A Design For Power Soaring

By ELTON H. ROWLEY

My ideas for a power glider were not conceived recently, but have been under consideration since 1930, although not until after learning to fly in 1933 did I contemplate seriously the merits of power soaring as a sport. Since then, I have had an intense interest in soaring, but at first the effort involved in getting into the air and staying aloft any reasonable length of time seemed out of proportion to the benefits derived. However, after having had some soaring time, my interests were temporarily diverted from the power aspect. Consequently, in 1938, I decided to build a glider. I resolved upon an intermediate class because of the ease of building the ship and the practicality of it in general as a starter. It was completed in 1941, and was flown successfully many times. But because of the inadequacies of the soaring sites available in my locality, the idea of power soaring again took root. Therefore, it was decided to attach an engine installation to this ship that was already built.

Among the first items considered were the type of power plant, whether two-cycle or four-cycle, and the power required, etc. An investigation of power plants available for purchase disclosed two possibilities: (1) A four-cylinder, two-cycle engine manufactured by a West Coast company; and (2) Revamping a two-cylinder outboard racing engine from liquid-cooled to air-cooled. Delivery on the former was impossible within a reasonable length of time and the work required to build new cylinders for the outboard would be no easy task; and in either case the result would be a two-cycle engine, which has been reputedly unreliable. Therefore, it was decided to design and build a four-cycle engine. A great deal of thought was given to the procedure and method of flying power gliders, and as a result such questions arose as: Should there be power enough available for takeoff within a reasonable distance? Should it be possible to stop and start the engine in the air? What could be done to the propeller to minimize drag when the engine was stopped? It was concluded that the following requirements were advisable:

1. An engine with sufficient power to get the ship off in 500 feet with no wind and that would give an initial climb of approximately 200 to 300 feet a minute.

2. A hand starter that would start the engine in flight by a method similar to that used in outboard motors.

3. An automatic propeller that would fold when stopped and unfold when started.

4. Fuel capacity for at least one hour at 60% power.

5. A unit sufficiently light weight, including fuel and oil, the installation of which would not exceed the ship's required margin of safety.

6. A landing gear satisfactory for ground handling that would not appreciably increase drag or weight.

7. A device which would enable detachment of the complete power unit as easily as one would take an outboard motor from a fishing boat, thus making it possible to fly the glider without power when extremely good thermal conditions or slope soaring was available.

It might be well at this point to expand on the subject of the power plant, that is, how to get 15 to 20 horsepower from a four-cycle engine with a weight not in excess of 40 pounds. First, the number of cylinders, total displacement and cylinder arrangement were considered. The final decision was an opposed twin with a 40 cubic inch displacement; the bore was three and one-sixteenth and the stroke was two and three-quarters. The opposed cylinder arrangement seemed to lend itself to reducing the size of the engine, which is, of course, a basic consideration in cutting down weight. Also the opposed arrangement for the particular installation in mind had advantages in mounting and cooling.

Second, to obtain maximum horsepower without supercharging or any other weight consuming ideas, it was decided to turn the engine a maximum of 5,000 r.p.m. and gear it 2 to 1 with a compression ratio approximately 7 to 1, making it necessary to use 90 or 100 octane fuel. Another consideration was whether the valve arrangement should be L-head or overhead. To cut down the width of the engine, it was decided to use the L-head type. Again this no doubt had weight saving advantages.

Then the matter of cooling came under consideration. In view of the fact that the installation was to be of the pusher type, it was decided to have complete cylinder housing and baffling and a centrifugal blower, and also as an added aid to cooling to have an exhaust with a rearward emission through a venturi outlet in the cylinder housing. This arrangement no doubt would also increase the thrust two to three per cent. Many tricks in the automotive racing field brought forth valve timing with a great overlap of exhaust and intake valve opening, and ignition timing advanced as much as 40° before top center. The above should produce an engine that would develop 20 horsepower for takeoff and, because of adequate cooling, would be able to hold that power from three to five minutes.

The next item to warrant detailed discussion no doubt should be the propeller. Several ideas along this line were thoroughly investigated, such as a clutch to disengage the propeller from the engine, thereby allowing the propeller to windmill to reduce drag. However, the weight and complexity were considered to be as great as that of a folding propeller, which would necessarily have a considerable mechanism. Finally the design arrived at was a two-bladed automatic folding pro-