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(19)

(54) CALCULATOR

(71) I, HARALD RIEHLE, a German citizen, of Anna-Schieber-Weg 18, 7300 Esslingen a.N., Germany, 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:—

The present invention relates to a calculator comprising at least three concentric, scale-bearing rings placed one inside the other with their scale-bearing surfaces forming one smooth surface, which rings are coaxially rotatable relative to each other upon a base plate and are connected to each other by a planetary gearing arrangement in which at least one sun wheel and one planet wheel-carrier are provided by said scale-bearing rings.

In the case of a calculator of this kind described in German Patent Specification No. 882,151 the base plate is provided along its entire peripheral edge with a flange carrying a cover plate firmly connected thereto in which a window is cut beneath which pass three interrelated logarithmic factor scales which are shown on corresponding annular scale-carriers. Said scale-carriers are actual rings which can be printed when laid flat and can then be connected by countersunk screws to the related parts of the planetary gearing. Such a form of construction is costly to manufacture. Moreover, it is not possible in this arrangement of a window with stationary hair line, to displace this hair line along the scales, which is desirable to facilitate the calculation.

The object of the invention is to provide a calculator of the type initially described but which is distinguished by an improved overall picture of the calculating operation and which in particular, due to its simplicity of construction, is inexpensive to manufacture.

For this purpose the calculator according to the invention is characterised in that the scales themselves are formed directly on the scale-bearing surfaces are of the scale-bearing rings and are completely covered by annular cursors of a transparent material, each of which carries at least one reading mark or hair line, the cursors being concentrically mounted one inside the other, and mounted in such a manner that they are freely rotatable and not readily detachable.

Since the scale-bearing surfaces are of the scale-bearing rings, the manufacturing process is considerabdly simplified. Moreover, the freely rotatable transparent cursors afford an excellent overall picture of all the scales and also provide a means for easy adjustment of the hair lines relative to the scales to suit the particular calculation required. In addition, since the cursors cover over completely the normally printed scales, the risk of the scales being damaged during use is elinmiated.

Whilst, in themselves, the scales can be graduated according to the desired type of calculation, in the case of a preferred embodiment the arrangement is such that three scale-bearing rings each bear logarithmic factor scales which are interrelated and of which the centre scale is graduated in half-raton to that of the other two scales adjoining it on either side, whilst said scale adjoining it on one or other side is graduated in opposite direction to the centre scale. Furthermore, the transmission ratio of the planetary gearing is such that the centre scale-bearing ring is movable in the same direction as, but at half the speed of the driven inner scale-bearing ring, whilst one cursor carries at least one hair line which covers over two adjoining scales and follows a radial line.

By this construitios and arrangement of the logarithmic factor scales, in connection with the selected transmission of the plane-

tary gearing, a so-called "drag" effect is obtained as a result of which, in the case for example of a multiplication of two factors, the product appears together with the two factors on one and the same radial line upon which the hair line of the associated cursor may then be simply adjusted. This is quite different from the system employed for example in the normal rectangular-type slide rule with movable slide. As is known, in such slide rules, the slide is adjusted of course at a point on the corresponding logarithmic scale for one of the factors to be multiplied, whilst the product can be read off at another point corresponding to the second factor to be multiplied. This means that, at two different points on the scales with an interval between, adjustments or readings must be made, whereas, in the new calculator, the result of such a calculation can always be adjusted and read off along one single radial line.

Preferably, the base plate is provided with annular flanges on which the scale-bearing rings are radially guided and axially supported. Also, at least one scale-bearing ring may have supporting flanges moulded integral therewith, the purpose of which is to support the scale-bearing ring axially against the base plate.

This axial support means for the scale-bearing rings enables the scale-bearing surfaces of the scale-bearing rings to be conveniently printed because the supporting flanges absorb the pressure applied in the printing operation.

In order to ensure that satisfactory securing and guide means for the scale-bearing rings are provided, it is preferable that the centre scale-bearing ring should have, around its circumferential surfaces, annular peripheral ledges to co-operate with the adjoining scale-bearing rings, which annular ledges ensure that the centre scale-bearing rings is radially guided relative to said adjoining scale-bearing rings and is axially secured irremovably relative to the base plate. It is also of advantage if the outermost scale-bearing ring is connected to the base plate by an annular profile ring of U-shaped cross-section. Said profile ring may be of resilient material so that it may be simply prised open as the apparatus is being assembled. In addition, one of the cursors can be mounted in this ring.

Finally, it is of advantage that the innermost scale-bearing ring should have a disc-like cursor rotatably mounted on a hub, the arrangement being preferably such that the hub is formed on a milled knob which is irremovably connected to the scale-bearing ring. This connection may be achieved by the provision on the milled knob of moulded-on hooks which engage in holes in the scale-bearing ring so that, when the apparatus is being assembled, the selector knob is simply placed upon the scale-bearing ring in such a way that the hooks engage in the holes.

In order to increase the range of applications of the new calculator the base plate preferably has on its reverse side a smooth scale-bearing surface with whose scales a rotatably mounted disc, provided with scales and/or a hair line, is associated.

By this form of construction it is possible to have provision for calculation and reading operations, not only on the front but also on the reverse surface of the calculator; it is also conceivable that the scales on front and reverse surfaces may be interrelated.

The disc may advantageously be rotatably carried in the profile ring and it is also possible for the disc to have at least one reading window with hair line associated with one of the scales on the base plate.

In order to facilitate reading of the solutions and the like adjusted on the various scales, the arrangement is preferably such that the calculator has on the reverse face a rotatably mounted transparent cursor with hair line which covers the disc at least partially.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a plan view of the calculator according to one embodiment of the invention;

Fig. 2 is a sectional elevation of the calculator of Fig. 1 along the line II-II of Fig. 1, and on a different scale;

Fig. 3 is an underneath plan view of a calculator according to a second embodiment of the invention; and

Fig. 4 is a sectional elevation of the calculator of Fig 3, the view being similar to that of Fig 2.

In the drawings, identical parts in the two calculators are denoted by like reference numerals. Referring further to Figs. 1 and 2, the calculator comprises three concentric scale-bearing rings 1, 2, 3 placed one inside the other, which are coaxially rotatable relative to each other about a rotation axis 4 and whose scale-bearing surfaces 1*a*, 2*a* and 3*a* together form a smooth plane surface, shown most clearly in Fig. 2. The three scale-bearing rings 1, 2 and 3 are rotatably mounted on a circular base plate 5 and are coupled together by means of a planetary gearing system. The planetary gearing has a number of symmetrically distributed planet wheels 6 in the form of stepped gears, one of which is shown in Fig. 2, which are in engagement, on the one hand with a toothed rim 7 integral with the base plate and, on the other hand with a toothed

rim 8 formed on the scale-bearing ring 1. The planet wheels 6 are in addition each freely rotatable on bearing pins 9 which project downwards and are moulded integral with the scale-bearing ring 2. Thus the scale-bearing ring 2 forms the planet wheel carrier whilst the scale-bearing ring 1 forms a sun wheel of the planetary gearing thus described.

The base plate 5 carries upstanding, moulded-on, annular flanges 10, 11, 12 on which the scale-bearing rings 3, 2, 1, respectively, are radially guided and axially supported, as will be seen from Fig. 2. In addition to these, the scale-bearing rings are also provided with moulded-on support flanges which extend downwards to the base plate 5 and provide additional axial support for the scale-bearing rings. Said support flanges for the scale-bearing rings are indicated at 13 and 14 (Fig. 2). The bearing pins 9 of the planet wheels 6 also act as axial supporting elements for the scale-bearing rings 2.

Along both circumferential surfaces the centre scale-bearing ring 2 is provided with annual peripheral ledges 15, 16 which cooperate with corresponding overlapping annual peripheral ledges 17, 18 on the two adjoining scale-bearing rings 1 and 3, whereby the centre scale-ring 2 is radially contained and at the same time axially contained relative to the plate so that it is irremovable axially.

The scale-bearing surfaces 1*a*, 2*a* and 3*a* are applied directly to the scale-bearing rings 1, 2 and 3 and are completely covered by annular cursors 21 and 22 of transparent material, each of which carries at least one hair line 19, 20 (Fig. 1) and which are concentrically mounted one inside the other, as will be seen especially in Fig. 2. The two cursors 21 and 22 are freely rotatable and mounted so as to be not readily detachable by an arrangement in which the outer cursor 22 rotates with an annular flange 23 beneath a ring 24 of substantially U-profile and of resilient material, thus forming an annular seal round the face of the calculator. The outer scale-bearing ring 3 is firmly attached to the base plate 5, for example by an adhesive, and has a rounded peripheral edge 25 by means of which it is secured to the ring 24. The inner scale-bearing ring 1 has a hub 26 against which the inner cursor 21 is rotatably mounted. The hub 26 is formed on a milled knob 27 which is connected irremovably to the scale-bearing ring 1. For this purpose the milled knob 27 has moulded-on hooks 28 which engage in corresponding associated holes 29 in the scale-bearing ring 1 and are thus located therein.

The inner scale-bearing ring 1 itself is rotatably mounted on the base plate 5 by means of a tubular rivet 30 which is inserted into a corresponding central bore in the base plate 5.

As will be seen from Fig. 2, the two transparent cursors 21, 22 are of slightly wedge-shaped cross-section and are arranged so that they face towards each other at the thinner periphery of the wedge.

In the embodiments illustrated the scale-bearing surfaces 1*a*, 2*a* and 3*a* of the calculator each carry graduated logarithmic factor scales 1*b*, 2*b* and 3*b*. These scales are applied in the following manner.

The centre factor scale 2*b* carries graduations in half-ratio to those of the adjoining inner and outer scales 1*b* and 3*b*; also the inner scale 1*b* adjoining the centre scale 2*b* has graduations proceeding in opposite direction to those of said centre scale. The transmission ratio of the planetary gearing 6, 7 and 8 is such that the centre scale-bearing ring 2 is moved in the same direction as but at half the speed of the rotated inner scale-bearing ring 1 the rotation of which is effected by means of the milled knob 27.

The arrangement operates as follows. If, for example, a multiplication is required, the two factors to be multiplied and the product will appear one above the other following one single radial line, upon which the associated hair line 20 can be placed quite simply by rotating the cursor 22. In the case of the scale arrangement of Fig. 1 an example of this can be seen at 31 when the multiplication 2 x 2 = 4 can be read off.

The hair lines 19 of the inner cursor 21 are associated with the scale 1*b* and a further scale 33 which is additionally imposed on the inner scale-bearing ring 1 and which enables one to convert foreign currencies in a simple manner into Deutsch-Marks. For this purpose only one inner hair line 19 is adjusted to the scale graduation of scale 33 corresponding to the particular foreign currency, whereupon the inner scale-bearing ring 1 is rotated until the hair line 19 rotating therewith points to the scale values on scale 2*b* showing the number of foreign currency units, the answer to the conversion being read off on the outer scale 3*b* on the same radial line on which the hair line 19 lies.

It is manifest that, apart from the arrangements of scales which has been described, other scale graduations can be employed which answer other calculation requirements or other purposes.

All components of the present calculator are produced from plastics material and the scales, as already mentioned, are printed on the scale-bearing rings.

Whereas in the embodiment shown in Figs. 1 and 2 the reverse side of the base plate 5 is not of any particular construction, this blank reverse side may be ex-

ploited to extend the range of applications of the new calculator. A suggested manner of use is illustrated in Figs. 3 and 4. The calculator shown here corresponds otherwise, that is to say structurally, in every respect to that of Figs. 1 and 2; like parts therefore bear the same reference numerals but it is unnecessary to provide a complete description of all parts already described. On its reverse side the base plate 5 has a smooth plane surface which is provided in the embodiment shown with two scales indicated at 41 and 42. A rotatably mounted disc 43 is associated with the scales 41 and 42 and carries a scale 43*a* matching with the scale 42. The disc 43, which is partly transparent, engages in the region of its peripheral edge in the U-shaped profile ring 24 which for this purpose is provided with a sealing annular flange 24*a*. The disc 43 is also provided with a window 44 to which a hair line 45 is added to co-operate with the scale 41 on the reverse side 40 of the base plate 5, which scale 41 is visible through the window 44.

Finally, on the reverse side of the calculator a separate rotatable cursor 46 of transparent material is provided for the scales 42 and 43 and carries a hair line 47, the tubular rivet 30 serving as pivot pin. The cursor 46 enables one to read off calculation data obtained by co-operation of scales 42 and 43.

WHAT I CLAIM IS:—

1. A calculator having at least three concentric scale-bearing rings placed one inside the other with their scale-bearing surfaces forming one smooth surface, which rings are coaxially rotatable relative to each other upon a base plate, and are connected to each other by a planetary gearing arrangement in which at least one sun wheel and one planet wheel-carrier are provided by said scale-bearing rings, the scales themselves being formed directly on the scale-bearing surfaces of the scale-bearing rings and being completely covered by annular cursors of a transparent material, each of which carries at least one reading mark or hair line, the cursors being concentrically mounted one inside the other, and mounted in such a manner that they are freely rotatable and not readily detachable.

2. A calculator in accordance with claim 1, in which three scale-bearing rings each bear logarithmic factor scales which are interrelated and of which the centre scale is graduated in half-ratio to the other scales adjoining it on either side and one of which is graduated in the opposite direction to the centre scale, the transmission ratio of the planetary gearing being such that the centre scale-bearing ring is movable in the same direction as, but at half the speed of the rotated inner scale-bearing ring, whilst one cursor carries at least one hair line which covers over two adjoining scales and follows a radial line.

3. A calculator in accordance with claim 1 or 2, in which the base plate carries upstanding moulded-on annular flanges on which the scale-bearing rings are radially guided and axially supported.

4. A calculator in accordance with any one of the preceding claims, in which at least one scale-bearing ring carries moulded-on support flanges by means of which it is supported axially upon the base plate.

5. A calculator in accordance with claim 2, or claims 2 and 3 or 4, in which along both circumferential surfaces, the centre scale-bearing ring is provided with annular peripheral ledges, which co-operate with the two adjoining scale-bearing rings whereby the centre scale-bearing ring is radially guided relative to said adjoining scale-bearing rings and at the same time is axially contained relative to the base plate so that it is axially irremovable.

6. A calculator in accordance with any one of the preceding claims, in which the outermost scale-bearing ring is connected to the base plate and carries an annular profile ring of U-shaped cross-section.

7. A calculator in accordance with claim 6, in which said profile ring is of resilient material.

8. A calculator in accordance with claim 6 or 7, in which one of the cursors is mounted in the profile ring.

9. A calculator in accordance with any one of the preceding claims, in which the inner scale-bearing ring carries a disc-like cursor rotatably mounted on a hub.

10. A calculator in accordance with claim 9, in which said hub is formed on a milled knob which is irremovably connected to the inner scale-bearing ring.

11. A calculator in accordance with claim 10, in which said milled knob carries moulded-on hooks engaging in holes in the inner scale-bearing ring.

12. A calculator in accordance with any one of the preceding claims, in which the cursors are of slightly wedge-shaped cross-section and are arranged so that they face towards each other at the thinner periphery of the wedge.

13. A calculator in accordance with any one of the preceding claims in which the base plate has on its reverse side a smooth plane scale-bearing surface, and a rotatably mounted disc with scales and/or a hair line co-operates with the scales of said surface.

14. A calculator in accordance with claims 6 and 13, in which said disc is rotatably carried in the profile ring.

15. A calculator in accordance with claim 13 or 14, in which said disc is provided with at least one window with hair line to

co-operate with a scale on the base plate.

16. A calculator in accordance with any one of claims 13 to 15, in which on its reverse side, it has a rotatably mounted cursor with hair line which covers the disc at least partly and is of transparent material.

17. A calculator substantially as hereinbefore described with reference to Figs. 1 and 2 of the accompanying drawings.

18. A calculator substantially as hereinbefore described with reference to Figs. 3 and 4 of the accompanying drawings.

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Sheet 1

Fig. 1

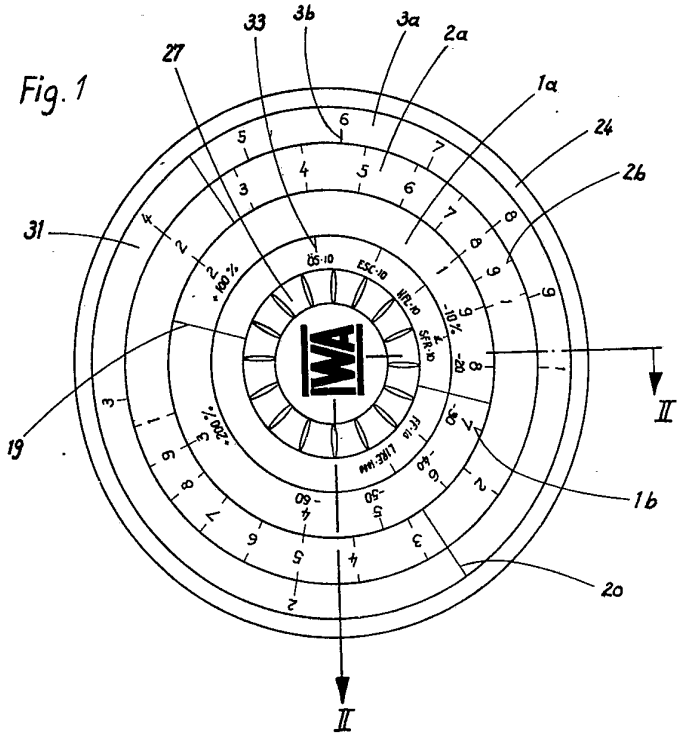
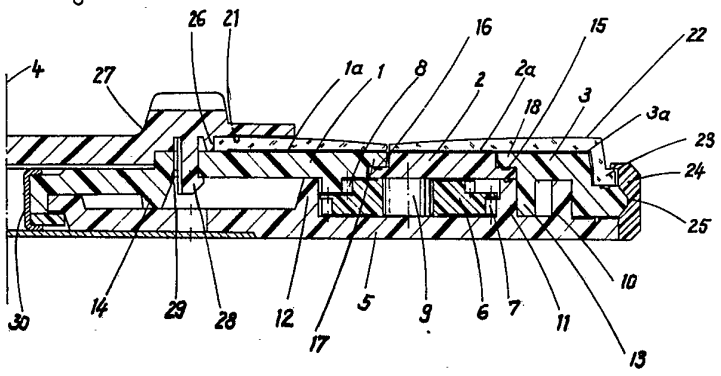


Fig. 2



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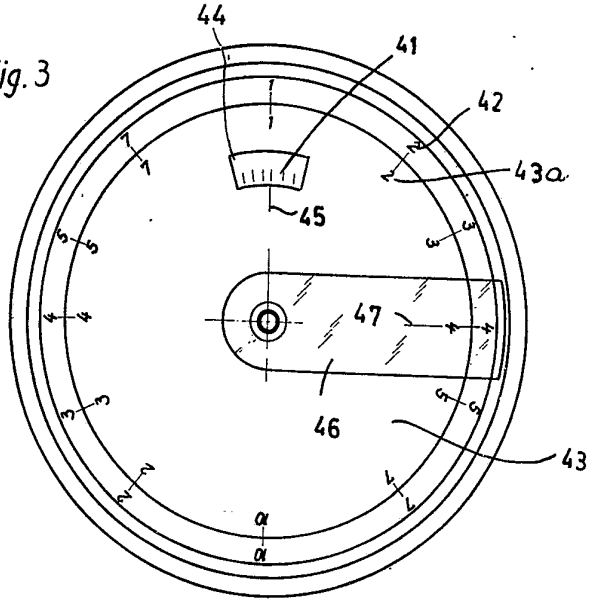
Sheet 2

Fig. 3



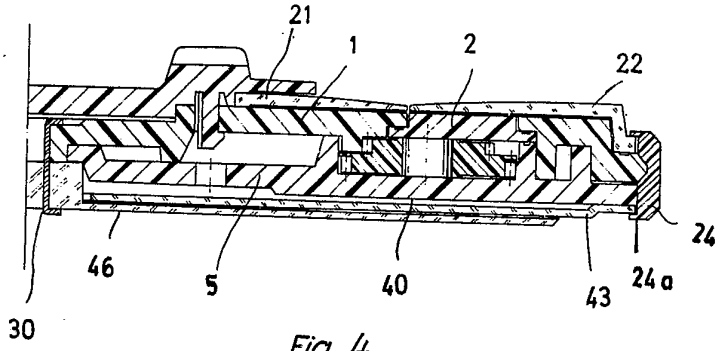


Fig. 4