PATENT SPECIFICATION

754,203

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COMPLETE SPECIFICATION

Balance with device for mechanically placing in position and lifting-off Weights

I, ERHARD METTLER, a Swiss Citizen, trading as E. Mettler, Fabrik für Analysenwaagen, of Grundstrasse, 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 a balance with device for mechanically placing in position and lifting-off weights.

Known devices for mechanically placing in position and lifting-off weights in balances, and particularly in laboratory or analytical balances, usually provide a separate operating device for each set of weights, with the aid of which the weights of the set are placed in position or lifted off. As a rule the set of weights comprises the weights of one weight decade, and these weights are moved in a constrained sequence on operation of the controlling device, in such manner that the sum of all controllable weights placed in position or lifted off varies by steps by the unit of the weight of the decade in question.

In addition to other constructions of devices of the type indicated, it is known to form the weights as annular or disc-shaped bodies, which are disposed horizontally in relation to their ring or disc plane. The individual annular or disc-shaped weights are disposed coaxially one above the other and have dimensions such that each weight of the respective set of weights can lie on the next lower weight.

In one known form of construction of a device for mechanically placing in position and lifting off annular or disc-shaped weights of this type, a carrier is articulated to the beam of the balance and has at its upper end a support plate for the weights to be laid thereon. The entire set of weights is disposed above the support plate and the operating device for the lifting-off means is in turn situated above the set of weights. A separate tubular lifting-off means is associated with each of the annular weights, and passes freely through the other weights which are situated above the weight in question. All the tubular lifting-off means are in turn disposed centrally in relation to one another and each is displaceable individually in the vertical direction. On the operation of the operating device, the tubular lifting-off means allocated to the lowermost weight is first lowered, and the lowermost weight is placed on the support weight. The next lifting off means allocated to the lowest weight can then be lowered, and the next lowest weight placed on the lowermost weight. The same is done with the remainder of the weights of the set of weights. An arrangement of this type is however very expensive and complicated if the weights of various weight decades are to be operated in the manner described.

Another known form of construction of a device for mechanically placing in position and lifting off annular weights makes use of a carrier pivotally connected to the beam of the balance and having on its part situated beneath the balance beam a plate-like supporting part for each annular weight of the set of weights in question. All the annular weights are placed coaxially one beneath the other on their respective supporting parts, the latter being fastened to the carrier at corresponding vertical distances from one another. The diameters of the plate-shaped supporting parts and of the central annular apertures of the weights are so graduated that when a lower weight is lifted off the next higher weight is carried with it, while the supporting part for the upper weight can pass with clearance through the annular aperture in the bottom weight. The lifting-off means is common to all the weights of the set of weights and consists of a ring slidably guided in the vertical direction and the annular aperture of which is so large that the supporting part for the lowermost weight, and hence also all other supporting parts, can freely pass through the annular aperture in the lifting-off means. On the upward movement of the lifting-

[Price 6d]

off means therefore all the weights are lifted off from their supporting parts in succession, and each weight then rests on the next lower weight of the set of weights. A plurality of sets of weights are so disposed that at different distances from the central knife edge of the balance beam a number of external knife edges, equal to the number of sets of weights, are provided, while on each external knife edge a carrier with supporting parts for the controllable weights of the set of weights in question is suspended. The operating devices for the different sets of weights are disposed side by side in the direction of the balance beam in an arrangement of this type. A larger number of external knife edges on the balance beam is however very undesirable particularly in the case of more accurate analytical balances.

A disadvantage of all these previously known devices for lifting off and placing in position annular weights lies in the fact that a set of weights comprising a full decade must consist of nine weights, each of which is equal to one unit of weight of the decade. On the other hand, it is known that a decade can be covered with only four controllable weights, which however must be of different values, so that in this respect the use of annular weights with the aid of the previously known devices for placing in position and lifting off is less advantageous. In previously known devices for placing in position and lifting off annular weights the relatively great structural height is also an undesirable feature, as the result of which they can be accommodated, particularly in analytical balances of customary dimensions, only with difficulty. In balances with constant loading of the balance beam, in which the weighing pan and the controllable weights are mounted on the same suspension means, a great structural height of the apparatus for operating the weights is particularly inconvenient.

The present invention relates to a balance having a device for the mechanical placing in position and lifting off of weights, and especially to laboratory or analytical balances with constant loading of the balance beam, which is then of asymmetrical construction, wherein for each set of weights an operating device is provided by means of which the weights of the set of weights in question can, in a constrained sequence, be placed on or lifted off a carrier pivotally connected to the balance beam, by means of lifting-off means, and in which the set of weights has horizontally disposed annular weights.

According to the invention, the deficiencies, briefly outlined above, of previously known devices of this type are obviated by the fact that the weights of the set of weights have such dimensions that in each case any one of the annular weights encloses with clearance the next smaller, so that the smaller weight can be moved through the annular opening of the next larger weight in the vertical direction. The carrier pivotally connected to the balance beam preferably has a plurality of supporting parts extending like spokes, on which all the weights of set of weights in question can be laid down in a position concentric to one another, while moreover, the operating device allocated to this set of weights has for each weight of the set a plurality of simultaneously operated lifting-off means, which pass through in the space between the supporting parts of the carrier.

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 shows a vertical section through the balance with the device for mechanically placing in position and lifting-off controllable weights, along the line 1—1 in Figure 2; and

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

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 intermediate horizontal partition 4 and at its upper end has the pan 7 for supporting the central 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 counter weight fastened to it, but not shown. The shorter left-hand arm of the balance beam 9 on the other hand has an outer knife-edge 10, on which a rod-shaped carrier 12 is suspended in known manner by means of a bearing part 11. The partition 4 has an aperture 13, through which the carrier 12 projects freely. At the bottom end the carrier 12 has an internal thread 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 device 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 controllable weights is accommodated above the intermediate horizontal partition 4. The controllable weights are suported on the same carrier 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 carrier 12 has three supporting parts 15 which are fastened on it like spokes, and which extend radially outwards, as shown in Figure 2. For reasons of clarity, only one of these supporting parts 15 fastened to the

carrier 12 is shown, in section. The supporting parts 15 have a number of wedge-shaped recesses 16 corresponding to the number of weights; in them the annular weights 17, 18, 19, 20 of a set of weights can rest (Figure 1). In accordance with Figure 1, only the weights 17 and 20 of the set of weights are deposited on the supporting parts 15, while the weights 18 and 19 are lifted off the supporting parts. Figure 2 shows the annular 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 beneath the weights. The weights 17 to 20 have such dimensions that in each case a larger weight embraces the next smaller weight with a clearance, so that each weight of the set of weights can be moved in the vertical direction through the annular aperture of the next larger weight when all the weights 17 to 20 are disposed concentrically to one another and horizontally in respect of their annular plane. In order that the annular weights 17 to 20 may embrace an entire weight decade, the weight 17 can for example be given five weight 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 (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 annular 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 23 is clamped fast in a bent-over plate 24, or in the case of a non-resilient lever the latter is pivotally connected to the plate 24. 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 all so disposed (Figure 2) that that they extend in the tangential direction in relation to the appertaining annular weights 17 to 20. At their bottom end (Figure 1) the lifting members 21 have rotatable rollers 26. Below the annular weights 17 to 20 is situated a rotatable disc 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-like carrier 12. 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 turning 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 means 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 means 21 which are allocated to an annular 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 on the lifting-off means 21. In Figure 2 the highest part of the cams 34 is shown solid, while the bevellings 34′ situated at the two ends of the cams are indicated by the outlining not filled in.

As Figure 2 shows, a separate cam track 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 annular 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 annular 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 supporting 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 turning 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 annular controllable 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 carrier 12 for these weights, the lifting-off means 21 for all the weights, and the means of transmission of the operating device, which consist 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 controllable 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 fastened on the rod-like carrier 12 and provided with recesses 36 to receive the annular 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 means 41 have wedge-shaped guides 42 for the annular 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 pivotally connected to said plates 44, unless, as illustrated, they are composed of flexible leaf springs. The plates 44 are screwed to the column 6 or to the supports 35 in such manner that the levers 43, viewed in ground plan, 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 rotatably mounted by means of V-rollers 48 and their bearing bolts 49. The rod-like carrier 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 knobs 33 and 53. In accordance with Figure 1, the annular weights 37 and 38 lie on the lifting-off means 41 and are thus lifted off, while the annular weights 39 and 40 rest on the supporting parts 35.

The unit which contains the annular weights 37 to 40 has practically the same individual parts in the operating device for lifting-off and placing the weights in position 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 annular weights, which are concentric to one aonther and in relation to the rod 12, and also the above described operating device ensure the lifting-off and placing in position of the annular 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 a symmetrical balance beams, in which the balance pan and the controllable weights are suspended on the same balance beam arm.

What I claim is:—

1. A balance having means for the mechanical placing in position and lifting-off of weights, especially a laboratory or analytical balance, in which an operating device is provided for each set of weights by means of which the weights of the respective set of weights are placed on, or removed from, a carrier pivotally connected to the balance beam by lifting-off means in a constrained sequence, and in which the set of weights has horizontally disposed annular weights, characterised in that the weights of the set of weights have such dimensions that in each case any of the annular weights encloses with clearance the next smaller weight, so that the smaller weight can be moved through the ring aperture of the next larger weight in the vertical direction.

2. A balance as claimed in Claim 1, in which the carrier pivotally connected to the balance beam has a plurality of supporting parts which extend like the spokes of a wheel and on which all the weights of the respective set of weights can be deposited in a position concentric to one another, and in which the operating device allocated to said set of weights has for each weight of said set of weights a plurality of simultaneously operated lifting-off means, which pass through in the space between the supporting parts of the carrier.

3. A balance as claimed in Claim 1 or 2, in which in the space below the annular and coaxially disposed weights of the respective set weights the operating device has a disc which is adapted to rotate about the common axis of the weights and which is provided with a number, equal to the number of weights, of cam crowns which are concentric to one another, while each of these cam crowns with the aid of transmission means effects the raising or lowering of the lifting-off means allocated to the respective weight.

4. A balance as claimed in any of Claims 1 to 3, in which the transmission means consist of levers which are situated above the disc and extend tangentially to the cam crowns, and which by their free ends are moved up or down by the cams of the cam crowns and at their free ends each have an upwardly pointing lifting-off member.

5. A balance as claimed in any of Claims 1 to 4, in which the levers are of resilient construction and clamped fast at one end, while at their free ends they carry rollers which are disposed below the lifting-off members and which roll on the cams of the cam crowns.

6. A balance as claimed in any of Claims 1 to 3, in which the rotatable disc has an aperture

situated inside the innermost cam crown and its periphery is mounted by means of a plurality of rollers, in which the carrier is a vertical rod which passes through the aperture in the disc and is provided with supporting parts situated above the disc and projecting radially outwards, and in which all the weights surround the vertical rod.

7. A balance as claimed in any of Claims 1, 2, 3, and 6, in which the rotatable disc has a toothed crown disposed externally of the outermost cam crown by means of which crown said disc can be turned through a toothed wheel gear by the operating knob of the operating device.

8. A balance as claimed in Claim 1 or 2, in which when a plurality of sets of weights are used, the annular weights, the supporting parts disposed on the carrier, and the lifting-off means of the operating device form for each set of weights a unit, and in which said units corresponding to the different sets of weights are disposed one above the other in space.

9. 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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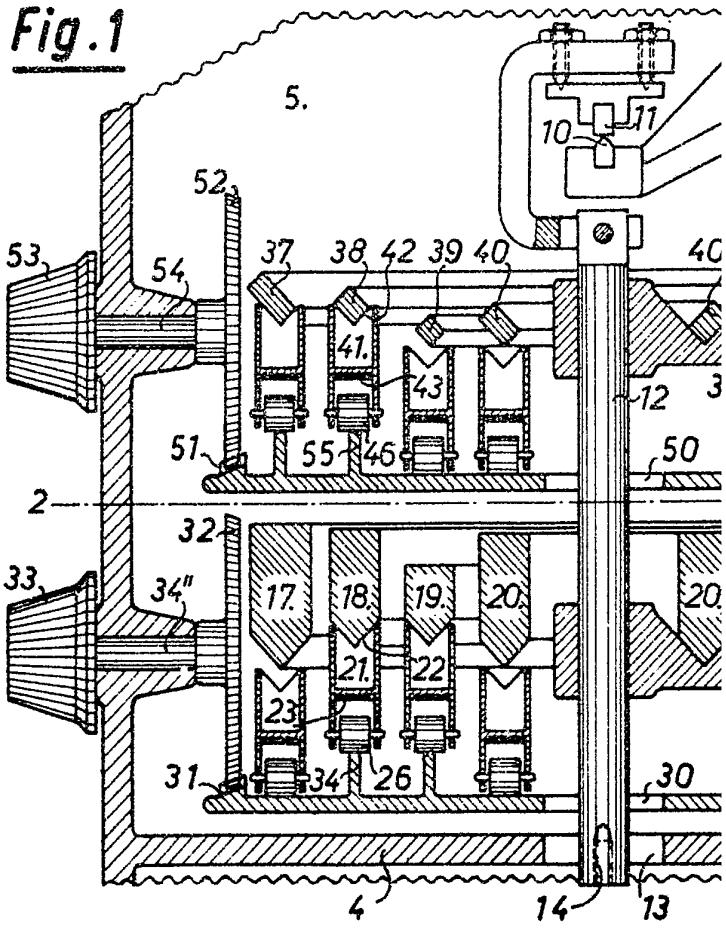
Fig.1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754,203 COMPLETE SPECIFICATION

2 SHEETS

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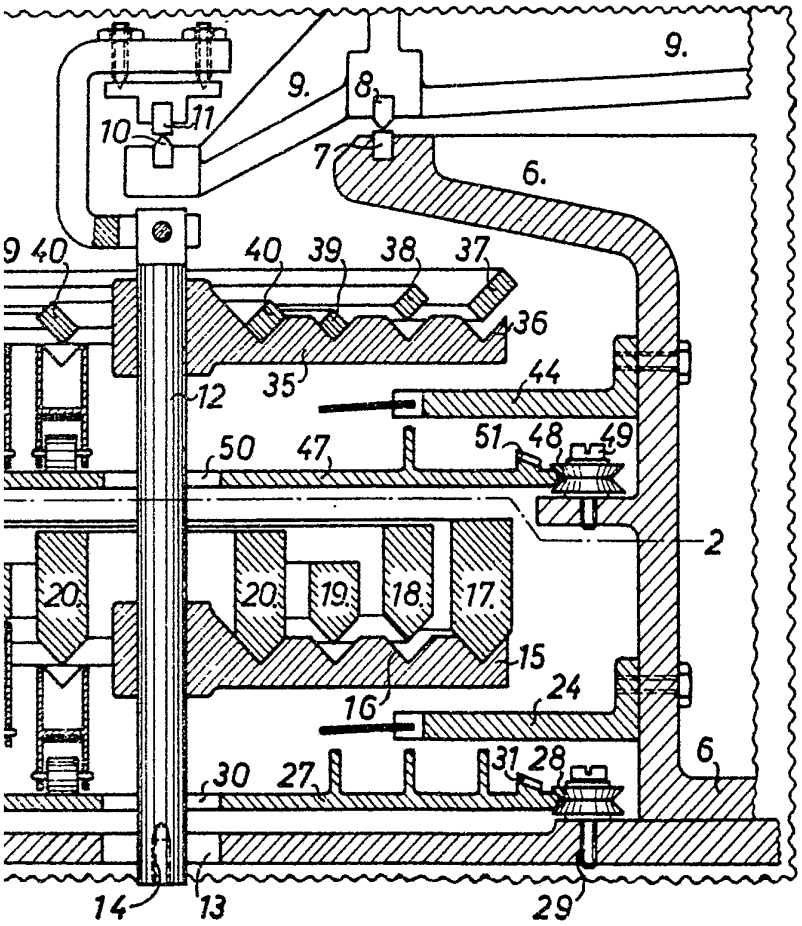

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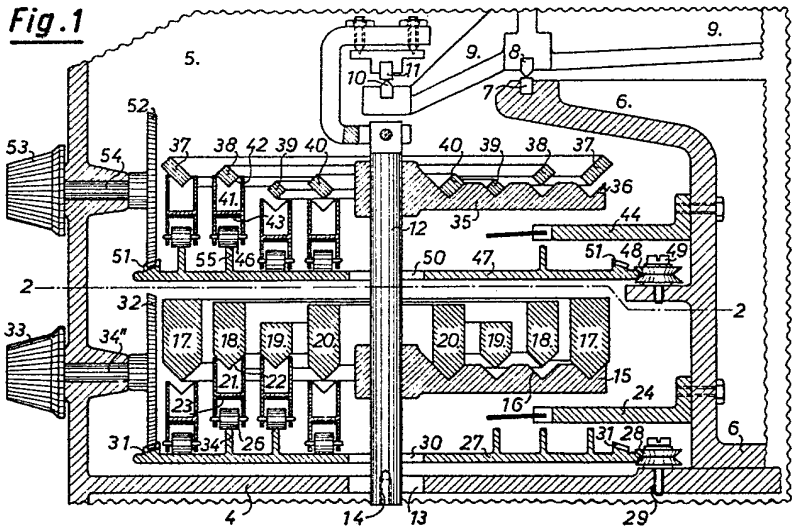
SHEET 1

Fig.1



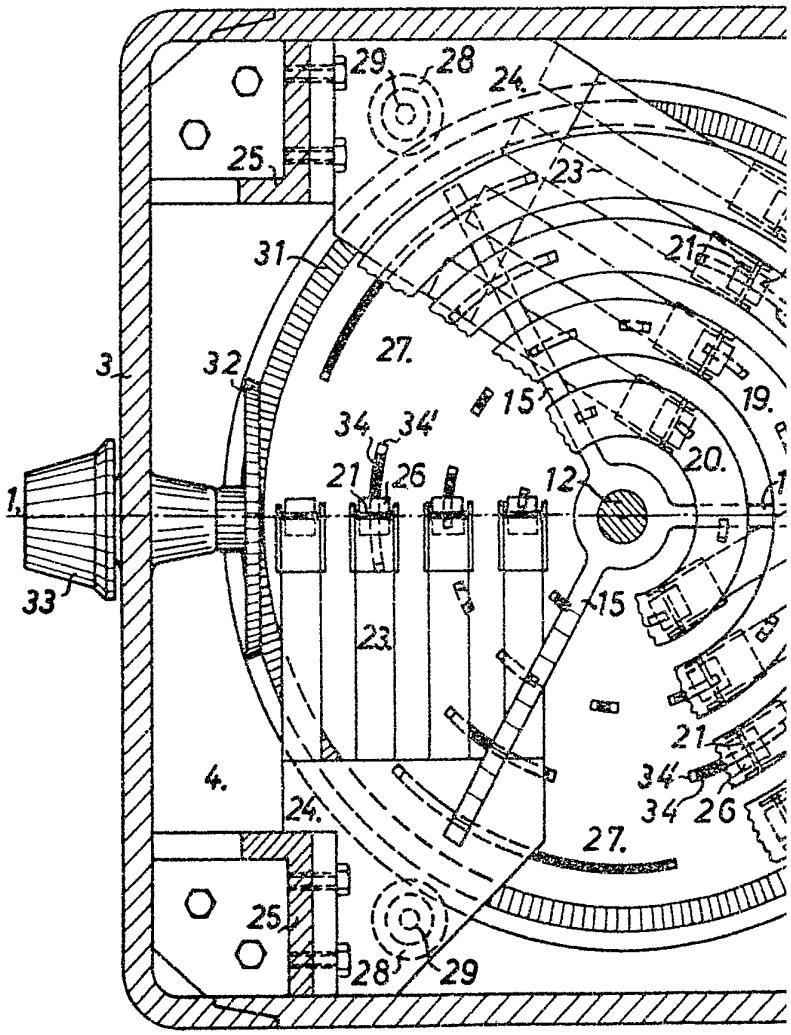

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Fig. 2

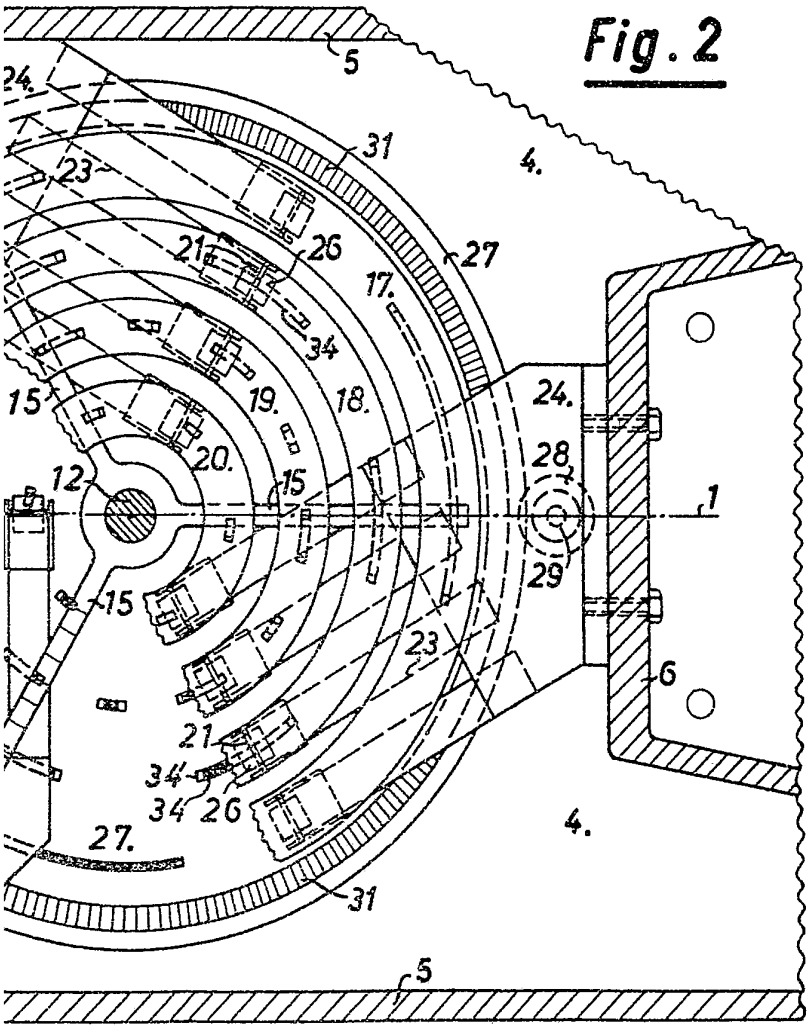

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Fig. 2