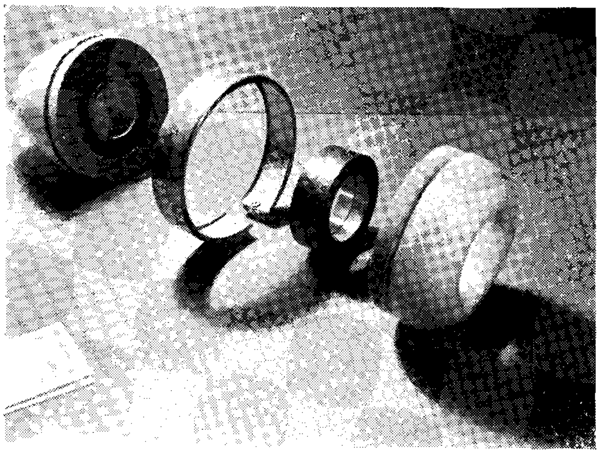
THERMAL SNIFFERS

by Mabel Raspet

THE THERMAL GRADIOMETER FOR DETECTING VERTICAL CONVECTION IN THE ATMOSPHERE



Components of Model No. I Sniffer

Of the many physical properties which can be used to delineate the structure of our invisible atmosphere, the most direct is that of temperature measurement. All other variations in physical properties are the result of temperature differences. It is the change in density of the air with respect to the surrounding air that causes vertical convection.

The measurement of temperature is, however, complicated by the fact that air temperature varies not only in space but also with time. If one is, therefore, to obtain reliable data from such measurements alone, which will lead to the interpretation of the air structure, one must record the temperature at a large number of points simultaneously. One might get a fairly accurate picture of the air structure if he were to record the temperature in the form of a curve plotting temperature against time. One would thus know what discontinuities he has passed thru and could thus predict the location of convection ahead. It is such a method that has been tried in Germany utilizing very sensitive thermometers. For such a technique it is extremely important that the lag of the thermometer be kept very small for otherwise the readings would not indicate the transient temperature but, rather, an average of the values passed thru. Another serious handicap is the fact that, if the period of the thermometer is 30 seconds, the sailplane will have flown 2500 feet before the instrument indication is made evident. In order to secure information on small structures such as thermals, the thermometer would have a sensitivity such that the maximum deflection corresponds to one degree Centigrade. Such an instrument would have for its finest reading 0.01 degrees and would be classed as a precision instrument, entailing as most such instruments do, extremely delicate movements, and would not stand many landings. Since some success has been attained by such a technique, one can immediately see that the additional information of direction of increasing temperature will lead to ease of interpretation.

Fundamentally, temperature is a scalar quantity; measured at one place it yields only a number which is defined on some arbitrary scale. Thus a series of temperature measurements along the line of flight would yield only information on this line, none about the points on either side of the flight path or ahead of it. If one has recorded the temperatures thru which he has passed, he would know the structures behind him, but that to a soaring pilot is no longer interesting.

There is, however, a physical entity called temperature gradient or thermal gradient which yields not only a measure of the stability of the air but also points in the direction of increasing temperature. Sailplanists are familiar with the term vertical lapse rate which is merely the vertical temperature gradient expressed most generally in degrees Centigrade per thousand feet. It is obtained by measuring the slope $\frac{\Delta T}{\Delta h}$ of a plot of temperature vs. altitude.

In order to define the complete temperature gradient there are two other components of it both orthogonal to the lapse rate. These will be defined by the quantities $\frac{\Delta T}{\Delta x}$ and $\frac{\Delta T}{\Delta y}$.

In Fig. 1 is shown a highly idealized plan view of a

(*Continued on page* 13)

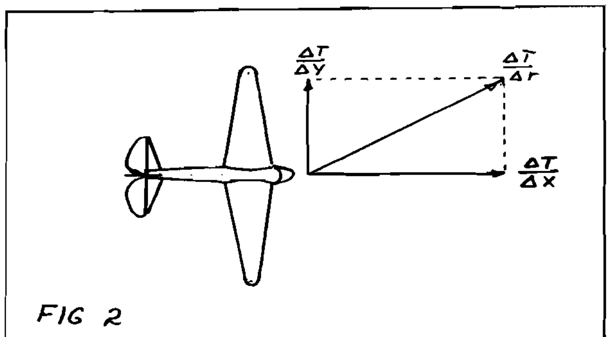


FIG 2

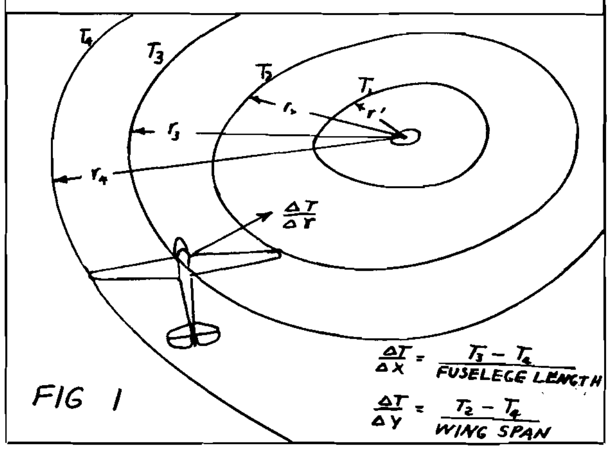


FIG 1