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Riehle

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[54] **COMPUTING OR CALCULATING DEVICE**

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[52] **U.S. Cl.** **235/119,** 235/78, 235/88

[51] **Int. Cl.** **G06c 27/00,** G06c 3/00

[58] **Field of Search** 235/119, 116, 88, 78

[56] **References Cited**

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[57] **ABSTRACT**

Three concentric disks are supported on a base plate, rotatable with respect to each other. The center disk forms, additionally, the sun gear and the intermediate disk the planetary carrier of a planetary drive interconnecting the three disks, the top faces of which have scales engraved or printed thereon (for example logarithmic, so that the disks can function as a slide rule); the disks are covered by two relatively freely rotatable transparent cover plates having an index marking, and forming cursors. All scales are retained together by overlapping ridges, or notches, or the like. The backside of the bottom disk, or support plate, may likewise be formed with scales, and windows through which the scales therebeneath on the plates may be visible.

18 Claims, 4 Drawing Figures

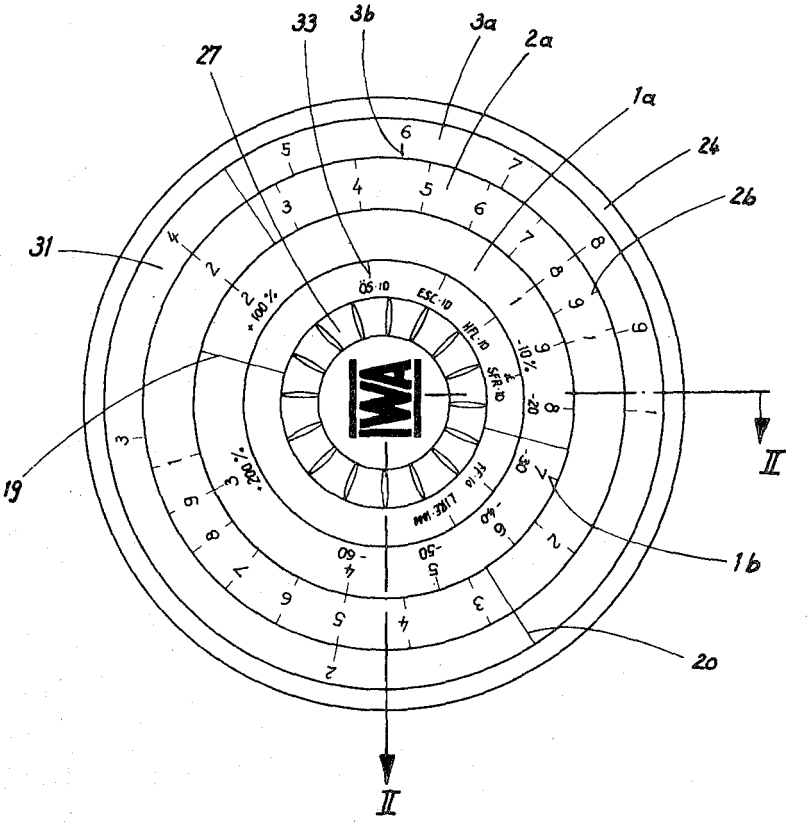
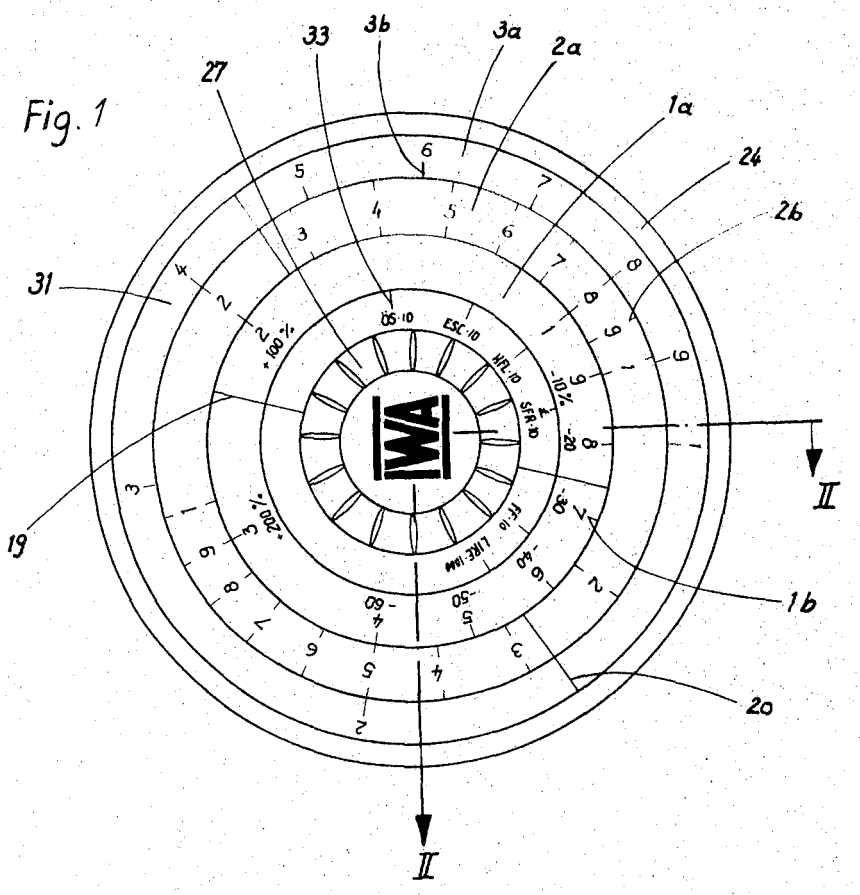


Fig. 1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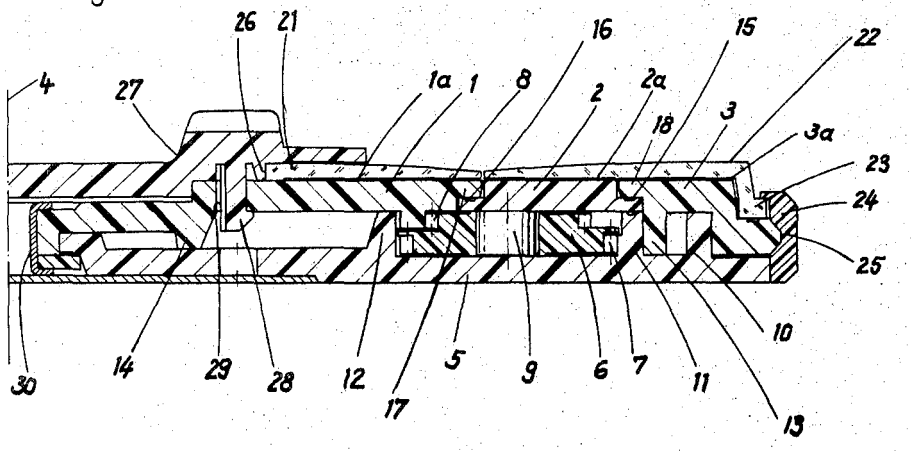
3b
3a
2a
27
1a
24
26
31
19
1b
2o
II
II

Fig. 2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21
16
15
22
4
27
1a
1
8
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2a
18
3
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6
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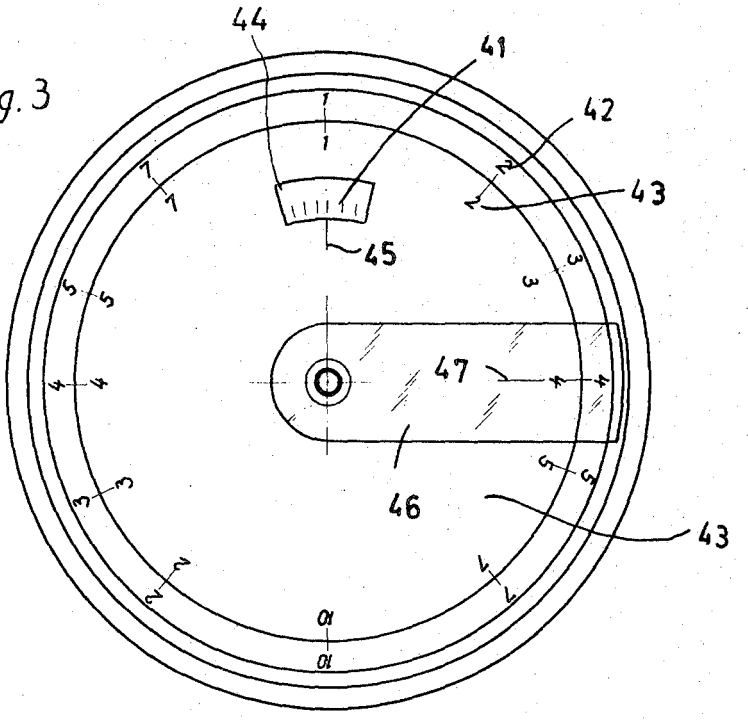
11
13

Fig. 3



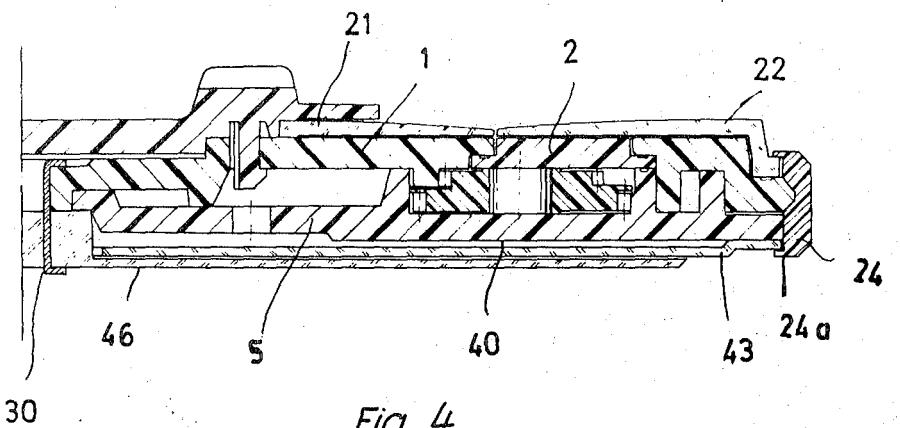


Fig. 4

COMPUTING OR CALCULATING DEVICE

The present invention relates to a calculating or computing device, for example to the type of calculating device which can be used as a multiplication instrument having a number of scales, similar to a slide rule, and in which a plurality of ring-shaped concentric scale carriers are located in a support, the scale carriers being coaxially rotatable with each other and coupled with each other by a gear drive.

Circular slide rule-type devices to which the present invention relates have been previously proposed (see, for example, German Pat. No. 882,151) in which a base plate is provided, the outer circumference of which is formed with a circular edge on which a fixed cover plate is secured, the cover plate being formed with a reading window. Three logarithmically subdivided scales are located beneath the window, on suitable disk, or ring-shaped scale carriers. These scale carriers are individual rings, printed on their flat surface, and secured by means of recessed screws with associated portions of a planetary drive. Construction of such a device is expensive, and the arrangement of a single window with fixed index marking does not permit movement of the marking with respect to the scales, as would be desirable in various computation processes.

It is an object of the present invention to provide a computing device of the aforementioned type which is so arranged that the computing steps are more easily checked, which is simple in construction, can be made of molded or otherwise formed plastic parts, and which can be inexpensively produced.

Subject matter of the present invention: Briefly, the surfaces carrying the scales are printed on disk-shaped elements (concentrically arranged, the two outer disks being ring-shaped). The concentric disk-shaped carriers are completely covered by cover disks of transparent material, having at least one index marking to form a cursor. The elements are rotatable with respect to each other and retained by means of interengaging construction so that they cannot become separated from each other.

Surfaces carrying the scales are directly formed on the scale carriers. This provides for substantial simplification of manufacture, which, when the scale carriers are covered by freely rotatable cursors of transparent material, permit complete survey of the entire scale, facilitating adjustment, and reading of the scales with respect to index marking. Covering the scales entirely by a transparent carrier additionally protects the scales from mechanical damage, or other deteriorating influences which affect readability of the scales and their markings.

The scales can be subdivided in accordance with any desired computation step; in a preferred embodiment, the arrangement is so made that the three scale carriers have logarithmic scales placed thereon; the center scale, preferably, has half the circumferential length distribution as the two fitting and outer scales, and the inner scale is marked off in a direction counter the other two scales. The transmission ratio of the planetary drive is then so selected that the central scale carrier rotates with half the speed with respect to the other scales. Forming a radial index line on the cursor covering at least two adjacent scales then permits computation of multiplication steps in one easy setting.

In accordance with a feature of the invention, the bottom or obverse sides of the plates or disks can likewise be supplied with scales, for example visible through a window in the support plate and/or additionally supplied with a movable index marker to include additional computation features which may, or may not be coordinated with the scale markings on the facing side of the disks or plates.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a general top view of the computing device;

FIG. 2 is a section taken along line II—II of FIG. 1, and to a different scale;

FIG. 3 is a bottom view, flat, of the apparatus in accordance with the present invention and

FIG. 4 is a modified embodiment, in sectional view, taken similar to FIG. 2.

Referring first to FIGS. 1 and 2: Three scale carriers 1, 2, 3 are coaxially rotatable about an axis 4 (FIG. 2). They are disk-shaped, the central disk 1 having a central opening, the two concentric outer disks 2, 3, being ring-shaped. The upper surfaces 1*a*, 2*a*, 3*a* of disks 1, 2, 3, carry scales mounted thereon. The upper surfaces are in a common plane, as best seen in FIG. 2. The three scale carriers 1, 2, 3 are rotatable on a circular base of support plate 5, and coupled together by means of a planetary drive. The planetary drive includes a plurality of symmetrically distributed planet gears 6, one of which is shown in FIG. 2. The gears are axially stepped, and engage on the one hand, a gear ring 7 which is secured to the base plate 5 and, on the other hand, an inner or sun gear ring 8 formed on the inner scale carrier 1. The planet gears 6 are freely rotatable about a bearing pin 9, which is secured to the scale carrier 2, for example by being unitary therewith and projecting downwardly. The scale carrier 2 thus forms the planetary gear carrier; scale carrier 1 forms the sun gear for the planetary drive.

The base plate 5 is formed with projecting extensions 10, 11, 12 to provide radial guidance for the scale carriers 3, 2, 1, respectively, and further to provide an axial support therefor. The scale carriers, additionally, are formed with projections which extend to the base plate 5 and provide for additional axial support. These support projections 13, 14 extend from the scale carriers 1, 3, respectively. Further support projections may be provided. The bearing pin 9 for the planetary gears 6 also functions as an axial support element for the scale carrier 2.

The central scale carrier 2, which is ring-shaped, is formed along its circumferential surfaces with ring-shaped projecting flanges 17, 18 which cooperate with overlapping flanges of the adjacent scale carriers 1, 3, so that the central scale carrier ring disk 2 is both radially guided and further retained to be properly axially located with respect to the base plate 5.

Scale markings are directly formed on the surfaces 1*a*, 2*a*, 3*a* of the scale carriers 1, 2, 3 respectively. A pair of concentric, immediately adjacent cover disks 21, 22 completely cover the scale carriers 1, 2, 3. The cover disks 21, 22 are made of transparent material and are formed with reading index 19, 20 (FIG. 1); additional index markers may be used. The cover disks 21, 22 operate as cursors. The two cover disks 21, 22 are freely rotatable and located so as to be unremovable

and inseparable from the entire unit. The arrangement is so made that a ring flange **23** formed on the outer disk **22** is overlapped by a ring **24** which has a generally horizontally placed U-shaped profile. The ring **24** is made of elastically deformable material and forms an end cover for the calculating device. The outer scale carrier **3** is secured to the base plate **5**, for example by an adhesive. It is formed with a projecting nose **25**, which engages a similar groove in ring **24**, to retain the ring **24** in position.

The inner scale carrier **1** is formed with a hub **26** on which the inner cursor **25** is rotatably journaled. Hub **26** is formed to project as a rotatable button **27**, which is attached to or secured to the inner scale carrier **1**. In a preferred form, and as shown in FIG. **2**, the button **26** has projecting hooks **28** which snap into associated openings **29** of the scale carrier **1**, the button **27**, like the other materials of the device, being made of plastic so that the projecting hook **28** is slightly deformable for snap-in engagement.

The inner scale carrier **1** itself is rotatably journaled on the base plate **5** by means of a hollow rivet **30** (FIG. **2**) which is fitted into a suitably formed central opening of the base plate **5**.

The two concentric cursor disks **21, 22** are shaped to be slightly converging in cross section, so that they fit against each other in the region of decreased wall thickness.

Referring to FIG. **1**: the scale carrying surfaces **1***a*, **2***a*, **3***a* are formed with logarithmically subdivided scales **1***b*, **2***b*, **3***b*, respectively. These scales are arranged such that the central scale **2***b* has half the circumferential extent as the two outer adjacent scales **1***b*, **3***b*, that is, the central scale **2** is repeated twice on the circumference thereof. The transmission ratio of the planetary drives **6, 7, 8** is then so selected that the central scale carrier **2** operates at half the speed, and in the same direction as the driven inner scale carrier **1**. The inner scale carrier **1** is rotated by means of the button **27**.

The arrangement provides that, for example upon multiplication, the factors to be multiplied and the multiplication result will appear in a single radial line opposite each other. The result to be read can readily be set by means of the index line **20** on the outer cursor disk **22**. The illustration of FIG. **1** shows multiplication of 2 × 2 = 4. This result is indicated at **31** in FIG. **1**.

The index mark **19** of the inner cursor disk **21** is associated with a further scale **33** which is additionally placed on the inner scale carrier **1**. The further scale **33** can carry additional constants which often arise in certain multiplications; in the example shown, the constants are various currencies which can be used for simple calculation of multiplication factors to convert foreign currencies into equivalent values. The inner index mark **19** is set to the respective currency of the scale **33**, and the inner carrier **1** is then rotated until the index mark **19**, rotating therealong, fits the amount in foreign currency on scale **2***b*. The result of the currency conversion is then read on scale **3***b* in the same radial line as the index mark **19**.

Other arrangements of scales, other transmission ratios and other scale distributions or values can be used, as desired, depending on the use to which the calculating device will be put.

All parts of the device are made of plastic material; the scales **1***b*, **2***b*, **3***b* can be printed or engraved directly on the surfaces **1***a*, **2***a*, **3***a*, respectively, of the carriers **1, 2, 3**.

The base plate **5** may have any desired shape, preferably circular so that it fits directly and can be secured with the outer ring **24**. The free space of base plate **5** may, however, be used to increase the utility of the calculating device, as seen in FIGS. **3** and **4**. Basically, the construction of the device of FIGS. **3** and **4** is similar to that of FIGS. **1** and **2** and similar parts have been given the same reference numerals and will not be described again. The base plate **5** has a flat surface on its back, which is formed with two scales **41, 42**. The scales **41, 42** have a rotatable disk **43** associated therewith which has a scale **43'** located thereon, cooperating with scale **42**. Disk **43** is partially transparent and located and secured by ring flange **24'** (FIG. **4**) which is formed with an additional overlapping flange **24***a* (FIG. **4**). Disk **43** is additionally formed with a window **44**, and provided with a reading index **45** which cooperates with scale **41** of the bottom surface **40** of base plate **5**, and visible through the window **44**. A separate rotatable cursor **46** of transparent material is additionally secured to the bottom of the device, the cursor **46** having a reading marker **47**. All the rotatable elements are held together centrally by an extended central hollow rivet **30'**. The cursor **46** facilitates reading of the cooperating scales **42, 43**, and calculating results.

The transparent disks, and cursors permit simple adjustment of the device, and easy reading, while providing, further, for a ready check of any calculating steps. Additionally, they prevent damage to the scales in use, or storage.

The arrangement of the logarithmic scales, as described, in combination with the transmission ratio as described provides a coupled drive which has the result that, for example in multiplication of two factors, the multiplication result of these two factors will appear at a single radial line, which can readily be read by adjustment of a single index marker on the associated cursor. This is in contrast to the relationship which obtains, for example, in the usual longitudinal slide rules with a longitudinally slidable central scale slider and longitudinally slidable cursor. Longitudinal slide rules, as well known, are used by arranging the slider at a position of the corresponding logarithmic scale with respect to one of the factors to be multiplied, the multiplication result being read off by aligning the cursor with the other factor to be multiplied, and reading of the result on the first scale. As a result, the setting operation and the reading operation are separated from each other along the length of the slide rule. In the apparatus of the present invention, the factors and the result are read in a single radial line, thus greatly facilitating the visualization of a calculating operation.

The projections extending from the carrier disks permit easy application of the scales, for example by printing, since the projecting supports can accept the printing pressure which arises during the printing operation. The outer ring **24, 24'** is preferably made of deformable, elastic material, such as slightly stretchable plastic, so that it can be merely snapped in place when the calculating device is assembled. One of the cursors is, further, held in position by means of an inwardly extending flange, overlapping the cursor.

The rotating knob **27** of the central hub is preferably a projecting ring which is grooved, or knurled, as schematically indicated in FIG. **1**, and also seen in FIGS. **2**

and 4. The snap connection of this knob with the inner scale carrier 1, therebelow, provides for easy assembly, and prevents removal of the knob, and loss of any parts.

The scales on the reverse side of the unit (FIGS. 3, 4) can be independent of the scales on the front (FIGS. 1, 2) or cooperating therewith, for example the back scales may contain trigonometric functions, relationships which frequently arise in computations (for example multiplication with π) or may be entirely independent to carry out different computations (for example to base e).

Various changes and modifications may be made within the scope of the inventive concepts, and features described in connection with any embodiment may be used with other embodiments described.

I claim:

1. Calculating or computing device comprising
a base support plate (5);
three circular, concentric disk-like scale carriers (1, 2, 3) coaxially located on the base plate (5) and relatively rotatable with respect to each other, said scale carriers having
first, second, and third scales (1*b*, 2*b*, 3*b*) located, respectively, thereon, one scale on each carrier;
a planetary gear drive (6, 7, 8) coupling said scale carriers (1, 2, 3) together;
one scale carrier forming the sun gear for the planetary gear drive and a second scale carrier forming the planetary gear carrier for the planetary gear drive;
and wherein the first, second, and third scales (1*b*, 2*b*, 3*b*) are formed directly on the upper surfaces (1*a*, 2*a*, 3*a*) of the scale carriers (1, 2, 3);
a pair of disk-shaped cursors (21, 22) of transparent material together entirely covering said scales;
and means (24, 24'; 27; 30, 30') rotatably securing and assembling said cursors to the scale carriers to cover said scales while permitting free and independent rotation of each of said cursors with respect to the scale carriers and with respect to each other.

2. Device according to claim 1 wherein the scales (1*b*, 2*b*, 3*b*) are logarithmic scales; the intermediate one (2*b*) of said concentric scales being at half scale measure with respect to the two adjacent inner and outer scales (1*b*, 3*b*), and the inner scale subdivided in a direction extending counter to the direction of the other scales;
and the transmission ratio of the planetary gear drive (6, 7, 8) is so selected that the intermediate scale carrier (2) located between the inner and outer concentric scale carriers (1, 3) is driven at half speed and in the same direction as the inner scale carrier (1);
and a radial index marker (20) is formed on at least one of the cursors (22), said cursor covering at least two adjacent scales, and said index marker (22) extending over said adjacent scales.

3. Device according to claim 1 wherein the base plate (5) is formed with ring-shaped projecting protrusions (10, 11, 12) radially guiding and axially supporting said scale carriers (3, 2, 1).

4. Device according to claim 1 wherein at least one of the scale carriers (3) is formed with protrusions (13) extending axially towards the base plate (5) to provide a counter-support with respect to the base plate.

5. Device according to claim 1 wherein said concentric scale carriers form an inner disk (1) an intermediate ring-shaped disk (2) and an outer ring-shaped disk (3);
the intermediate ring-shaped disk, and the adjacent inner and outer disks being formed with engaging, overlapping flanges (15, 16) to provide radial guidance and axial non-separable connection between said disk carriers.

6. Device according to claim 1 wherein one of said disk carriers (3) is secured to the base plate (5).

7. Device according to claim 5 wherein the outer ring-shaped disk (3) is secured to the base plate (5).

8. Device according to claim 1 wherein said securing and assembly means comprises a circumferential ring (24) of generally U-shaped cross section, overlapping one of said cursors and secured to the base plate (5).

9. Device according to claim 8 wherein the ring (24) comprises elastic material and is snapped in place over the circumference of the base plate.

10. Device according to claim 8 wherein the circumferential ring (24) has an interiorly radially extending projecting flange, said flange overlapping the outer one of the disk-shaped concentric cursors.

11. Device according to claim 1 wherein said cursors are a pair of concentric ring-shaped disks (21, 22);
the inner scale carrier (1) being formed with a hub (26);
and the inner one of said cursor disks (21) being rotatably journaled on said hub (26).

12. Device according to claim 11 further comprising a rotating knob (27) secured to the hub (26), said knob and hub being secured to said inner scale carrier (1).

13. Device according to claim 12 wherein the knob (27) is formed with projecting hooks (28);
the scale carrier (1) is formed with openings (29), said hooks being slightly deformable and snapped into said openings.

14. Device according to claim 1 wherein the cursors are concentric ring-shaped disks having a respective tapered cross section, the minimum wall thickness of said cross sections being located at adjacent, facing ends of said disks.

15. Device according to claim 1 wherein the base plate (5) is formed with a flat surface (40) and including:
a rotatable disk (43) fitting against said base plate and being rotatably secured thereto;
and index scales (41, 42; 43'; 45) formed on said disk (43) and on said surface (40) of the base plate (5).

16. Device according to claim 15 wherein said securing means comprises a circumferential ring having inwardly radially projecting flanges;
and said disk (43) is rotatably journaled in said circumferential ring (24').

17. Device according to claim 15 wherein said disk (43) is formed with a partially transparent zone or window (44), and an index marker (45) adjacent said window or transparent zone and cooperating with a scale (41) on said base plate (5).

18. Device according to claim 15 further comprising a back cursor (46) located adjacent said disk (43) and at least partially covering said disk, said back cursor (46) being transparent and being formed with an index marker (47).

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