PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Analytical Balance

I, ERHARD METTLER, a Swiss citizen, trading as E. Mettler, Fabrik für Analysenwaagen, of Stäfa, Zürich, Switzerland, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an analytical balance, and particularly to a micro-balance. The balance of this invention has an unsymmetrical balance beam which has an intermediate knife-edge offset from the centre, an outer knife-edge mounted on the shorter arm of the balance beam, and a counter-weight mounted rigidly on the longer arm of the balance beam. The pan on which the objects to be weighed are placed and the carrying means for the controllable weights, both hang on an outer knife-edge mounted on the shorter arm of the balance beam. Weighing is effected by placing the object to be weighed on the pan and then removing from the said carrying means approximately as many weights as make up the weight of the object to be weighed thus restoring the beam to approximate balance. The last decimals of the weight are measured by the slight inclination of the balance beam occurring at the approximate balance. An air damping device is normally provided to simplify rapid reading of the said last decimals of the weight. This device damps the vibrations of the balance beam to effect an approximately aperiodic setting. The air-damping device generally consists of a rigidly disposed damping cup, inside which a damping disc is freely movable with some play. The damping disc is attached to a holder, which projects centrally through an aperture in the cup. Generally in an analytical balance, and particularly a micro-balance having an unsymmetrical balance beam, the holder is fastened to the longer arm of the balance beam and the holder carries the counter-weight in addition to the damping disc. This construction of the damping device has the advantage that the unsymmetrical balance beam can be removed from the top without dismantling any parts whatever. One disadvantage of this damping device however consists in that the damping has an unsymmetrical action, because, for example, given a fall of the damping disc the volume of air present between it and the bottom of the cup is compressed, while a rise of the damping disc causes the said volume of air to expand. As a result, fluctuations in the external air pressure, which are produced for example by the opening or closing of a door or by air-conditioning installations, act on the damping disc and cause a movement of the balance beam. This movement is particularly serious with very sensitive analytical or micro-balances having a light and unsymmetrical balance beam.

The present invention aims at reducing this disadvantage in this kind of balance and, at the same time, permitting ready removal of the balance beam. This is achieved by providing the damping cup with a longitudinal slot parallel to the axis of the damping movement. The holder for the damping disc which is fastened on the longer arm of the balance beam projects with some clearance through this longitudinal slot in the damping cup. The damping cup is also provided with a removable cover, so that when the cover is attached the damping disc situated inside the damping cup produces a symmetrically acting damping of the vibrations of the balance beam, and when the cover is removed the damping disc can be introduced into or removed from the damping cup.

In order to enable the invention to be more readily understood, reference is made to the accompanying drawings which illustrate diagrammatically and by way of example, one embodiment thereof, and in which:—

Figure 1 is an elevation of the unsymmetrical balance beam, the damping device acting on its longer balance beam arm being shown in section; and

Figure 2 is a cross-section on the line 2—2 in Figure 1, through the damping device.

The unsymmetrical balance beam 3 of an

[Price 3s. 0d.]

analytical or micro-balance has on its shorter balance beam arm an outer knife-edge 4 from which is suspended the carrying means (not shown in Figure 1) for the pan and for the controllable weights. In the operational state of the balance beam 3, its middle knife-edge 5 is mounted on the plane seat 6, which is fastened in a carrier 7. The longer arm of the balance beam carries on its screw bolt 8 the counter-weight 8^1. By means of three columns 9, 9^1, 9^{11} the carrier 7 is supported on a base (not shown). Furthermore, the longer arm of the balance beam has a mounting 10 to accommodate a graduated plate 11, which in conjunction with an optical and illuminating device, not illustrated, provides an optical reading of the inclination of the balance beam 3. A holder 12 is mounted on the extreme end of the longer arm of the balance beam. This holder carries a damping disc 13 of an air damping device. The damping disc 13 is situated so as to be freely movable with some clearance inside a damping cup 14, the bottom part 15 of which is screwed by means of two headed screws 16 to the carrier 7. In Figure 2 one of said headed screws 16 is illustrated in section. The damping cup 14 has a longitudinal slot 17 disposed parallel to the axis of the damping movement, through which the holder 12 projects. The upper part of the damping cup 14 is closed with an attached and easily removable cover 18. The holder 12 has a tapered cross-section where it passes through the slot 17. In this way the holder 12 has sufficient play within the slot when the damping cup 14 is correctly adjusted. In order to render such an adjustment possible, the foot part 15 of the damping cup has screw apertures 19 (Figure 2), which have a larger diameter than the screw bolts of the headed screws 16. When the headed screws 16 are lightly released, the damping cup may be displaced as a whole by small amounts until the damping disc 13 and the holder 12 are freely movable, without touching the damping cup 14. The headed screws 16 may then be tightened to retain this position of the cup. This adjustment of the damping cup 14 is best effected with the cover 18 removed. It is then possible, according to Figure 2, to determine with ease the correct position of the damping cup 14 in relation to the damping disc 13 and its holder 12.

In Figure 1 the balance beam 3 is shown in its true position of balance, in which a straight line running through the edges of the knife-edges 4 and 5 runs horizontally. When the balance is in use, the arms of the balance beam may assume slightly inclined positions upwardly or downwardly in relation to this true balance position. The damping device shown is now designed and constructed in such manner that in the true balanced position of the beam 3 the damping disc 13 is situated exactly in the middle between the inner surfaces of the cover 18 and the base piece 15. On both sides of the damping disc 13 there is the same volume of air and the parts of the longitudinal slot 17 extending above and below the holder 12 are equal. These conditions alter in practice only insignificantly when the balance beam 3 assumes a slightly inclined position, since the movements occurring in the damping disc 13 remain small by comparison with the height of the damping cup 14. Fluctuations in the external air pressure therefore are transmitted substantially equally through the longitudinal slot 17 and do not exert displacing forces on the balance beam 3. When, as shown in Figure 1, the plane 20 passing through the damping disc 13 and shown in chain-dotted lines passes through the middle knife edge 5, the damping disc 13 causes a symmetrical acting damping of the vibrations of the balance beam 3 and no lateral forces are acting on the knife edge 5. Furthermore, when deviations from the shown middle position occur the volume of air present on one side of the damping disc 13 always becomes greater by an equal amount as it becomes reduced on the other side of the damping disc 13.

The balance beam 3 may easily be removed for transport of the balance, without the damping cup 14 needing to be dismantled for this purpose. It is only necessary to take off the cover 18 in order to be able to remove the damping disc 13 together with the holder 12 from the top of the damping cup 14. When the damping disc 13 has been guided out the balance beam 3 is removed as a whole.

What I claim is:—

1. Analytical balance, particularly a micro-balance, having an unsymmetrical balance beam which has an intermediate knife-edge offset from the centre, an outer knife-edge mounted on the shorter arm of the balance beam, a counterweight mounted rigidly on the longer arm of the balance beam, and in which there is provided an air damping means comprising a fixed damping cup and a damping disc which is disposed to be movable with some clearance inside said cup, said damping disc being fastened by means of a holder to the longer arm of said balance beam to damp the vibrations of said beam, wherein the damping cup has a longitudinal slot disposed parallel to the axis of the damping movement through which slot said holder projects with clearance, and wherein the damping cup is closed by a removable cover so that with said cover in position the damping disc situated inside the damping cup produces a symmetrically acting damping of the vibrations of the balance beam, while when the cover is removed the damping disc can be guided into or removed from the damping cup.

2. An analytical balance, particularly a micro-balance, as claimed in Claim 1, in

which the damping cup and the plane for supporting the middle knife-edge of the unsymmetrical balance beam are fastened on a common carrier, and in which the damping disc fastened to the longer arm of the balance beam by means of the holder extends in a plane which passes through the pivot of the intermediate knife-edge of the unsymmetrical balance beam.

3. An analytical balance, particularly a micro-balance, as claimed in Claim 1 or 2, in which said holder is fastened to the extreme end of the longer balance beam arm, and the counterweight to a part of the longer balance beam arm situated between the damping disc and the middle knife-edge.

4. An analytical balance, particularly a micro-balance, as claimed in any of Claims 1 to 3, in which the damping disc and the damping cup are so disposed and constructed that in the true balance position of the unsymmetrical balance beam the damping disc is situated centrally between the bottom of the damping cup and the cover of the damping cup.

5. An analytical balance, particularly, a micro-balance, as claimed in any of Claims 1 to 4, in which the damping cup is fastened on the carrier with the cover uppermost, and in which said cup is so disposed as to be adjustable.

6. A micro-balance, constructed, arranged and adapted to operate, substantially as described with reference to the accompanying drawings.

W. H. A. THIEMANN,
Prestige House, 14—18, Holborn,
London, E.C.1,
Agent for the Applicant.

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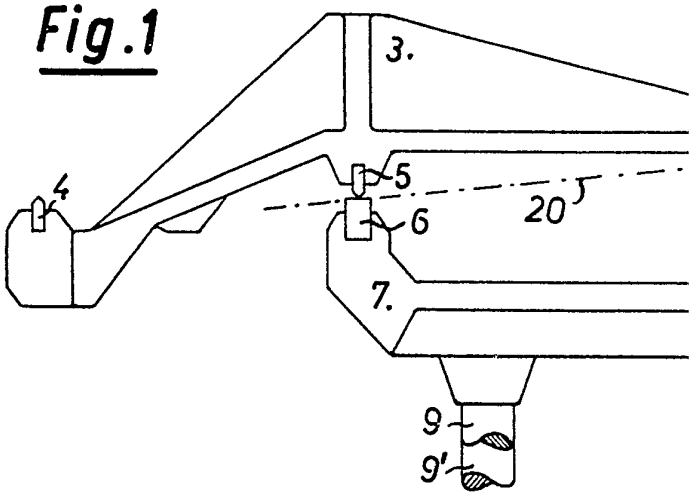
Fig.1



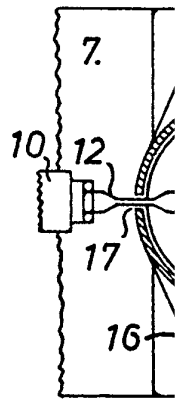


Fig.2

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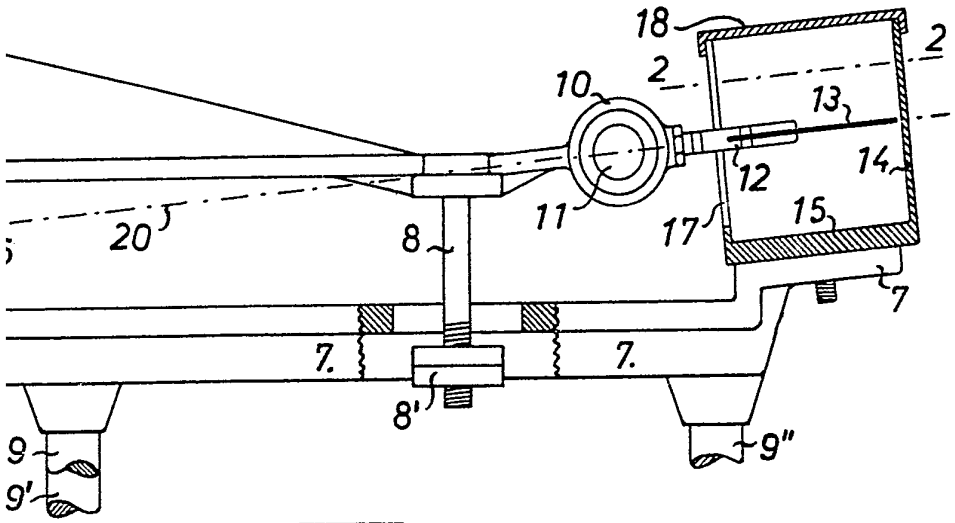
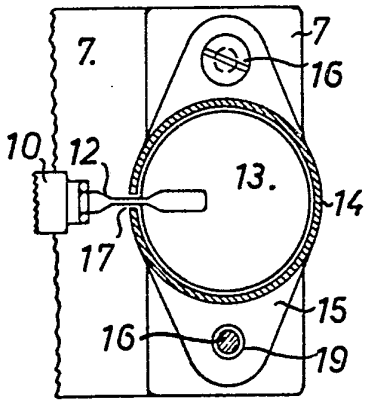
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*





7.2

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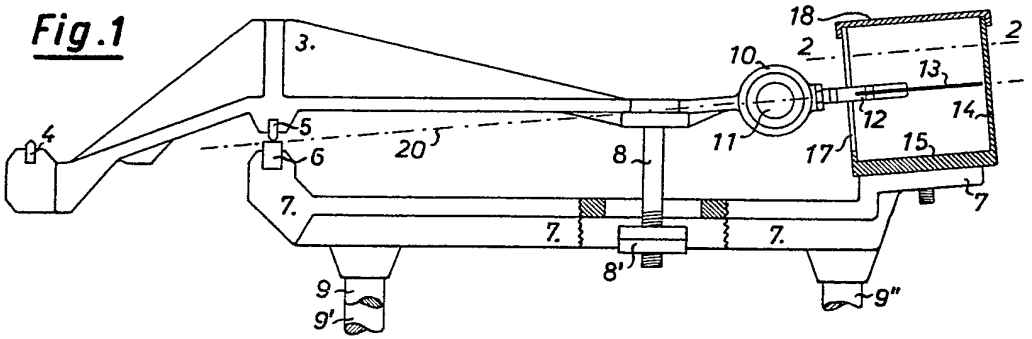
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig.1



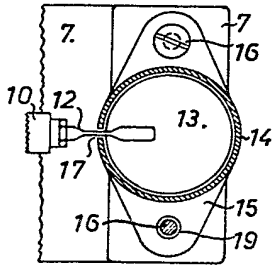


Fig.2