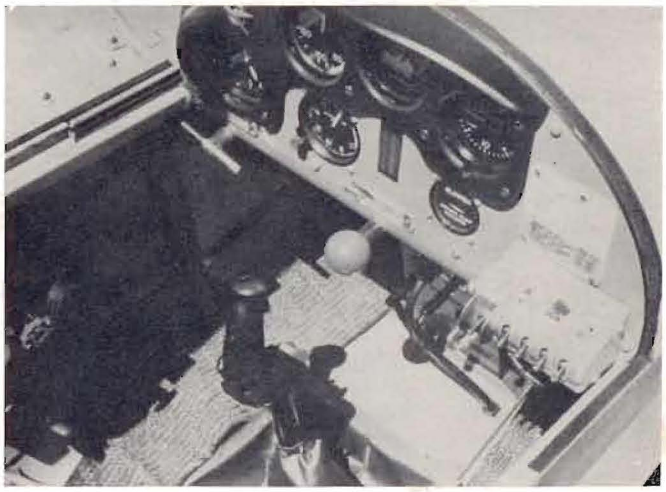

The Schweizer 1-26 built from a kit by Max Dreher of Venice, Calif. Extreme care in construction and fine attention to detail prompted Schweizer Aircraft Corp. to refer to it as the "Queen of the 1-26's" in a letter to the builder.

The cockpit and panel of the 1-26 built by Max Dreher, undoubtedly one of the plushiest on the American scene.

"breathing" rather than expanding, but its small size might make conductivity effects too great. Alternatively, an altitude correction can be made electronically (with some complexity) with the altimeter.

**Turn Direction Information**

If the center of a thermal is warmer than the surroundings, then logically one could measure the temperature difference between the wing tips and so determine which way to turn to head toward the center. Many people have constructed "thermal sniffers," but definite accounts of their successful application are hard to find (see References 16, 17, 18 and 19). The previous discussion of buoyancy points out one problem—a thermal can be buoyant due to water vapor without being warmer inside. When the thermal is warmer, it may be so by only an average of say ½ °C in 1000 meters — a small amount to measure — and yet random turbulent temperature fluctuations exceeding this amount can be present as "noise" on the instrument. Thus following the "thermal sniffer" would have a weak tendency to direct you properly, but with many false instructions included. Finally, when you bank toward an imagined center, the lower wing goes into warmer air -- since the vertical temperature gradient is generally an order of magnitude greater than the horizontal temperature gradient, making the pilot observe a false favorable indication. Reference 20 discusses recent developments with a "thermal sniffer."

There are improvements in tip temperature sensors to overcome some of these problems, but the value of even an ultimate unit is still a question. To eliminate tip speed dynamic heating effect and tip elevation differences, Temple developed a trial system where at each tip the temperature difference between the present time and one second earlier is measured.

Other gradients than temperature may be more meaningful. Consider water vapor content. It may vary by 500 percent across a thermal, while temperature varies only by a fraction of a percent. Near the top of a good "dry" thermal the moisture in the surrounding air may be 2 grams of water per kilogram of air, and 8 grams per kilogram in the thermal center. A fast responding water vapor sensor at each wing tip might thus indicate the direction to the center of the thermal far more reliably than a temperature activated "thermal sniffer" could, even though turbulent fluctuations will still cause lack of reliability. Fast water vapor sensing poses instrumentation difficulties; tiny wet-bulb thermistors are feasible, and several experimental methods show promise.

Other variables could conceivably also be used. Ions, pollutants and conductivity are characteristic of the inside of thermals due to the thermal having its original roots in air representing surface conditions. Thus variations of these could give thermal orientation clues.

The difference in vertical velocity between the wingtips also obviously will show the direction of the thermal center (with some "noise" signal, however). Accurate measurement of the velocity gradient in a sailplane is difficult, although in extreme cases a strong lifting of one wing shows the pilot which way to turn. It seems likely that an instrument indicating this variable qualitatively could be developed, at least for use in straight flight.

**Optimizing Flight Maneuvers**

Some of the factors in maneuvering in thermals have already been discussed. For improving your knowledge of a particular thermal, precision maneuvers are a must. The optimum maneuvers in probing and utilizing the thermal may be rather complicated to compute, as the factors of instrument performance, turn radius, turn time, sailplane performance and control, and drag energy loss should all be considered with respect to meteorological factors.

In the case of true dynamic soaring (getting energy from horizontal or vertical gusts) performance gains are conceptually feasible but actually not practical. This subject is thoroughly covered in Klemperer's classic paper, Reference 21.

For determining the best speed for flight between thermals, the use of an optimum speed selector is now standard. It is based on the downcurrent strength, the sailplane performance curve, and the expected strength of the next upcurrent. With the drag correction device built into a total energy variometer the speed selector can be redesigned and will immediately indicate the optimum speed (rather than indicating just faster or slower) and so permit faster and more decisive flight corrections (see References 10 and 22). Various mechanisms can be constructed to make the indication even more readily available to the pilot — say having optimum speed indicated as a second needle on the airspeed indicator — and in the ultimate a servo could even be made to supplant the pilot. Reference 23 cites an automated approach.

In any case, in rough air the ef-