

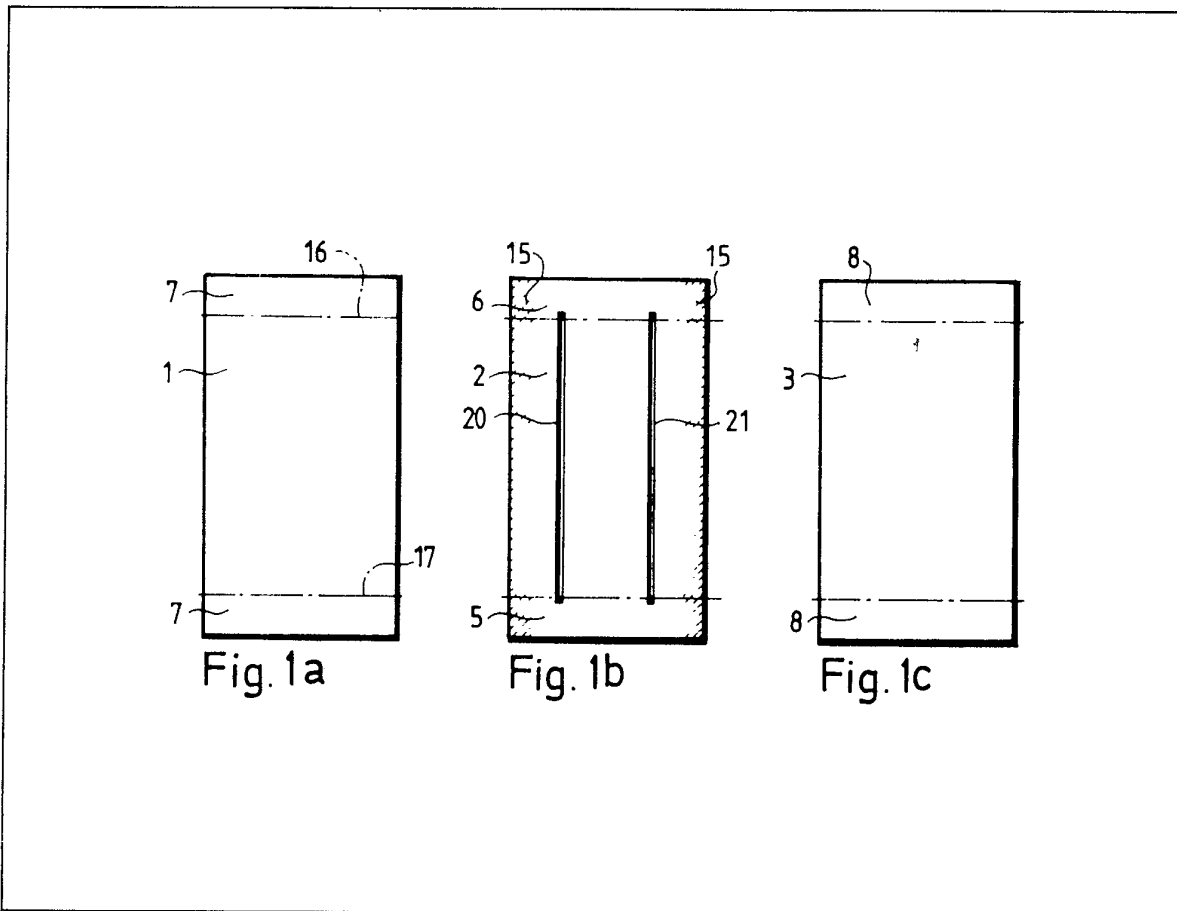
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- (71) Applicants
Harald Riehle,
Anna-Schieber-Weg 13,
D-7300 Esslingen,
Federal Republic of
Germany.
- (72) Inventors
Harald Riehle

(74) Agent and/or Address for
Service
E.N. Lewis and Taylor,
144 New Walk,
Leicester LE1 7JA.

(54) Slide-rule

(57) A slide-rule is obtained by superpositioning and connecting three plates (1, 2, 3) into the middle one of which slots (20, 21) are milled, and thereafter cutting off the boundary areas (5, 6, 7, 8), including the boundary areas (5, 6) of the middle plate (2), into which the slots (20, 21) do not extend. The slots may be parallel, or, in the case of a rotating disc slide-rule, a single port circular slot is cut. The plates may be of plastics, metal, or cardboard.



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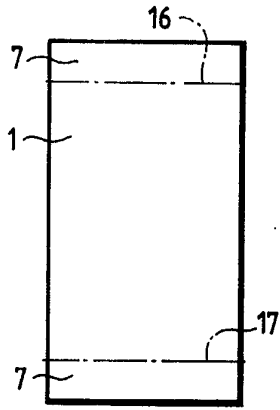


Fig. 1a

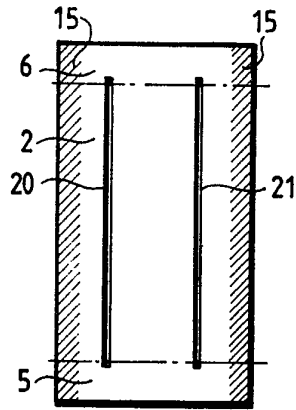


Fig. 1b

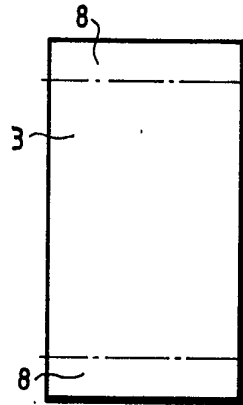


Fig. 1c

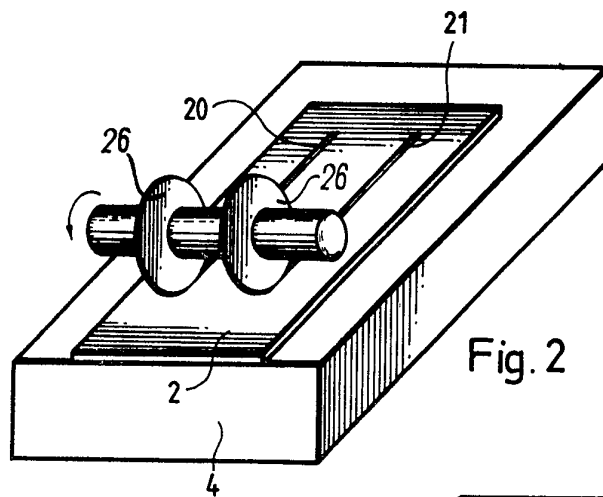


Fig. 2

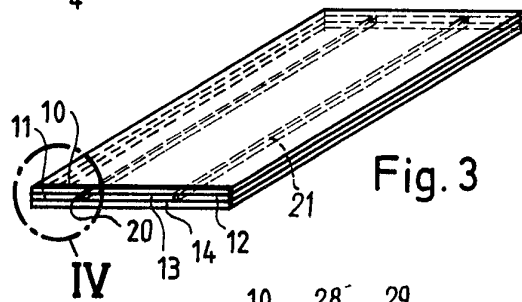


Fig. 3

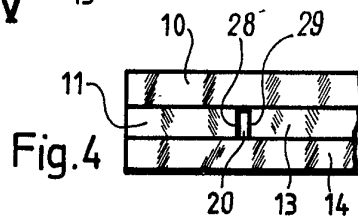
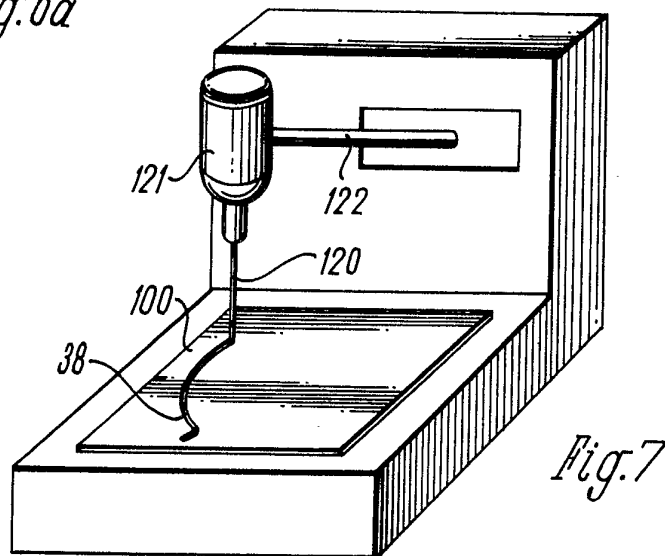
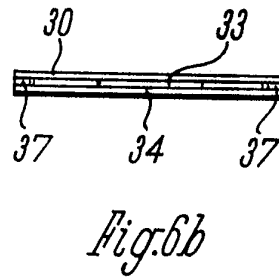
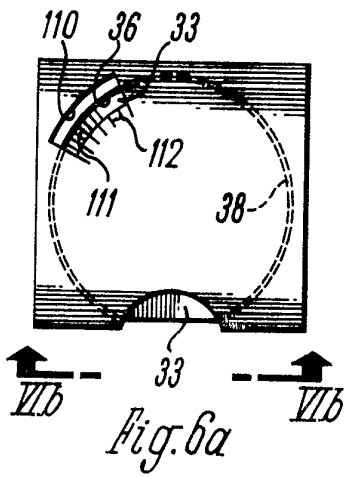
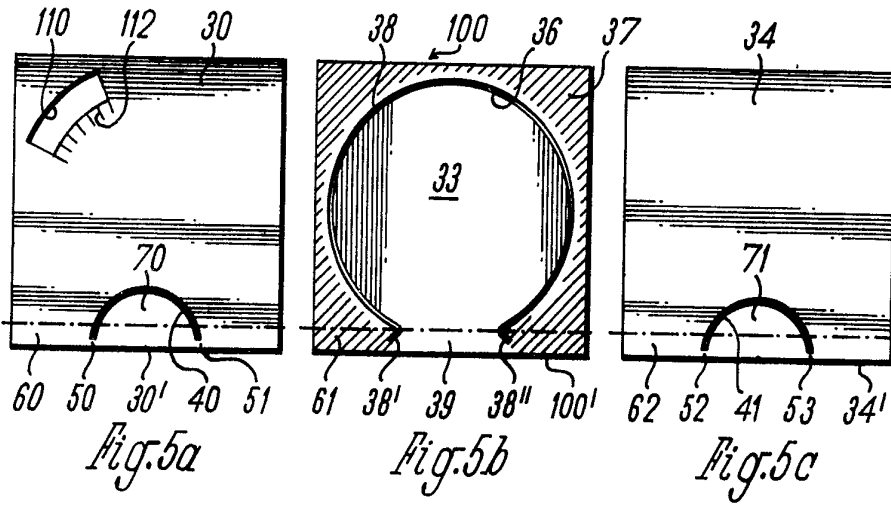


Fig. 4



SPECIFICATION

Slide rule

5 The invention relates to a slide-rule comprising of an upper cover plate, a lower cover plate and a slide positioned between those cover plates and further surrounded at both sides by guide members. Slide rules of this general kind are known.

10 With a known method for producing such slide-rules, the guide members are bonded to the lower cover plate. Thereafter the upper cover plate is bonded to the guide members and the structure, in which the slide is guided, is thus obtained. Even-
15 though resulting in a simple construction of the slide-rule, this requires some time and still, since in order to maintain parallelism of the guide members and keep the exact required distance of the same special gauge means are necessary when connect-
-20 ing the guide members to the cover plates. It is also known to construct slide-rules by cutting two parallel lines with a knife or the like into a card board plate; the cutting lines thereby do not fully separate the plate. Thereafter, the plate is connected to an upper
25 and a lower cover plate and the boundary areas, which include the portions still connecting the guide members and slide, are cut off.

With this type of production, no adjustment steps or means are necessary; however, by the cutting
30 action oblique surfaces with burrs are generated. Some material along these obliquely cut edges is displaced and results in a bow or vault along the edges. It is not possible to obtain rectangularly cut surfaces opposing each other as required for accu-
35 rate sliding of the slide on the surfaces of the guide members. The parallelism of the guide surfaces is not accurate enough. As a consequence of the obliqueness of the side surfaces - especially when the slides are of broader width - a danger exists that
40 the slide slips or moves between the guide members and the cover plates. This means that the guidance of the slide and the accuracy of reading the scales on the cover plates largely deteriorates. Further, with this procedure one can only produce slide-rules of
45 paper board. If the mentioned process is applied to plastic foil or sheets, the bows or vaults generated by the displacement of material along the cutting edges will become too large.

A further procedure is known from German Patent
50 22 54 387. It provides that the cover plates are connected between two connecting rails, which serve as guide members and which are generally E-shaped. The middle flanges at the E-shaped rail serve as the guides of the slide. This method
55 provides precisely guided slides; however, it requires a certain effort during production and therefore is too time consuming.

It is the object of the present invention to provide a slide-rule, with which the slide member and the
60 guide members for guiding said slide member can be as simple as possible and produced from one part only; it is a further object that the disadvantages of the state of the art, especially with respect to the accuracy of guiding the slide, are avoided.

65 It is a further object of the invention that a slide

member of type mentioned above can be easily and rationally produced; such production also shall be possible from other materials than paper board, especially from plastics or metal blank sheets.

70 Further, it is an object of the invention, that a particular adjustment of the cover plates, the guide members and the slide is not necessary.

Further, it is an object of the invention that one can easily select a predetermined clearance between the
75 guide members and the slide.

The invention provides a slide rule, comprising an upper cover plate, a lower cover plate, and a slide freely movable between said cover plates and also between guide members arranged at the sides of the
80 slide, wherein the slide and the guide members are formed by providing in an intermediate plate a pair of parallel slots with side surfaces, which are rectangularly parallel to each other and spaced from each other by a certain predetermined distance, and
85 wherein the intermediate plate is connected, in a manner per se known, to an upper cover plate blank positioned above the intermediate plate and to a lower cover plate blank positioned below the intermediate plate, wherein the boundary areas of the
90 assembly obtained thereby are cut off, said boundary areas including unslotted boundary areas of the intermediate plate and the boundary areas of the other plate blanks overlying the same.

By providing within a plate parallel slots with
95 accurately rectangular and spaced surfaces, it is possible to attain a very accurate guiding mechanism of the slide within the guide members; at the same time a predetermined clearance can be selected by selecting the distance between the side
100 surfaces of the slots, i.e. the width of the slots. The guidance of the slide between the guide members still can be improved, when a lubricating agent is retained by the roughness of the surfaces of the slots.

The slot is not provided by cutting action, since this would in practice squeeze the material and therefore result in oblique surfaces and a displacement of the material mentioned above, as it is the case with the prior art. It is rather important that the
110 slot is provided in such a manner that rectangular and parallel side surfaces result, which are spaced from each other by a predetermined distance. Preferably this is attained by chip removal, as e.g. by milling with circular saw blades.

It is possible, by using the invention, to make the
115 guide members and the slide from plastics or metal sheets. This leads to simple mass production with materials, with which this has not yet been possible. The connection of the plate, from which the slide and
120 the guide members are made, with the upper and the lower cover plates can be attained by glueing, by high frequency or ultrasonic welding and/or by rivetting. When metal is used, the connection also can be made by spot-welding.

The principle of this invention also can be used
125 with slide-rules of the rotatable disc type. Such a slide-rule comprises an upper cover plate, a lower cover plate, and a round disc received rotatably between the cover plates and further received within
130 a recess in a guide member of corresponding

circular form.

The invention provides in this respect that the slide-rule is produced by producing the disc and the guide member from a plate by providing this plate with a slot, which has the form of a full circle - with the exception of a small bridging portion closed to one edge of the plate. Further, both cover plates also are provided with slots, which extend from the edges in the direction of the disc beyond the

bridging portion of the first mentioned plate; additionally, these slots are separated from the edges of the plates, from which they extend into the interior of the same, also by small bridge portions. The slide-rule then is formed in a manner per se known in the art by connecting the first mentioned plate with both cover plates; subsequently, the boundary portions, within which the bridging portion are provided, are simply cut off, whereby the disc is made rotatable within the guide member.

In addition to the same advantages mentioned above, namely accurate guidance of the rotating disc within the guide member, it is no longer necessary to connect the centre of the disc to the cover plates by means of a shaft or a hollow rivet. Centering of the disc is achieved without such connection solely by the exact correspondence of the recess in the guide member to the disc.

This and other advantages of the invention will become clear from the following description of various embodiments. It will be understood that the description is given by way of example only and not by way of limitation.

In the drawings:-

Figure 1a, 1b, 1c show plates used to make the first embodiment;

Figure 2 depicts a schematic illustration of the production of plate 2 in accordance to *Figure 1b*;

Figure 3 shows a first embodiment;

Figure 4 shows an enlarged illustration of area IV in *Figure 3*;

Figure 5a, 5b, 5c show plates used to make the second embodiment;

Figure 6a and *6b* are a top view and front view respectively of a second embodiment;

Figure 7 depicts a schematic illustration of production of plate 100 as used with the second embodiment.

For the production of a slide-rule shown in *Figure 3*, three plate blanks as shown in *Figure 1a, 1b* and *1c* are provided. Plate 1 is for use in obtaining the upper cover plate 10 of the slide rule, intermediate plate 2 is for use in obtaining the guide strips 11, 12 and the slide 13; plate 3 is for use in obtaining the lower cover plate 14.

The slide-rule in accordance to *Figure 3* consists of upper cover plate 10, guide strips 11, 12, a slide member or slide tongue 13 (hereinafter referred to simply as slide) and lower cover plate 14. In the slide-rule, the guide strips 11, 12 will be arranged on the both sides of slide 13 and the guide strips 11, 12 will be connected to upper cover plate 10 and lower cover plate 14 for example by glueing. The slide 13 then is freely movable between the cover plates 10, 14 and between guide strips 11, 12. The cover plates and the slide are carrying scales, the relative move-

ment of which can be observed through a window in the cover plate. For purposes of simplification, however, this is not shown in the present drawings.

Slots 20 and 21 in plate 2 are made such that after connecting plates 1, 2, 3 together and thereafter cutting off the unslotted boundary areas 5, 6 of plate 2 and further boundary areas 7 and 8 of plates 1 and 3 along lines 16 and 17, guide strips 11, 12 are formed, separate from slide 13.

First, plates 1, 2 and 3, as shown in *Figure 1a, 1b* and *1c*, are positioned over each other. The lowest plate is plate 3; on plate 3, plate 2 is positioned; on plate 2, plate 1 is positioned. Thereafter, plates 1 and 2, as well as plates 2 and 3 will be glued to each other, after glue has been deposited on the hatched areas 15. Thereafter, the composite structure obtained thereby is cut along dash-dotted lines 16 and 17.

The slots 20 and 21 are milled into plate 2 as shown schematically in *Figure 2* by means of thin cross-saw-blades 26, driven by a rotating spindle (not shown).

During this process plate 2 is held on plate 4 and plate 4 is moved relative to the circular saw-blades 26 such that slots 20 and 21 are generated. The circular saw-blades 26 for example may have a thickness of 0,1 mm. Correspondingly the width of the slots as milled by blades 26 into plate 2, also is 0,1 mm. It is also possible to have e.g. widths of 0,15 or 0,2 mm. This depends on what clearance one would like to have between the guidance strips 11, 12 and slide 13. Thereby, one obtains exact guidance of the slide 13; especially exact parallelism of the edges of guiding strips 11, 12 and slide 13 is obtained. Further, one obtains sufficient clearance between slide 13 and guide strips 11, 12, such that the slide 13 is easily movable between the guide strips 11, 12. This manner of providing slots 20, 21 also guarantees that the side surfaces 28 and 29 (see *Figure 4*) of the slots are exactly normal to the surface of the plate, into which they are milled. By the shown way of producing the slots, also a certain roughness of the side surfaces 28, 29 is obtained such that lubricating agent, e.g. Vaseline (R.T.M.), can easily be received by the unevennesses of the rough surfaces and held over long period of use.

It is essential for the shown method of production and the product resulting therefrom that the slots 20, 21 have exactly parallel and plane side surfaces 28, 29 and that the guide strips 11, 12 will also be automatically positioned exactly parallel to each other and to the edges of the slide 13 without the need of any type of adjustment. Thus, one obtains a highly precise slide-rule.

Alternatively the slots may be provided by the displacement of the material by means of laser or electron beams. The connection of plates 1, 2, 3 also can be achieved by other means, like e.g. like welding, screwing or rivetting. As a material for plates 1, 2, 3 preferably plastics foils or plastics plates are use; however, it is also possible to use metal, card board, paper board etc.

Figures 5 to 7 show a second embodiment. It relates to a slide-rule of the rotating disc type, in which a disc 33 is used, which is rotated and thereby

has the function of the member of the slide-rule. The rotating disc 33 is positioned between upper cover plate 30 and lower cover plate 34; the disc 33 further is rotatably received within guide member 37, which is provided for this purpose with a recess 36, the round form of which corresponds to the form of disc 33.

For producing this slide-rule, first three plates shown in Figure 5a to 5c are made.

Plate 100, shown in Figure 5b, is provided with a slot 38; this slot has the form of a full circle with the exception of the bridging portion 39 near edge 100' of plate 100. The ends 38', 38'' of the slot 38 are V-shaped as shown. Now, if one cuts plate 100 along the shown dash-dotted line to separate the boundary area 61 therefrom, one obtains as parts movable relative to each other the guide member 37 and disc 33. It may be noted that disc 33 is not completely round along that portion, along which the bridging portion 39 has been cut off. However, this is not of relevance.

Cover plate 30 is shown in Figure 5a. It is provided with a semi-circular slot 40, which extends closely to edge 30' that two bridging portions 50 and 51 remain unslotted. They are, however, narrower than the distance of the already mentioned dash-dotted line from edge 30. This results in the following fact: if the plate 30 is cut along the dash-dotted line and thereby the boundary area 60 is cut off, the semi-circular portion 70 will be removed from the remaining plate 30. Plate 34 is formed in the same manner; see Figure 5c.

After plate 30, 100, and 34, as shown in Figure 5a to 5c, have been produced, they are glued to each other. The upper cover plate 30 is placed on top, followed by plate 100, which is placed below the same, which is followed by lower cover plate 34. For this purpose the hatched area of plate 100 will be covered with glue or some other adhesive. Subsequently the plates are pressed against each other to allowed to form a permanent connection.

Thereafter, the composite structure obtained by connection of plates 30, 100, 34 is cut along the dash-dotted line. One thereby obtains the slide-rule in accordance to Figure 6a and 6b. The boundary area 60 of cover plate 30, the boundary area 61 of plate 100 and the boundary area 62 of plate 34 thereby are removed as well as the semi-circular portions 70 and 71 of plates 30 and 34. Disc 33 is accessible from the front and easily be rotated.

The upper cover plate 30 may have a window 110. Through this the rotation of disc 33 with scale 111 relative to cover plate 30 and scale 112 provided thereon can be observed.

Figure 7 shows schematically the production of plate 100, i.e. the milling of a slot 31 into it by means of a copying milling machine. With this machine, an engraving or milling tool 120 is provided, which is driven by a unit 121. This driving-unit is provided on an arm 122, which is moved by means of an automatic control mechanism (not shown) along a programmed path, which results in the desired circular form of slot 38. Such machines can be obtained in commerce; it therefore is not necessary to describe them in more detail.

For the embodiment of Figure 5 to Figure 7, it also is essential and it is guaranteed by the way of producing slot 38, that the side surfaces of the slot thereby are exactly parallel to each other and normal to the larger surfaces of the plates, into which the slot is cut.

CLAIMS

1. Slide rule, comprising an upper cover plate, a lower cover plate, and a slide freely movably between said cover plates and also between guide members arranged at the sides of the slide, wherein the slide and the guide members are formed by providing in an intermediate plate a pair of parallel slots with side surfaces, which are rectangularly parallel to each other and spaced from each other by a certain predetermined distance, and wherein the intermediate plate is connected, in a manner per se known, to an upper cover plate blank positioned above the intermediate plate and to a lower cover plate blank positioned below the intermediate plate, and wherein the boundary areas of the assembly obtained thereby are cut off, said boundary areas including unslotted boundary areas of the intermediate plate and the boundary areas of the other plate blanks overlying the same.

2. Slide rule in accordance with claim 1, wherein the slots are provided by milling.

3. Slide rule in accordance with claim 1 or 2, wherein the width of the slots is 0,05 to 0,2 mm, preferably 0,1 mm.

4. Slide rule in accordance with claim 1 or 2, wherein in that the side surfaces of the slots are provided with a certain surface roughness for receiving lubricating means.

5. Slide rule, comprising an upper covering plate a lower covering plate and an essentially circular disc received rotatably between the covering plates, said disc further at least partially surrounded along its periphery by a guide member within a recess thereof, wherein said disc and said guide member are formed by providing in a plate blank a slot, which - with the exception of a small bridge portion in the neighbourhood of one edge of the plate blank - has the form of a full circle, further by providing both cover plates with further slots extending from one edge of said plates into the interior of the same to such an extent that, when these last mentioned plates are positioned over the first mentioned plate blank, the portions defined by said further slots overlap the bridge portion of the first plate blank, and in that the three plates are connected to each other and thereafter boundary areas, which include the bridge portions, are cut off.

6. Slide rule in accordance with claim 1 or 5 wherein the plates are made of plastics, metal, or hard paperboard.

7. Slide rule constructed and arranged substantially as hereinbefore described with reference to and as shown in
- a) Figures 1 - 4,
 - b) Figures 5 - 7
- 5 of the drawings.

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