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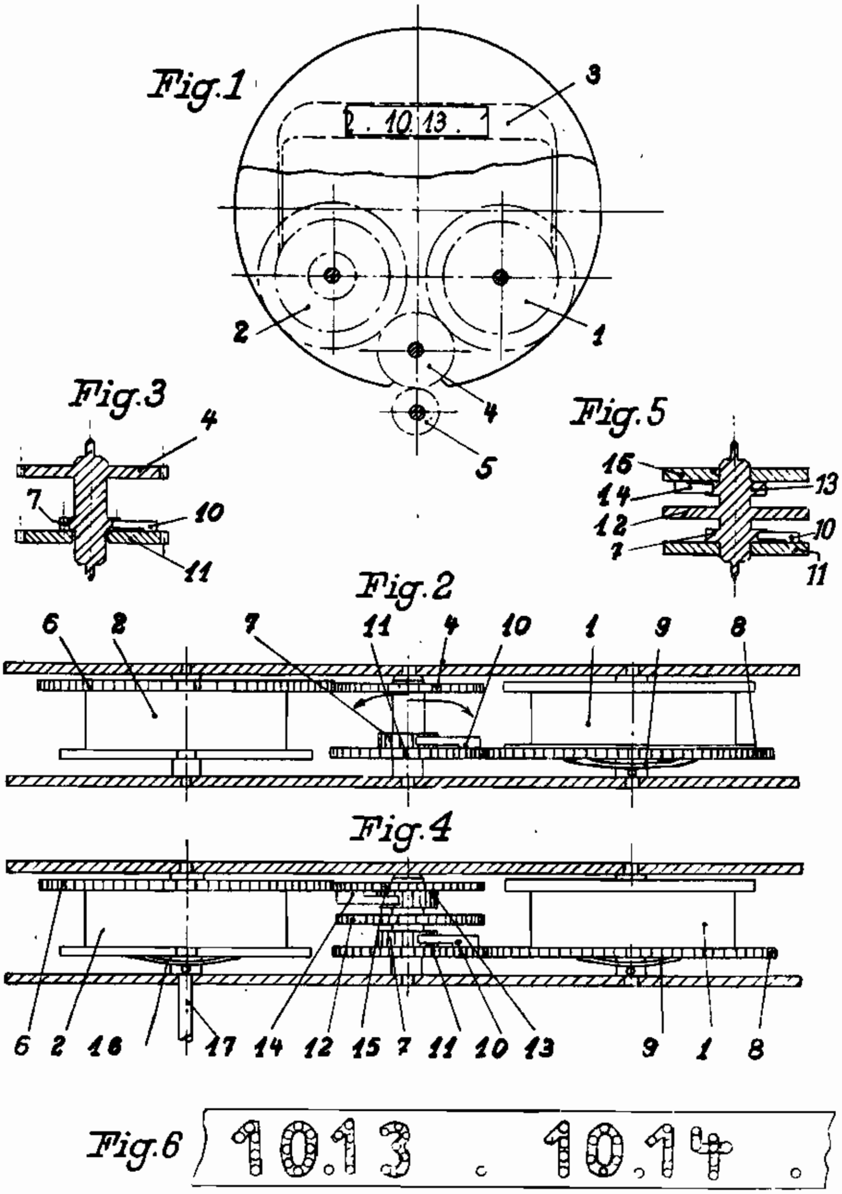

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ALTIMETERS

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The present invention relates to improvements in altimeters, which, as is known, have to be provided with a device for correcting the barometer level existing at any moment. Before reading the instrument a second reference pressure indicator has to be set to the pressure actually existing at ground level, in order that the reading on the altitude scale shall be free of error.

Hitherto the necessary correcting arrangement has generally been constructed with a second scale graduated in millimeters of mercury or millibars and connected with the meter mechanism, which is disposed behind the dial and is read off against a mark through an aperture in the dial. This scale is sufficient for a comparatively small range of pressure variation, such range being characterised roughly by the maximum and minimum barometer levels. But a larger range is becoming increasingly necessary, on account of the fact that landing grounds at considerable altitudes, up to say 2500 m., now come into question. For such altitudes it is necessary for the correction range to be extended considerably, and the difficulty then arises of providing a reference scale of length corresponding to the large pressure range. In addition to being governed by the pressure limits, the length of the scale is also determined by the precision with which the pressure can be adjusted. In this connection one cannot go below a certain minimum degree of accuracy of reading, for example one graduation per millibar, and the spacing of the graduations must be large enough to enable say half a millibar to be estimated with reasonable accuracy. The difficulty here arises that altitude and pressure are connected to one another by a logarithmic function so that the scale of the reference indicator is compressed towards one end.

The invention enables both the range and the accuracy of reading to be increased as much as is desired. The chief new principle upon which the invention is based consists in using a thin tape as a carrier for the reference pressure scale. This tape is wound onto two coiling elements or spools, between which it can be wound to and fro, running from one onto the other and vice versa, a short free portion between the spools running past the reading window. Since a tape for example 4 to 6 m. in length when wound up only forms a small reel a few centimetres in diameter, the tape can be conveniently installed in the case of the altimeter. With a length of some metres available for the scale, it is possible for the accuracy of reading even with a range of 850–1050 millibars, to amount to $\frac{1}{10}$th of a millibar at the most compressed part of the scale. In addition, owing to the positive logarithmic connection between the two scales, a strip has particular advantages as compared with those known arrangements which use for the reference pressure a counter mechanism that advances step by step in decimals. In such a case an element has to be provided between the reference indicator and the altitude indicator which evolves the logarithmic relationship. Such an evolving device however, can only be accurate to a very limited degree. Relatively high accuracy for example, $\frac{1}{10}$–$\frac{2}{10}$ millibar, cannot be achieved by such an arrangement, which has to solve the barometric altitude formula graphically. The tape arrangement is entirely free of such an evolving element with its consequent limited accuracy, since as a result of the continuous scale carrier the graduations for each fraction can be provided exactly at the theoretically correct places. The tape itself consists preferably of metal, for example stainless steel, to provide maximum safety against tearing or breakage and great constancy of length.

In carrying the basic principle of the invention into constructive effect the particular problem has to be solved of ensuring that each point of the tape always corresponds to the same position of the meter mechanism, independently of the direction of motion. This requirement can be met, for example, by perforating the tape and by causing the gear wheel effecting the displacement of the meter mechanism simultaneously to drive the toothed wheel engaging in the perforations, but Figures 1 to 5 of the accompanying drawings illustrate embodiments of the invention in which such perforation is unnecessary, the requisite synchronisation between the positions of the tape and the meter mechanism being achieved by a simple, durable and, in particular, absolutely reliable arrangement.

In order that the invention may be clearly understood and readily carried into practice, reference will now be made to the accompanying drawings, in which the invention is illustrated by way of example and in which—

Figure 1 is a diagrammatic front elevation of an altimeter according to the present invention.

Figure 2 is a horizontal cross-section illustrating one method of driving the reference pressure tape, the view being taken from beneath, so that the free part of the tape is on the far side of the plane of the drawing,

Figure 3 illustrates a detail of Figure 2.

Figure 4 is a view, similar to Figure 2, of an alternative embodiment of the invention, of which Figure 5 illustrates a detail.

Figure 6 illustrates a form of tape for use in altimeters according to the invention.

Referring to Figure 1, 1 and 2 are the two spools, 3 is the tape. The spools are driven by means of the gear wheel 4 and the externally operated gear wheel 5. The meter mechanism is driven either from the spindle of the gear 5 (Figures 2 and 3) or from the spindle of the spool 2 (Figures 4 and 5). The gear 4 meshes with gear 6, which is rigidly connected to spool 2, and on rotation of gear 4 in the direction of the left-hand arrow (Figure 2) the tape is wound onto spool 2. Spool 1 is not rigidly connected with the gear wheel 8, but through the intermediary of a spring washer 9 gear 8 exerts pressure on the side of spool 1, so that the tape being withdrawn by spool 2 is kept taut by friction. When gear 4 is rotated in the direction of the right-hand arrow (Figure 2) the tape is unwound from spool 2, but now spool 1 is also driven in the direction for winding up the tape coming from spool 2. This is effected by means of a ratchet wheel 7, fixed on the same spindle as gear 4 (Figure 3) which carries along a pawl 10 of a further gear wheel 11 mounted loosely on the same spindle and which meshes with gear 6; as mentioned above, the latter is frictionally coupled to spool 1. The bellies of the spools are of different diameter, that of spool 1 being equal to the diameter of spool 2 with the tape wound thereon. As a result the length of tape that can be wound up by the draft of spool 1 is greater than the length of tape positively unwound by spool 2. The difference between draft and feed is compensated by slipping of the frictional clutch between spool 1 and gear 8.

The important point in this connection is that the length of tape moved in both directions is governed by the rotation of one and the same spool 2 only. Since spool 2 is rigidly coupled to the mechanism drive by way of gear 4, this means that the same position of the mechanism always tallies with the same point of the strip in both directions of rotation. Moreover, no error is possible due to the increasing diameter of the spool as the tape is wound thereon, since the instrument is calibrated with this dependency taken into account. Calibration is actually effected when construction of the instrument has been completed by marking on the reference scale the exact millibar value based on the altitude formula for each value of the altitude scale. In this way the effect of the changing spool diameter is completely eliminated, since the calibration of each point of the tape is carried out in conjunction with the positive common displacement of the two scales, that is to say including the alteration in diameter that takes place.

In Figures 4 and 5 an alternative construction is illustrated. In Figure 4 the gear 12 is the one that is driven by the manually operated wheel 5. It is carried firmly on a spindle with gears 7 and 13 (Figure 5). Similarly to gear 7 the gear 13 has ratchet teeth so that the gear 15 can be clutched in one direction of rotation by means of the pawl 14. The teeth of gear 7 and the position of pawl 10 are opposite to those of gear 13 and pawl 14. Either one or the other of the two gears 15, 11 is entrained in each direction of rotation. The gear 15 meshes with gear 6 and gear 11 with gear 8. The gear 8 is rigidly attached to spool 1 and gear 6 is rigidly attached to spool 2. Spool 2 is braked in the same manner as spool 1 by a spring washer 16. Instead of the clutches by means of ratchet wheels and pawls that are illustrated, the known free-wheel type of clutch can be used with advantage. In the construction according to Figures 4 and 5 the meter mechanism is driven from one of the two spool spindles, such for example as the spindle 17 of spool 2, or from a gear wheel that is governed by one of these spools.

In the constructions illustrated by way of example the spool spindles are parallel to the longitudinal axis of the case, and consequently the tape has to be bent in a right angle to run past the window with its face parallel to the front surface, but of course it is quite possible to arrange the spools so that their axes are perpendicular to the axis of the case, when the bending of the tape can be avoided.

The figuring can be impressed in the tape. To ensure facility of reading, even in the dark, the figures may conveniently be made by perforations (Figure 6), when an area of luminous colour the size of the whole reading window is provided behind the tape.

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