The same location may be used for the combustion chamber in case of jet-propulsion. The gasoline tanks may be put inside the wings or the fuselage. It is difficult to answer the question of whether to use rocket or substitute jet propulsion. Powder rockets may be simpler to install and operate but there is no control after the charge is ignited. After the charge is spent, there is hardly any weight left.

Jet propulsion calls for a more elaborate installation and is more difficult to operate but the motor can be controlled. When the fuel is exhausted, there is still the additional weight of the combustion chamber.

Some Russian authors maintain that powder-rockets will not find application in those cases in which a long time of operation is necessary, but may find application in cases in which a short time of operation is required as in take-off. In order to have some idea about the weight of fuel needed in each of the cases, mentioned above, the results of the calculation of the size and weight of powder-rockets are given. The odd numerical values result from converting the original calculations which were in the metric system. Table I refers to land and powdered gliders, Table II to sea and powdered gliders. Black powder was used as the propulsion material. On an average from every square inch cross-section of the powder rocket, a force of 7 lbs. may be obtained.

It is unnecessary to calculate the weight of gasoline for jet-propulsion. The gasoline mixture is very similar in heat content and the velocity of gases as the black powder. Therefore, the masses of exhaust gases in both cases will be equal. The fuel-air by weight for gasoline mixture is equal to 1:13 to 1:18. Consequently, multiplication of the tabulated weights of the black powder in the various cases by this ratio, will give a close approximation of the weight of gasoline in corresponding cases. The question is whether this saving in the weight of fuel may be nullified by the weight of the jet motor and the gasoline tanks. It is apparent that in those cases where the weight of the powder rocket is great, it would be advantageous to use gasoline, since the weight of the jet motor is very small. Dr. Sanger built some models of jet motor, each weighing not more than 1 pound and giving up to 66 lbs. of measured thrust, when petroleum gas, oil and pure oxygen were used. The limitations of this paper do not permit discussion of all details of jet motors.

But one can assume that the problems of the jet motor, and the construction of the combustion chamber and the nozzle are capable of practical solution, that it will be possible to build for gliding purposes, jet-motors of a few pounds of weight.

Some words should be devoted to the problem of the improvement of the coefficient of external efficiency for use in gliders and in aviation generally. Two ways are indicated.

(a) To decrease the velocity of the outflowing gases. The chemist could be of help in developing a slow burning gasoline with the attendant decrease in the velocity of the gases and with a possible increase in the mass because of the added chemicals.

(b) To increase the mass of the outflowing gases by sucking in air from the outside. A multiple Melot's nozzle can be used for this purpose. Although some tests of the multiple Melot's nozzle were performed (Dr. Kort, NACA, etc.) the question has not been answered whether Melot's nozzle may be of advantage or not. Prof. Prandtl in one of his papers stated that the efficiency of Melot's nozzle may be low, because of the mixing of two gases having such highly different velocities causes a great loss in energy. The problem demands more tests, particularly tests of this nozzle in a windtunnel.

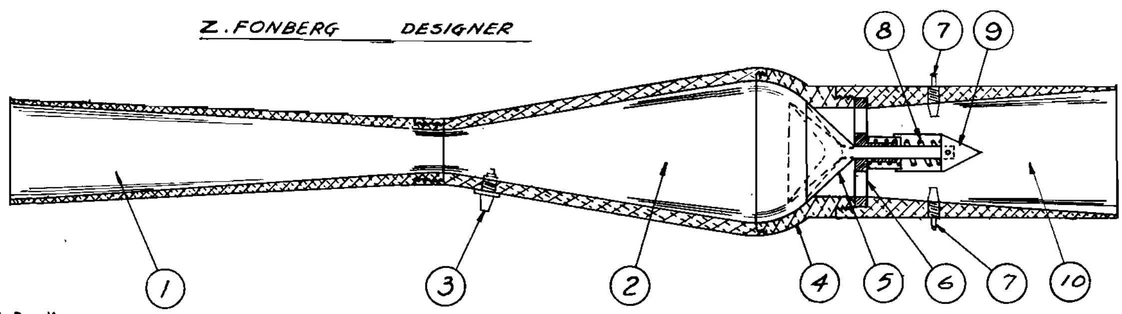
Following are conclusions for gliders with skids:

(1) About 24 lbs. of black powder or 1.5 lbs. of gasoline are needed to assist the take off of a 600 lb. powered glider.

(2) For the take off of a 440 lb. glider on an inclined hill top, about 9 lbs. of black powder or 0.56 lbs. of gasoline are needed.

## — UNIFLOW JET-PROPULSION - ENGINE —

Z. FONBERG DESIGNER




Patent Pending

| SPECIFICATION | | GENERAL DATA | | REMARKS |
|---|---|---|---|---|
| Nº | NAME | LENGTH | 21 1/4 " | WITHOUT MOLÉ NOZZLE |
| 1 | OUTPUT NOZZLE | MAXIMUM DIAMETER | 3 5/8 " | |
| 2 | COMBUSTION CHAMBER | OUTPUT NOZZLE MAXIMUM DIA. | 2 1/8 " | |
| 3 | SPARK PLUG | INTAKE NOZZLE MAXIMUM DIA. | 2 3/8 " | |
| 4 | HEAD | WEIGHT | 9 lb | MADE FROM ALUM. ALLOY |
| 5 | INTAKE VALVE | MAXIMUM REACTIVE FORCE | 15 lb | |
| 6 | GUIDE | MAX. REACTIVE FORCE WITH MOLÉ NOZZLE | 22 lb | MOLÉ NOZZLE NOT SHOWN |
| 7 | FUEL INJECTION NOZZLE | THEORITICAL POWER | 28 H.P | GASOLINE |
| 8 | VALVE SPRING | INTERNAL EFFICIENCY | 24 % | |
| 9 | COVER | MAX. EXTERNAL EFFICIENCY | 92 % | |
| 10 | INTAKE NOZZLE | FUEL CONSUMPTION PER HOUR | 2 1/2 GAL. | LOW OCTANE GASOLINE |