and the stabilizer of wood, flat plate type. Drag struts of \( \frac{3}{8} \) in. by \( \frac{1}{8} \) in. spruce stiffen the stabilizer. Leading edges are of steel tubing.

No long waits for the ship to gather headway and roll a mile before she's off! The Longster jumps into the air on short notice and flies strongly. She has been rolled, winged over without difficulty and is thoroughly afloat.

Any man who makes a bad landing with this ship should not fly at all. Visibility is par excellence, and the wide spread gear will tend to prevent shock and ground loops.

Side of the regular caps, top and bottom. The wire pulls here and at the butt rib are small ones as shown by dotted lines.

True the wing up perfectly square and straight and safety the turnbuckles. The ribs may now be nailed and glued to the spars, using 1 in. by 20 ga. nails. Shape the nose piece of light cedar or balsa and fasten with No. 3 by 1 in. screws and glue. Shape the two aileron spars and slip into place, after which they are glued and nailed. Apply the wing tip and trailing edge, using 22 ga. copper for the straps. After the straps are firmly nailed solder them to the tubing and also run solder over the nails. The aileron may now be cut out. It should be fitted with 3/16 in. eyebolt hinges and the horn should be made up and bolted on as shown.

The 1/4 in. square filling strips between ribs on the aileron and also on the rear beam at the aileron location are glued and nailed in. The two main pulleys are about 3 in. diameter and are mounted as shown, the brackets being made up of 16 ga. sheet. Be sure the pulleys line up and run free. They must also be fitted with light aluminum guards so that the cables cannot jump off. The small pulley is mounted about 10 in. in from the butt rib and is about 1 1/2 in. diameter. It runs on a plain stud bearing which goes through the spar.

The corner braces are next fitted in and the
Here's your rib pattern, in decimals of an inch if you are that fussy. This is accurate, as it was drawn full size.

The Driggs Dart, Aeronea and others have used the triangular type fuselage with high success. The Long type of fuselage fitting and station brazing is well depicted in this drawing, which is fully dimensioned.
little windows at the flying wire location are made up of \( \frac{3}{8} \) in. square stock. These window outlines are on the bottom of the wing only. The wing is now to be given two coats of clear spar varnish, covering wood and metal thoroughly. After it is dry it is covered with light airplane fabric, stitched and taped in the usual way. Give the fabric four coats of clear dope and two coats of colored dope or lacquer to suit your fancy. The Longster is finished throughout in silver with scarlet border striping. The completed wing should weigh between 33 and 35 lbs.

The next thing in order is the tail group. The drawings show the dimensions and sizes clearly so that little trouble should be had in building. The stabilizer is the usual wood construction with steel tube outline and the fin is of the same type. The elevators and rudder are of Chrome molybdenum tubing. You may either use the “braze and gusset” method as we do, or have them welded up. If you use gussets they should be of 20 ga. sheet. While the photographs show the rudder horn above the fuselage this was altered after the photos were taken, the horn being placed lower as shown in the drawings, making a much neater job. All hinges are of the 3/16 eyebolt type, bolted to the wood members and brazed to the tubing. Cover and finish as usual.

**Driggs Type Fuselage**

We now come to the fuselage. The design is the triangular type used in the Driggs Dart and the Aeronca. It is the lightest and cheapest possible to make. Before starting this we suggest that you get a copy of the 1931 Flying Manual. The article on the Anzani Longster gives a complete description of the joint used in the fuselage construction. Briefly, these joints are made by tack brazing the tubing together and then putting on a sheet steel gusset which is pinned to the tubing with small steel nails and the whole joint carefully brazed over. In three years use of this type of joint we have never had a single failure. The thickness of the gusset plate should always equal the wall thickness of the heaviest tubing in the joint group. If you prefer, the whole job may be welded up by a professional welder, but the tubing may not be as strong as in the above method.

You may construct this fuselage without a jig if you are careful. We did it. If welding is used a jig will be almost necessary. In any case make up the bottom first, tacking in all the cross and diagonal struts. Be sure to place the discs for the landing gear. Note that all struts that strike these discs are split with a hacksaw and slipped down over them up to the longeron. After the bottom is finished line up the top longeron and put in the side struts, working from a base line as shown.

Before the cabane struts are fastened to the top longeron you must see that the steel pieces for the wing attachments are slipped on. Steel discs like the ones on the lower longerons are also to be slipped on the stub longerons which form the top of the cockpit. These are for the top of the
landing gear struts. Check for squareness frequently as you finish up the fuselage. The bracing in station No. 1 is put in by flattening the members in the center, after which they are bent and arranged as shown. This arrangement allows full swing for the rudder bar. The support for the rudder bar is also attached to the flattened joint, the other end of the support being welded to the lower fuselage diagonals where they cross.

**Motor Mount**

The motor bearers are ash or birch and care must be taken to see that they are true and parallel with the imaginary base line. At station 2, corner braces are set in as shown to stiffen the fuselage against landing strains.

The landing gear should next be made up. It is similar to that used in the Driggs Dart and has proved quite satisfactory. The axle is 14 ga. and all the other tubing in the gear is 20 ga., all of chrome molybdenum. The stubs must be carefully welded to the rest of the axle and all joints in the gear must be reinforced by gusset plates. The rubber discs are 2\(\frac{1}{4}\) in. diameter by 1\(\frac{1}{4}\) in. thick and may be bought from any supply house.

The control system and seat must now be put in. The seat is of 1\(\frac{1}{4}\) in. plywood and is placed on three 3\(\frac{1}{4}\) in. by 1\(\frac{1}{4}\) in. spruce stringers strapped to the lower longerons. This seat extends half the length of the cockpit and the balance is also 1\(\frac{1}{4}\) in. plywood applied directly to the longerons. The next station forward is also floored in the same way. The stick is hinged to the center of the lower cockpit cross strut as shown. This causes the lower end of the stick to project below the fuselage a trifle, but is the simplest possible arrangement. The upper cable from the stick goes directly under the seat, the front stringer having a fiber plate screwed to it through which the cable runs easily. The lower cable slants up and goes through a similar bearing in the rear stringer. All cable except rudder cable is 3/32 in. flexible control cable. The elevator cables are made double for the rear half of their length, each of the four ends going to its respective elevator horn.

The aileron cables run from the stick to small, wide-groove pulleys at the lower corner of the cockpit, thence straight up into the wing and thence through the pulleys to the lower aileron horns. The cables must have been placed in the wing before covering. The return cable runs through the nose ribs, with a shackle splice at the space between the two wings. The rudder cables
are 1/16 in., and run from the rudder bar back through fiber tube guides about 3 in. long which are securely taped to the fuselage struts, and to the rudder horns.

The fuselage fairing consists of two 5/8 in. by 3/8 in. spruce sticks which run from the top of station 4 to the two rear cabane struts, per dotted lines, and two long pieces, 1/4 in. by 3/8 in. which run from the upper rear corners of the cockpit back along the center of the fuselage to station 6. They are held out by cross pieces of the same material which are taped to the vertical struts. The whole job should now be given a couple of coats of metallic paint. The running gear should be streamlined with cedar or balsa which is shaped and taped on and then enameled to suit your fancy. We used glossy black.

Skid Is Ford Leaf

Cover the fuselage by stitching and by tacking to nailing strips which have been taped to station 1. Tape and dope as before. The running gear may now be fastened on and the tail skid placed. The skid is a standard Ford spring leaf. The wings may now be fastened on. It is best to place a high horse under the tip of each wing, blocking them up until they set at the proper dihedral angle, about 1 1/2 deg. You will note that the pylon is held by the main wing bolts. The pylon is best made of 3/8 in. by 18 ga. chrome-moly and should be streamlined.

HENDERSON LONGSTER SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Unit</th>
<th>Value</th>
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<tbody>
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<td>Span</td>
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<tr>
<td>Length</td>
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<td>Chord</td>
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<tr>
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</tr>
<tr>
<td>Weight Fully Loaded</td>
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APPROXIMATE COST OF MATERIAL FOR HENDERSON LONGSTER

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Steel Tubing at 22c</td>
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<tr>
<td>Fabric at 20c</td>
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<tr>
<td>Varnish, Lacquer, etc.</td>
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<tr>
<td>Wire, Turnbuckles, Bolts, Fittings</td>
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<td>10.00</td>
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<td>Miscellaneous</td>
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All the flying and landing wires are 1/8 in., 19-strand aircraft cord. The turnbuckles are No. 326 or larger. Cut the landing wires first, taking great care to get them the correct length. The turnbuckles are at the pylon end. The method of attaching the wires to the wing spars is original with us, so far as we know. It has the advantage of great simplicity and lightness. Eyes are made

Readers who remember the Driggs Dart, plans for which ran in the 1931 Flying Manual, will see the familiar spread strut above which was considered radical even as short a while ago as the Driggs. The rubber shock discs have little recoil and are better than shock cord. The axle stub must be very carefully welded.
Here's the way the wings are "grafted" to the pylon clevis. There is 1\(\frac{1}{2}\) deg. dihedral, rigged as shown. The 2-gallon gas tank sits in the pylon V and is enough fuel for two hours extended flying. Gravity feed is used.

In the ends of the cables, using regular thimbles for the purpose, and the bolts pass directly through these and the spar, with a washer next to the bolt head and nut. The upper bolt of the fitting takes only the landing wire. The lower bolt takes two flying wires, one on each side of the spar. The bolts are put in place through the little windows in the wing, which are then covered with pyralin attached with small brass screws. Place heavy canvas discs around the wires where you have pierced the fabric for them to enter the wing.

Place the tail group in position, using No. 14 hard wire and 324 turnbuckles where wire braced, and \(\frac{1}{2}\) in. by 22 ga. steel tube for the little diagonal struts. True the tail up square and neat, keeping the stabilizer chord parallel with the top longeron.

The power plant is the final task. No doubt you have made a preliminary fit on the engine and it should now be permanently bolted down, and
The pilot puts one leg in the cockpit, runs himself across the longerons with head on one side, draws in the other foot, and there he is. Note the gas tank just over the center section leading edge, holding two gallons of gas.

Another view which shows the exceptionally clean little ship. One can gain an idea from this what slight drag there is. This is a requisite when light power, such as the Henderson is used. Henderson motors have often been very greatly over-rated as to power and require careful designing, but are reliable plants.

the bolts carefully cottered. The throttle, switch, tachometer, choke and oil pressure leads are brought back to the dash, which is of ¼ in. plywood. This dash is attached to the front sides of the cabane struts with aluminum clips, and is made with slightly rounding sides and rounded top. It should be finished in black or aluminum. The cowling is not as hard to make as on most jobs. While it is very hard to explain just what to do, a little experimenting with paper patterns will make it easy. A bulkhead of the same height as the dash, but narrower, is placed just back of the motor and fastened to the tubing with 20 ga. aluminum clips. The top cowling is simply a large sheet of 22 or 24 ga. aluminum bent down over the dash and bulkhead and is held to them with roundhead, nicked screws. It is held along the sides by machine screws passing through aluminum clips around the longerons. The lower part of the cowling is another large sheet which is bent up from below. The rear edge is screwed to a nailing strip which has been taped to the lower member of station 1. The front corners are screwed to the motor bearings and the sides are screwed to the nailing strips at station 1. On the left side a piece is put on to form the air scoop as shown in the photos. This should be readily detachable.

As to the fuel tank you may use your own judgment. A cowl tank would be best, but we had trouble with the long intake manifold necessary, but hope to work this out later. The tank we use is a simple flat job that rests on the top longeron between the pylon struts. It is the thickness of the spacing between the wing butts, and holds 2 gal. It is light and simple and holds enough gas for 1½ hours flying. The gas line comes down from the rear end, passing along the side of the cockpit and to the carburetor. A shut-off valve should be placed in the line.

In building this ship your first thought must always be for safety. Every bolt must be cottered. Every joint a perfect one. Don't leave anything to chance. While the description is naturally only a general one it should enable anyone with some knowledge of lightplanes to make a real ship.

And this makes your ship, when finished and painted and doped to please you.

We have a surprise in store for you next month. I have developed an engine made out of Harley Davidson parts that is a honey, and no maybe. She can be built by anybody, and I can furnish crankcases. She is a twin opposed job, and yanks these little wagons into the air right now, without a long overland grind.

There is a magneto for ignition, carburetor, of course, and a lot of perfectly obvious junk on her but she is cheap, and flies with a roar, and cannot be killed. The heart of any motor, aside from the crankshaft, is its lungs and the Harley lung is a world beater — you know that.

So until next issue, it's adios, and we'll see you in a good game over the motor, eh? • • •