

Sept. 25, 1956

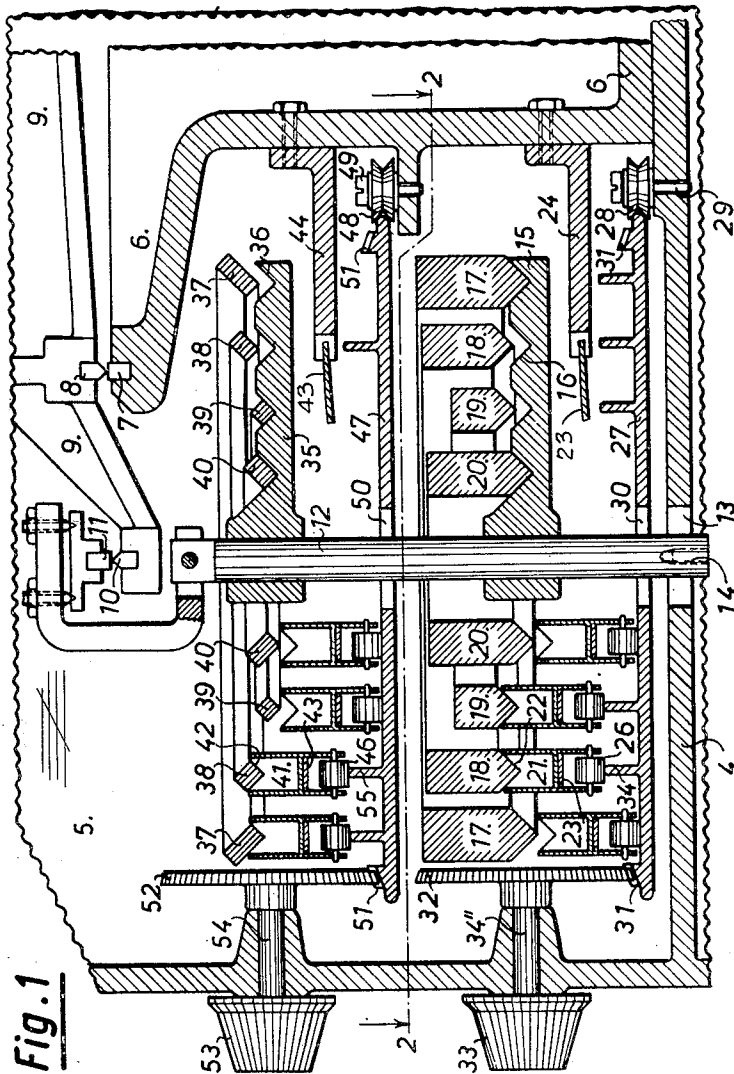
E. K. METTLER

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BALANCE

Filed June 30, 1955

2 Sheets-Sheet 1



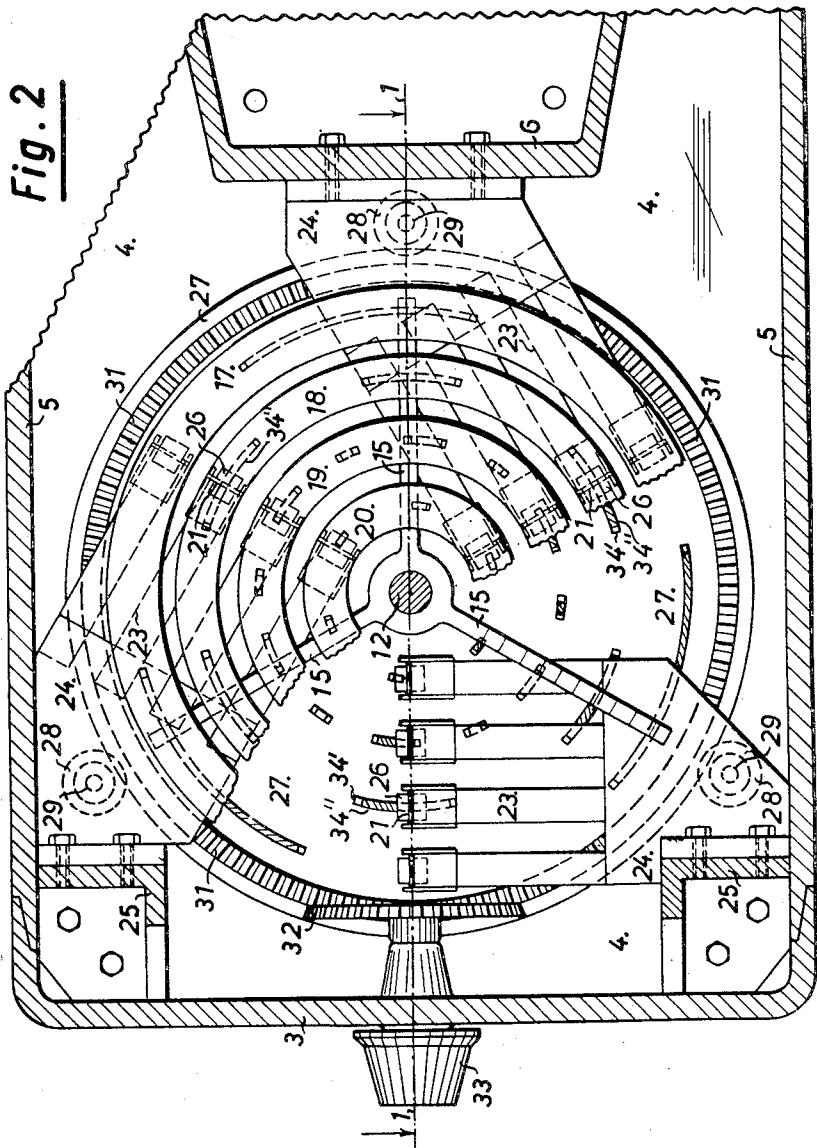
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BALANCE

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10 Claims. (Cl. 265—48)

This invention relates to a balance and more particularly to a laboratory or analytical balance having removable weights and an operating device for mechanically placing in position and lifting-off these weights.

Objects of the invention are to provide a balance of the type stated having a set of removable weights which are ring-shaped and have dimensions graduated in such manner that any ring-shaped weight encloses with clearance the next smaller weight so that the smaller weight may be moved through the ring aperture of the next larger weight, supporting means on a carrier suspended from the outer knife edge of the balance beam for horizontally supporting said ring-shaped weights, members for lifting-off said ring-shaped weights in a vertical direction from said supporting means, and an operating device for actuating said lifting-off members. The set of removable ring-shaped weights may embrace an entire weight decade, the heavier weights of said weight decade surrounding the lighter weights. Objects are to provide, in a balance of the type stated, a carrier suspended from the outer knife edge of the balance beam having a rod which extends in the vertical direction below said outer knife edge, a set of removable ring-shaped weights each of which surrounds said rod in the space below said outer knife edge, supporting means radially extending from said rod for horizontally supporting said ring-shaped weights, a plurality of simultaneously operated lifting-off members for each of said ring-shaped weights in order to lift-off the respective weight from said radially extending supporting means in a vertical direction, said lifting-off members passing through in the space between said radially extending supporting means, and an operating device for the lowering or raising of said lifting-off members. A further object is to provide a balance of the kind outlined having a carrier extending in the vertical direction and suspended from the outer knife edge of the balance beam, a set of concentrically arranged ring-shaped weights, a plurality of levers movable about horizontally disposed axes and extending tangentially to said ring-shaped weights, a lifting-off member fastened to the free end of each of said levers in order to move said weights in a vertical direction, supporting means on said carrier for supporting said ring-shaped weights in a horizontal position, a disc-like member adapted to rotate about the common vertical axis of said ring-shaped weights, a plurality of concentrically disposed cams on said disc-like member, rollers provided on each of said levers which rest upon said cams, and manually operable means for rotating said disc-like member, said means including an operating knob and a toothed wheel gear. Yet another object is a balance and more particularly an analytical balance of the character described and comprising a carrier suspended from the outer knife edge of the balance beam, a first set of concentrically arranged ring-shaped weights, a first set of supporting means on said carrier for horizontally supporting said first set of ring-shaped weights, a first set of members for lifting-off said ring-shaped weights in a vertical direction, a first operating device for actuating said lifting-off mem-

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bers, a second set of concentrically arranged weights disposed in the space below said first set of ring-shaped weights, a second set of supporting means on said carrier disposed below said first set of supporting means and adapted for horizontally supporting said second set of ring-shaped weights, a second set of members for lifting-off the ring-shaped weights of said second set of weights, and a second operating device for actuating said second set of lifting-off members.

These and other objects and the advantages of the invention will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawing, wherein like reference characters indicate like parts throughout the figures and in which:

Figure 1 is a sectional front elevation of a balance embodying the novel features of my invention, along the line 1—1 in Figure 2, parts thereof being broken away to better illustrate the construction; and

Figure 2 is a horizontal section seen along the line 2—2 in Figure 1.

Referring to the drawings, the balance housing is shown only in part for the sake of clarity. An intermediate horizontal partition 4 adjoins the upper parts of the front wall 3 of the housing. The two side walls 5 (Figure 2) are constructed to be removable in the customary way. The column 6 is screwed on the partition 4 and at its upper end has the pan 7 for supporting the centre knife edge 8 of the balance beam 9, which is preferably of asymmetrical construction. The right-hand arm (shown only in part) of the balance beam 9 carries a counterweight fastened to it (not shown). The shorter left-hand arm of the balance beam 9 has an outer knife edge 10 on which a carrier having a rod 12 is suspended in known manner by means of a pan 11 and an equalising joint. The partition 4 has an aperture 13, through which the rod 12 projects freely. At the bottom end the rod 12 has an internal thread 14 into which the suspension device, containing another joint, for the balance pan can be screwed. This suspension device and also the balance pan itself are not shown in Figures 1 and 2; these parts of the balance are located beneath the partition 4. The base of the balance with the levelling means and the slidable or rotatable windows, through which the objects to be weighed can be placed on the balance pan, are also situated below the partition 4.

The entire arrangement for mechanically placing in position and lifting-off the removable weights is accommodated above the intermediate horizontal partition 4. The removable weights are supported on the same rod 12 which also carries the balance pan, so that the loading of the balance beam 9 is approximately constant in known manner. For this purpose the rod 12 has three supporting parts 15 fastened on it like spokes, and which extend radially outwards, as shown in Figure 2. For reasons of clarity, in Figure 1 only one of these supporting parts 15 is shown in section. The supporting parts 15 have a number of wedge-shaped recesses 16 corresponding to the number of weights; in them ring-shaped weights 17, 18, 19, 20 of the set of weights can rest. In accordance with Figure 1, only the ring-shaped weights 17 and 20 are deposited on the supporting parts 15, while the ring-shaped weights 18 and 19 are lifted off these supporting parts. Figure 2 shows the ring-shaped weights 17 to 20 in a partly broken away representation, in order to be able to show in plan view the parts of the arrangement situated below these weights. The weights 17 to 20 have dimensions graduated in such manner that in each case a larger ring-shaped weight embraces the next smaller weight with a clearance, so that a smaller weight can be moved in the vertical direction through the ring aperture of the next larger weight when all the ring-shaped weights 17 to 20 of

the set are disposed concentrically to one another and horizontally in respect of their annular plane. In order that the ring-shaped weights 17 to 20 may embrace an entire weight decade, the weight 17 can for example be given five units of the decade, the weight 18 two, and the two weights 19 and 20 one weight unit each. Taking into account the different ring diameters, the weights are given, as illustrated in Figure 1, correspondingly different heights in the vertical direction, that is to say perpendicularly to the plane of the ring.

In order to be able to lift the annular weights 17 to 20 off the supporting parts 15 of the rod-like carrier 12, three lifting members 21 are associated with each weight, as is indicated for the ring-shaped weight 18. The lifting members 21 project upwards between the supporting parts 15 and have recesses 22 of suitable dimensions for receiving the weights (Figure 1). Each lifting member 21 is fastened to the free end of a lever 23 constructed as a leaf spring. The other end of the leaf spring is clamped fast in a bent-over plate 24, or in the case of a non-resilient lever 23 the latter is pivotally connected to the plate 24 in such manner that the lever 23 may be moved about a horizontally disposed axis. The plates 24 (Figure 2) are in turn screwed to the column 6 or to supports 25 fastened on the partition 4. For the sake of clarity the two supports 25 are not shown in Figure 1. The leaf springs 23 acting as one-armed levers are also disposed (Figure 2) that they extend in the tangential direction in relation to the appertaining ring-shaped weights 17 to 20. At their bottom end (Figure 1) the lifting members 21 have rotatable rollers 26. Below the ring-shaped weights 17 to 20 is situated a rotatable disc-like member 27, which in the embodiment illustrated is mounted by means of the V-rollers 28. Instead of the V-rollers 28 however, other means may also be employed for the rotatable mounting of the disc 27. The axes 29 for the V-rollers 28 are fastened directly in the partition 4 (Figures 1 and 2). A central aperture 30 provided in the disc 27 (Figure 1) allows the free passage of the rod 12 of the carrier. A gear wheel 32 meshes with a toothed crown 31 provided on the outside of the disc 27 and is mounted on the shaft 34' provided with the operating knob 33. The transmission ratio of the toothed gearing 31, 32 is such that three full revolutions of the knob 33 give one full revolution of the disc 27. In order now to operate the lifting-off members 21 for the different weights by turning the knob 33, the disc 27 has upwardly projecting cams 34, which are so distributed that in each case all three lifting-off members 21 which are allocated to a ring-shaped weight 18 are simultaneously raised or lowered. The cams 34 have bevellings 34' leading to the surface of the disc 27, in order that the rollers 26 can be gradually raised and lowered. In Figure 2 the highest part of the cams 34 is designated by 34'', while the bevellings situated at the two ends of the cams are indicated by 34'.

As Figure 2 shows, a separate cam is associated with each weight and is provided on the disc 27 beneath the respective weight, so that the cam tracks allocated to the different weights 17 to 20 are situated on circles concentric to one another. The length of the cams 34, viewed in the peripheral direction of the disc 27, and also their distribution in the peripheral direction are so arranged that on one full revolution of the knob 33 the ring-shaped weights 17 to 20 are lifted off in a cycle in which the sum of all weights lifted off is increased in stages by the unit of the respective weight decade.

As shown in Figure 1, the weights 18 and 19 are lifted off; in accordance with the foregoing explanations, this corresponds to a weight value of three units of the decade which can be covered by the weights 17 to 20. If the disc 27 is turned in the counter-clockwise direction, the weight 20 is first also lifted off, so that now four weight units of the decade have been lifted off the sup-

porting parts 15. On a further rotation of the disc 27 in the counter-clockwise direction the weights 18, 19, 20 are placed back on the supporting parts 15, and in return the weight 17 is lifted off, this latter weight comprising five weight units of the decade. A scale can accordingly be provided on the operating knob 33, showing the values of the weight units from zero to nine in their natural sequence. The indication of the weight values lifted off at any particular moment can also be shown on a figure roller, which is driven by means of a corresponding toothed wheel gear by the toothed crown 31.

As can be seen from Figure 1, a unit of the arrangement for mechanically placing in position and lifting off the ring-shaped weights has only a small structural height. By a unit is understood in this connection the controllable weights 17 to 20 of a set of weights, the supporting parts 15 disposed on the rod 12 of the carrier for these weights, the lifting-off members 21 for all the weights, and the means of transmission of the operating device, which consists of the levers 23, the disc 27, and the cam crowns 34. If a plurality of sets of weights are to be used, a plurality of such units can advantageously be disposed one above the other in space, without resulting in too great a structural height. In Figure 1, two such units are shown, the upper of the two units containing the removable weights 37 to 40, which for example all have a weight which is smaller by the factor ten than the weights 17 to 20 of the lower unit which are situated beneath them. The upper unit has supporting parts 35 fastened on the rod-like carrier 12 and provided with recesses 36 to receive the ring-shaped weights 37 to 40. Viewed in plan corresponding to Figure 2, the supporting parts 35 are situated exactly above the supporting parts 15. The lifting-off members 41 have wedge-shaped guides 42 for the ring-shaped weights 37 to 40, and are mounted on the free ends of spring levers 43. The levers 43 are in turn fastened in plates 44 which are screwed to the column 6 or to the supports 25 in such manner that the levers 43 come to lie exactly above the levers 23. Rollers 46 are provided as transmission means for the smooth lifting and lowering of the lifting-off members 41. Beneath the rollers 46, a disc 47 is rotatable by means of V-rollers 48 and their bearing bolts 49. The rod 12 projects through the central aperture 50 provided in the disc 47. The disc 47 has on the outside a toothed crown 51, in which engages a gear wheel 52 which is fastened on the shaft 54 together with the operating knob 53 allocated to this unit. The disc 47 has in addition cams 55, which in respect of their dimensions and distribution are of the same construction and arrangement as the cams 34 on the disc 27. The discs 27 and 47 can thus be turned completely independently of one another with the aid of the operating knobs 33 and 53. In accordance with Figure 1, the ring-shaped weights 37 and 38 lie on the lifting-off means 41 and are thus lifted-off, while the ring-shaped weights 39 and 40 rest on the supporting members 35.

The unit which contains the ring-shaped weights 37 to 40 has practically the same individual parts in the operating device for lifting-off and placing on the weights as the unit containing the weights 17 to 20. In the case of a plurality of units disposed one above the other a very easily visible construction of the entire arrangement is obtained, which moreover permits good utilisation of the space inside the housing of the balance. The ring-shaped weights, which are concentric to one another and in relation to the rod 12, and also the above-described operating device ensure the lifting-off and placing in position of the weights, without the movably suspended rod 12 changing its position. The rod 12 will therefore also perform no pendulum movement when weights are lifted off or placed in position. The arrangement described is consequently suitable for sensitive laboratory or analytical balances and in particular for balances having asymmetrical balance beams, in which the balance pan and the

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removable weights are suspended on the same balance beam arm.

The invention is not limited to the particular embodiment herein shown and described and modifications which may occur to those familiar with the art fall within the spirit and scope of the invention as set forth in the following claims.

I claim:

1. A balance, comprising a balance beam, a carrier, said balance beam having a centre knife edge for its support and an outer knife edge for suspension of said carrier therefrom, a set of ring-shaped weights having dimensions graduated in such manner that any of said weights encloses with clearance the next smaller weight so that the smaller weight may be moved through the ring aperture of the next larger weight, supporting means on said carrier for horizontally supporting said ring-shaped weights in a position concentric to one another, members for lifting-off each of said ring-shaped weights from said supporting means in the vertical direction, and an operating device for actuating said lifting members in order to lift-off or to place on said ring-shaped weights in a predetermined sequence.

2. The invention as recited in claim 1, wherein said set of removable ring-shaped weights embrace an entire weight decade, the heavier weights of said weight decade surrounding the lighter weights.

3. A balance, comprising a balance beam, a carrier having a rod, said balance beam having a centre knife edge for its support and an outer knife edge for suspension of the upper end of said carrier therefrom, said rod extending in the vertical direction below said outer knife edge, a set of concentrically arranged removable ring-shaped weights each of which surrounding said rod in the space below said outer knife edge, supporting means radially extending from said rod for horizontally supporting said ring-shaped weights, a plurality of simultaneously operated lifting-off members for each of said ring-shaped weights in order to lift-off the respective weight from said supporting means in a vertical direction, said lifting-off members passing through in the space between said radially extending supporting means, and an operating device for the raising or lowering of said lifting-off members.

4. The invention as recited in claim 3, wherein the centre of gravity of each of said ring-shaped weights is disposed vertically below the edge of said outer knife edge.

5. A balance, comprising a balance beam, a carrier extending in the vertical direction, said balance beam having a centre knife edge for its support and an outer knife edge for suspension of said carrier therefrom, a set of removable ring-shaped weights having dimensions graduated in such manner that any of said ring-shaped weights encloses with clearance the next smaller ring-shaped weight so that a smaller weight may be moved

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through the ring aperture of the next larger weight, supporting means on said carrier for horizontally supporting said ring-shaped weights in a position concentric to one another, members for lifting-off each of said ring-shaped weights from said supporting means in the vertical direction, a disc-like member adapted to rotate about the common vertical axis of said ring-shaped weights, a plurality of concentrically arranged cams on said disc-like member for the raising or lowering of said lifting-off members, and manually operable means for rotating said disc-like member.

6. The invention as recited in claim 5, wherein said rotatable disc-like member has a toothed crown disposed externally of the outermost cam and said manually operable means comprise an operating knob and a toothed wheel gear meshing with said toothed crown.

7. A balance, comprising a balance beam, a carrier extending in the vertical direction, said balance beam having a centre knife edge for its support and an outer knife edge for suspension of said carrier therefrom, a set of concentrically arranged ring-shaped weights, a plurality of levers movable about horizontally disposed axes and extending tangentially to said ring-shaped weights, a lifting-off member fastened to the free end of each of said levers in order to lift-off the respective weight from said supporting means in a vertical direction, a disc-like member adapted to rotate about the common vertical axis of said ring-shaped weights, a plurality of concentrically disposed cams on said disc-like member, for engaging the free end of each of said levers, and manually operable means for rotating said disc-like member.

8. The invention as recited in claim 7, wherein said levers are of resilient construction and clamped fast at one end.

9. The invention as recited in claim 7, wherein said levers have at their free ends rollers which roll on said cams.

10. The invention as recited in claim 7, wherein said levers are disposed in the space below said ring-shaped weights, said rotatable disc-like member is disposed below said levers, and said levers at their free ends each have an upwardly pointing lifting-off member.

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