

FORUM

An Inertial Drift Meter

from Robert W. Byerly

THE suggestion in this note is the result of reading D. E. Adams's paper on inertial navigation (this *Journal*, 9, 249) and Captain Maya's paper on dead reckoning (this *Journal*, 10, 84).

The drift meter which I suggest is simply an accelerometer fixed in an airplane to measure lateral accelerations. It is on a transverse line of the airplane passing through the centre of gravity. A single integrator is connected to the accelerometer to give lateral velocity.

With the airplane on course, the drift meter would indicate at once unexpected cross winds such as those mentioned by Captain Maya as a source of danger (this *Journal*, 10, 85). While the drift meter would not detect direct head- or tail-winds, a shift of heading for a few moments would enable it to provide data as to two wind components from which the true wind direction and velocity could be computed. The computation is very simple when the temporary change in heading is 90° . The results of the computations could be tabulated in advance for any lesser convenient temporary change of heading, although a very small shift would make them less accurate.

According to Dr. Adams the greatest difficulty in making a complete inertial navigation device lies in obtaining sufficient accuracy in the gyros which orient the accelerometers. Further difficulty, he suggests, lies in the very large range of acceleration to which the accelerometers and integrators must respond (this *Journal*, 9, 256). Neither of these difficulties would arise in making a device in which the accelerometer is on a fixed line *of the airplane* and responds only to lateral accelerations of the airplane.

Even if the decrease in accuracy with lapse of time, which Dr. Adams found to be a limitation on the use of a complete inertial navigation device (this *Journal*, 9, 255, 258) should apply to the drift meter with its single accelerometer and single integrator, the device would still be useful. Its lateral velocity indication could be corrected at any time by flying in a small square, for on opposite courses the lateral wind drifts must be equal and opposite.

During a turn when the airplane is banked the lateral velocity indicated would not correctly indicate a wind component, as it would be measured at an angle to the horizontal; but the making of a turn should have no effect on the accuracy of lateral velocity indication thereafter. This is because the component of gravity and the component of centrifugal force applied to the accelerometer during a turn would cancel out. Thus the accelerometer would respond only to changes in the component of wind velocity parallel to the transverse line of the airplane on which the accelerometer is mounted.

In saying this I have assumed that there is no side-slip through the air in an airplane which is properly flown. If I am wrong in this, a corrector for side-slip, such as an airspeed indicator set sideways, could be introduced. I believe this is unnecessary, as, for the reason indicated above, the readings of lateral velocity should not in any event be made during turns.

I hope that someone who knows more about accelerometers than I do may follow up this suggestion, as a simple comparatively inexpensive inertial drift meter would determine the one unknown factor—wind—which now makes airplane dead reckoning uncertain and sometimes dangerous.

Mr. W. A. W. Fox comments:

If the above proposals have been interpreted correctly the accelerometer is mounted rigidly in the aircraft so that if one wing drops the component of gravity in the plane of the aircraft floor is registered as a steady acceleration. Quite a small tilt would appear as a serious change of speed (1° held for a minute would register as about 20 m.p.h. change in wind). In a turn the errors built in could be worse. Improvements could be achieved by mounting the accelerometer on some more sophisticated (gyro) platform but it must be accepted that there is no way of distinguishing between a gravitational force and an acceleration except by devices which have a long memory so that they can take the mean direction of gravity over a period long compared with the accelerations likely to be imposed on the craft.

Reviews

METEOROLOGY FOR MARINERS

Meteorology for Mariners. Meteorological Office, cloth 9.5 x 6 in., x, 274, illustrated, H.M. Stationery Office 1956, 20s.

The Head of the Marine Branch of the Meteorological Office has had a particularly difficult problem to solve in preparing a textbook for mariners and he is to be congratulated on achieving a considerable measure of success. Among the early decisions to be made were, presumably:

- (a) Should the book be written by one person, or by a team of which each member would write on the subjects with which he was most experienced? It is evident that the latter method was adopted, for while many of the chapters are excellent one receives the impression of a collection of essays rather than a harmonious whole.
- (b) How much information should be included, or to what standard should the book be written? It might be argued that as the young officer of the present day has a great deal to learn about many subjects, especially with the increasing use of electronic aids, he should be given a sufficient understanding of the subject to enable him to carry out his duties efficiently. But officers sitting for their Extra-Masters' certificates are, one might say, 'fair game' for the examiners; and it would be to their advantage if not only could they find all they would be likely to need in one book but the examiners themselves might be persuaded not to delve into other books in order to produce a difficult question. Rightly or wrongly, presumably rightly, the latter scheme was decided upon with the result that officers studying for Mates' and Masters' certificates are advised in the 'Foreword' which parts of the book they should read.
- (c) Should the book include guidance on observing and recording weather and on the maintenance and care of instruments or should these aspects be omitted since they had already been very satisfactorily dealt with in the *Marine Observers' Handbook*? The latter alternative was decided upon with the result that the student needs both of these books. This does not necessarily imply further expense because the Handbook is issued free to voluntary observers in merchant ships.

The sections on Ocean Currents, Ice and Oceanography are among the best, though most of the contents are not meteorology and are outside the syllabus