Altimeter Reading

Errol Billing

I had just taken my new altimeter out of the box and my little voice was already saying what it says whenever I get a new precision device like that. "I wonder what's inside this puppy." I am fortunate that my little voice comes complete with its own little voice that immediately shouts overtop this comment, "Don't even think about it, fool."

With any luck at all my little voices are a cool, macho guy thing and not just garden variety insanity.

The upshot of that little conversation was that instead of my tool kit I reached for my laptop, with which I Googled a bunch of queries about altimeters, hoping to get a virtual look at what's in that nice little case. What I came up with instead was a minor epiphany.

Though numerous websites define an altimeter in much the same way, as "An instrument for measuring altitudes or elevations with respect to a reference level, usually mean sea level." they also tacitly admit that there is actually no such thing as an 'altimeter' such as we use for skydiving.

More research showed that it's true, there is nothing within a normal humans price range, carrying capacity, or resistance to x-rays and lasers that will measure altitude directly. Instead there are devices that measure changes in atmospheric pressure and spoof a barometric pressure reading onto an altitude scale.

Yup, all these years you have been relying on a barometer to tell you weather or not it's time to pull (no, it's not misspelled, it's a pun).

Figure 1. Aneroid capsule, top

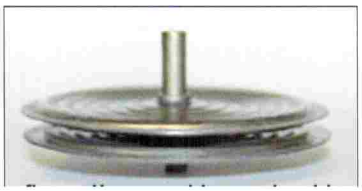

Figure 1b. Aneroid capsule, side

It's a really ingenious piece of slight of hand that works so well and so accurately that the principal is not only used in altimeters, but is also used in precision airspeed indicators, and no one notices.

I'll explain how it works.

Virtually all altimeters and barometers have at their core one or more doohickeys called sylphon cells, more commonly called aneroid capsules (Figure 1 and Figure 1a).

An aneroid capsule is a small, sealed, flexible, usually metal, can inside of which a partial vacuum is created so that small changes in outside air pressure will cause the capsule to expand or contract, and thus increase or decrease the capsules thickness.

The overall thickness of an aneroid capsule is known exactly, and any change in its thickness (caused by changes in surrounding barometric pressure) can be measured and transmitted through a calibrated set of springs and levers to an indicator arm that points to an atmospheric pressure (or altitude) scale printed on a dial face (Figure 2).

If you follow along in Figure 2 you can see how, as altitude increases, the pressure inside an altimeter equalizes to the reduction or increase in pressure around it through a "static air" port in the case. Static air is simply air that is at the same pressure as the air surrounding the instrument and not subject to fluctuations such as those caused by burbles or wind blast. An interesting factoid about static ports is that, if one is precise about the size and shape of the hole, the altimeter can actually be sitting in a burble or direct wind blast and still work fairly well. It has something to do with the stickiness of air as a liquid.

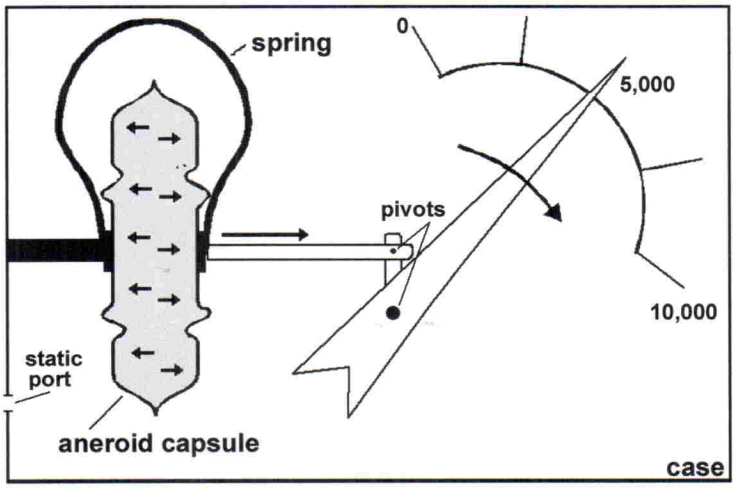

Figure 2

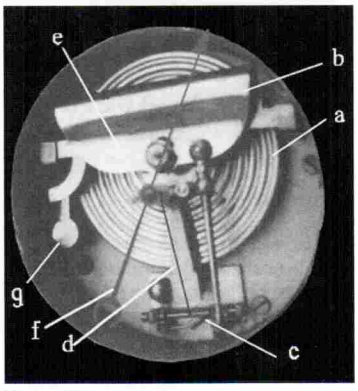

Figure 3

ANYway... as the air pressure in the case lessens the pressure on the aneroid capsule lessens and the can expands against the tension spring. As it expands it pushes on a calibrated linkage that, in turn, rotates the needle across the dial face towards the higher numbers.

Exactly the opposite thing happens when you exit the plane. The pressure against the aneroid capsule increases as you get lower, flexing the can flatter, which pulls on the linkage, which rotates the needle towards the lower numbers.

Simple.

For a photo view of what the insides of a skydiving altimeter look like, see Figure 3.

In that picture you can see (a) the aneroid capsule, (b) the spring, (c) a gizmo (d) a gizmo arm (e) the pivots and linkage, (f) the indicator needle, and (g) a fine calibration adjustor for the capsule.

I'm not exactly sure what the gizmo thingies are because that picture is actually of the inside of a marine barometer. I think they are needle position adjustments, for 'zeroing' the barometer... like you do with your skydiving alti... ummmm... barometer.