indication; deceleration has the opposite effect. It is important to realize that the attitude indicator only approximates actual aircraft attitude. However, pilots have traditionally relied excessively on the instrument, occasionally finding themselves helpless without it. Once, when flying over Atlanta on a clear morning I chanced to overhear a student pilot declare an in-flight emergency. When asked about the problem by air traffic control, the student somewhat shakily explained that his attitude indicator had just failed and he was lost over the city on his first solo flight. The controller in the tower had to explain to him that he could parallel the airplane's wing struts with the ground to make turns and he would be safe.

## Heading Indicator

The purpose of the heading indicator, diagramed in Figure 2-12, is to provide the pilot with stable heading information because the free-floating magnetic compass is unreliable under any conditions other than straight-and-level, unaccelerated flight.

The heading indicator, which is not a magnetic-north-seeking instrument, must be set to a compass. The instrument needs to be reset periodically due to both random and apparent drift. Random drift is caused by bearing friction and slight imbalances in the gyro and its gimbals. Apparent drift is caused by several things. The rotation of the earth is responsible for some of the apparent drift. At the equator there is zero effect, but as the aircraft operates farther and farther away from the equator, the drift increases until at the north and south poles there is as much as l5 degrees of drift per hour.

A second cause of apparent drift is the aircraft changing positions over the earth. To minimize this, the instrument technician balances the gimbal rings to compensate for local drift. If the aircraft is flown to the opposite hemisphere, or even a different part of the country, the error may become quite pronounced. Changes in excess of 50 degrees latitude necessitate recalibration of the instrument.

It is worth noting that checking for precession (drift) is not quite as simple as one might think. The average pilot will set the heading indicator before takeoff and check it against the magnetic compass approximately every 15 minutes. Based on the comparison, the pilot makes a judgment as to the instrument's accuracy. Unfortunately, it is an inappropriate test.

To accurately check for gyroscopic precession, the pilot should turn the aircraft to the same heading used to set the heading indicator originally. This is because compass deviation varies with heading and the error you may see could be the result of a different compass deviation at the present heading. Yet another problem is compass variation—the result of crossing isogonic lines. If you are flying cross-country, this should definitely be taken into account when calculating the amount of precession.

For the pilot fortunate enough to have a synchronized gyro, there is no need to worry about precession. The gyroscopic heading indicator is electromechanically "slaved" to a magnetic sensing element. Remotely mounted, typically in the wing tip, the element is isolated from local magnetic disturbances. This provides a constant magnetic update to the gyro, preventing precession and precluding the need to reset the indicator after engine start.