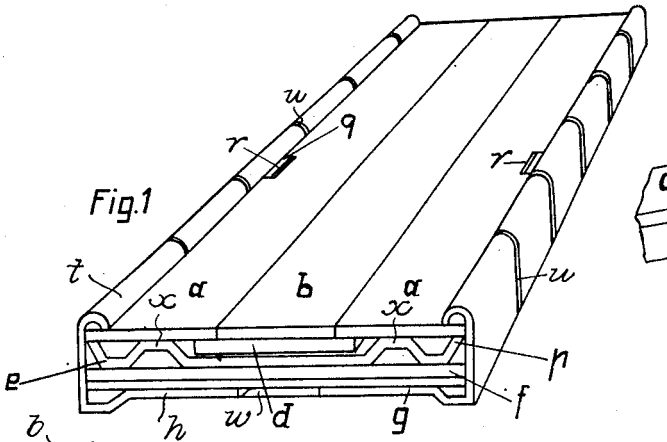
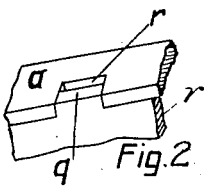
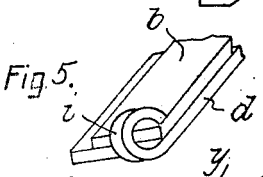
Dec. 27, 1932. H. SEEHASE 1,892,012

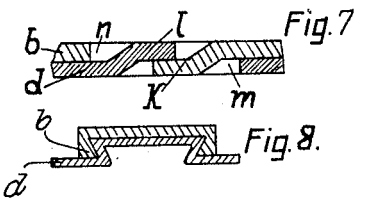
FLEXIBLE SLIDE RULE

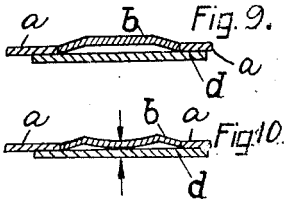
Filed Jan. 31, 1929

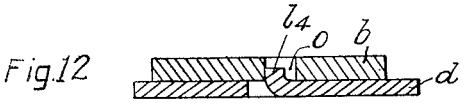


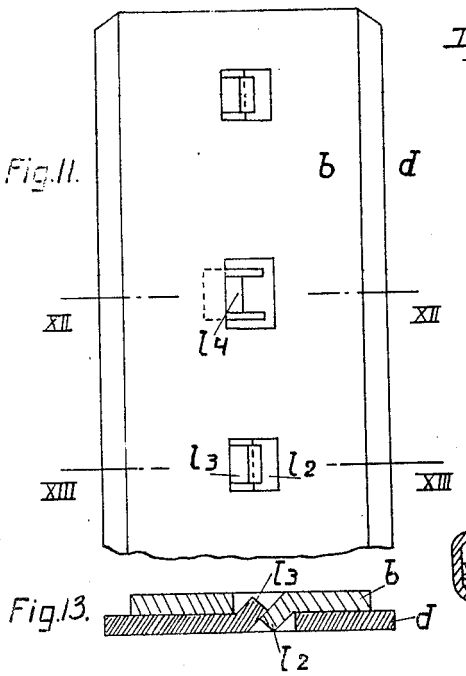


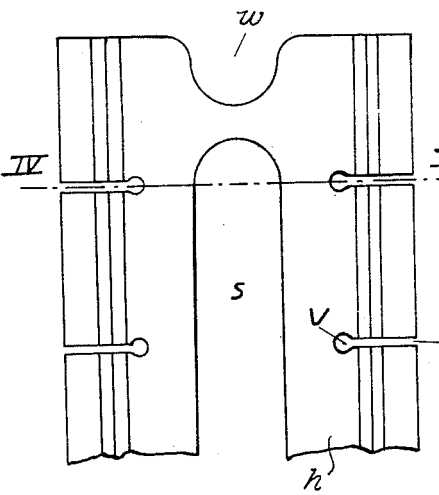


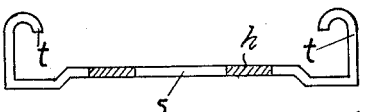


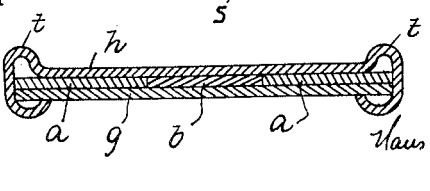












Hans Seehase.

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UNITED STATES PATENT OFFICE

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FLEXIBLE SLIDE RULE

Application filed January 31, 1929, Serial No. 336,572, and in Germany October 22, 1927.

My invention relates to slide rules. It is an object of my invention to provide a slide rule which is practically unbreakable and will not undergo deformation through bending, while at the same time it is so designed as to be readily manufactured on a quantity production basis. Flexibility is a desirable but not an indispensable property of my slide rule.

To this end I provide flat strips as the scales, one of them being the fixed, and the other being the movable scale. The individual strips are arranged in a single plane and means are provided for holding them in their plane with their edges engaged.

In a preferred embodiment of my invention I provide a frame of channel section, with its flanges beaded over at their upper edges, and below each beaded-over flange I arrange a fixed scale strip. The movable scale is inserted centrally between the two fixed strips and provided with a base strip projecting from its edges and engaging below the fixed scale strips. A sectioned member is inserted between the scales and the frame and formed with two parallel upwardly projecting ridges for holding the fixed strips engaged with the beaded-over flanges of the frame, while the base strip of the movable strip slides in the groove between the ridges.

In the drawing affixed to this specification and forming part thereof a slide rule embodying my invention is illustrated diagrammatically by way of example.

In the drawing

Fig. 1 is a perspective illustration of the slide rule,

Fig. 2 is a detail showing a lug on the sectioned member engaging in a slot of one of the fixed scale strips,

Fig. 3 is a plan view showing one end of the channel frame, viewed from above,

Fig. 4 is a section on the line IV—IV in Fig. 3,

Fig. 5 is a perspective illustration showing a connection for the movable scale and its base strip in which curved tongues are formed at the ends of the base strip, with their inner ends bearing on the scale,

Fig. 6 is a section of a rivet connection for holding the movable scale on the base strip,

Fig. 7 shows a connection having holes and tongues,

Fig. 8 shows a dovetailed connection,

Figs. 9 and 10 show movable scale strips which are sectioned for bracing their edges,

Fig. 11 is a plan view showing one end of the movable scale and its base strip,

Figs. 12 and 13 are sections on the lines XII—XII and XIII—XIII in Fig. 11, respectively, and

Fig. 14 is a cross section of a modified rule.

Referring now to the drawing, and first to Figs. 1 to 4, h is the frame of the slide rule. The frame is of channel section as best seen in Fig. 4, with the flanges t beaded over at their upper edges, and the web with a central elevation. The web is preferably cut out at s for reducing the weight and increasing the flexibility of the frame, and also for displaying certain printed matter, as will presently appear, and is recessed at its ends for facilitating the handling of the movable scale b, one of the recesses being shown at w in Figs. 1 and 3. The flanges t are slotted at u for increasing the flexibility of the frame which would be rather stiff with continuous flanges t. v are the usual extensions at the inner ends of the slots u which prevent the formation of cracks beyond the slots.

e is the sectioned member referred to which is placed on the inner side of the web of the frame directly or with strips f and g interposed between the web and the section, for a purpose which will be explained. The member e has two upwardly projecting ribs p at its outer edges and two ridges x which extend to the same level as the ribs p.

The fixed scale is here subdivided into two strips a which are inserted at opposite sides of the frame between the flanges t and the ribs f and ridges x and are held by these in parallel position to the web of the frame h and to the strips f and g which are inserted between the web and the member e. Inserted between the parallel inner edges of the strips a is the movable scale b, with the base strip d secured to its back. The base strip d projects into the space between the ridges x, x

of the member *e*. It will appear that in this manner the three strips *a*, *b*, *a* are supported in a single plane, and held in this plane with their edges engaging, by the means described. Preferably the flanges *t* in the channel form *h* are pitched apart for a distance which is slightly less than the overall width of the scales *a*, *b*, *a* so that the reaction of the flanges holds the strips engaged at their edges.

Means must be provided for preventing shifting of the strips or fixed scales *a*. As shown in Fig. 2, the strips have recesses *r* in their outer edges, and *q* are lugs projecting from the ribs *p* into the recesses *r*.

The fixed scales *a*, *a*, and the movable scale *b*, *d* consist of flat strips the thickness of which is very small in proportion to their width. In this form all materials used are resilient and the dimensions of the scales are so determined that the elastic limit of the material is not overstepped if the slide rule is bent, the strips are not permanently deformed and the graduations of the scales are preserved in full precision. Such graduations may be made by printing, stamping, etching or engraving methods. The entire graduation is preferably made in one piece which is afterwards divided into the parts *a*, *b*, *a*.

Obviously it is necessary that the comparatively stiff unit *b*, *d* should not exert an undesired bracing action on the slide rule. Means will now be described by which the scale strip *b* is connected to its base strip *d* in such manner that the two strips are permitted to perform a slight relative displacement when bent, without, however, undergoing permanent disalignment.

Referring first to Fig. 5, *i* is a turned-over tongue which projects from one end of the base strip *d* and bears on the scale *b*, pressing the scale *b* resiliently against the member *d*. The member *b*, therefore, is capable of being displaced a little along member *d* when the unit *b d* is bent. This connection is especially adapted for short scales or in combination with another method of connecting the movable scale *b* to its member or base plate *d*.

Referring now to Fig. 6 the two members *b* and *d* are connected by rivets *y* or other equivalent means. One of the members, for instance the member *d*, possesses a longitudinal slot. The rivets allow longitudinal displacement of the scale *b* and its member or base plate *d* with respect to each other. The rivets *y* may be substituted by other elements, as for example by screws or any other suitable connecting means (not shown), or especially by parts which are drawn.

Fig. 7 shows a longitudinal section of a further modification of the flexible unit *b*, *d*. The tongues *k*, *l*, stamped out of the members *b* and *d* are shaped in such a manner that tongue *k* of member *b* projects into an opening *m* of member *d* and that tongue *l* of member *d* projects into an opening *n* of member *b*. These tongues are formed in such a manner, that they overlap each other and do not project from the outer surfaces of the scale and that the scale *b* and the base strip *d* are free to bend.

Fig. 8 shows a dovetailed connection of the scale *b* and its base strip *d* which also permits the relative movement of the two members required for bending without permitting disalignment.

Referring now to Figs. 9 and 10, these show means for preventing damage to the edges of the movable scale *b*.

The scales are normally made of very thin sheet metal, for instance, .2 millimetres thick, and it will be undertood that the edges of such thin material are subjected to denting and creasing even under slight stress. This is prevented by beveling the edges of the scale *b* and/or the edges of the scales *a*, *a*. In Figs. 9 and 10 only the scale *b* is shown as beveled. Beveling may be effected by bending down the edges of the scale as shown in Fig. 9, or, in addition to such downward bending, pressing the central portion of the scale *b* down on the base strip *d* by forces indicated by the two arrows.

Referring now to Figs. 11 and 13, tongue-and-groove connections somewhat similar to that illustrated in Fig. 7 are shown in combination with connections for preventing lateral relative displacement of the scale *b* and the base strip *d*. Referring first to Fig. 13, l^2 is a tongue which is punched out of the strip *b* and extends downwardly into a hole in the base strip *d*. The hole in the base strip *d* is formed by punching a tongue l^3 out of the base strip and bending it upwards so as to bear on the tongue l^2. These tongues while preventing disalignment obviously will not prevent lateral relative displacement of the scale *b* and the base strip *d* and therefore are supplemented by the hooked connection illustrated in Fig. 12. Obviously there must be at least two such hooked connections. l^4 is a tongue which is punched out of the base strip *d* and projects into a slot *o* in the scale *b*. While the tongues l^2 and l^3 have a considerable clearance in their respective holes and will not prevent lateral relative displacement of the scale *b* and the base strip *d*, the tongues l^4 fit their slots *o* without clearance in transverse direction so that the two members of the unit are positively connected. On the other hand the slots *o* must not interfere with the longitudinal displacement required for bending the strips *b*, *d* and therefore are made a little longer than the tongues l^4. One of the tongues l^4, for example that which is arranged in the centre of the scale *b*, may be made without longitudinal play in its slot *o* in order to obviate a permanent relative longitudinal displacement of the members *b* and *d*.

Due to the described constructions of the combined scale *b*, *d* it is possible to bend the same without prejudicing its accuracy, its exact sliding fit with the fixed scales *a*, *a* and its good appearance. The scale *b* and the base strip *d* may be made of different materials for instance member *b* may consist of cardboard and member *d* of metal, the difference of the coefficients of expansion and contraction which caused distortions in known constructions have no effect in the construction described. Trouble of this kind is prevented by the described connections permitting the base strip *d* and the scale *b* to slide on each other without becoming permanently displaced longitudinally with respect to each other.

It is understood that my invention may be modified in various ways without departing from its gist. For instance, instead of recessing the fixed scale strips *a* and providing lugs *q* on the ribs *p* as shown in Fig. 2, the flanges *t* of the frame *h* might be recessed for the reception of projections on the scale *a*, or the connection of the scales *a* to the frame might be modified in any other suitable manner.

The plates *f* and *g* between the sectioned member *e* and the web of the frame *h*, if provided, may be used for the reception of any printed matter, for instance, conversion tables and the like, or advertisements. For instance, the upper plate *f* may be of printed cardboard and the plate *g* of transparent celluloid. The print is protected against soiling and may nevertheless be well read through the windows which are provided in the web of frame *h*. In the case of very thin and long rules it is preferable to make one or both of the strips, *f* and *g*, of steel, to give sufficient mechanical strength, or several strips *f* may be combined in the manner of a laminated spring.

In the case of small slide rules not only the plates *f* and *g* but also the base *e* may be omitted. The scales *a a* may in this case be placed directly on the web of the frame *h*, or on a corresponding member. This modification which is illustrated in Fig. 14, is particularly suitable for cheap rules on account of its simplicity. The frame *h* is reversed as compared with the arrangement in Figs. 1 to 4, and made of transparent material, such as celluloid, so that the scales *a*, *b*, *a* are plainly visible. The sectioned member *e*, the base strip *d* and the strip *f* are dispensed with and only the transparent strip *g* is provided for holding the strips *a*, *b*, *a* assembled, the beaded-over edges of the flanges *t* bearing on the lower face of the strip.

All the elements of the slide rule with the exception of frame *h* and member *e* are flat and flexible plates. The frame *h* which may be of pressed sheet metal, would not be flexible to a sufficient extent without the slots *u* in its flanges *t*. The number and width of the slots *u* is determined in conformity with the dimensions of the slide rule and the purpose for which the same is employed.

I claim:

1. A slide rule comprising fixed and movable scales, the individual scales being flat strips arranged in a single plane, and resilient means for holding said scales engaged at their edges and in their plane.

2. A slide rule comprising fixed and movable scales, the individual scales being flat strips arranged in a single plane, means for holding said scales engaged at their edges and in their plane, and interengaging members on said fixed scale and said holding means for holding said fixed scale against lateral displacement.

3. A slide rule comprising fixed and movable scales, the individual scales being arranged in a single plane, and a resilient casing for holding said scales engaged at their edges and in their plane.

4. A slide rule comprising fixed and movable scales, the individual scales being flat strips arranged in a single plane, and a resilient casing for holding said scales engaged at their edges and in their plane, with a flange beaded over for engaging the top face of said fixed scale.

5. A slide rule comprising fixed and movable scales, a casing in which said scales are mounted, and slotted flanges at the sides of said casing for holding said scales assembled.

6. A slide rule comprising a pair of flat strips making up together a fixed scale, a third flat strip mounted to slide between said fixed scales as the movable scale, the individual scales being flat strips arranged in a single plane, means for holding said scales engaged at their edges and in their plane, a base strip at the rear face of said movable scale, with its sides engaging below the inner edges of said fixed scales, a tongue on the flat strip which is inclined to the plane of the flat strip, a tongue on the base strip which has the same inclination as said tongue on the flat strip and is adapted to engage said tongue for holding said base strip and said flat strip applied to each other with their faces, and a tongue on one of said parts engaging a slot in the other part for preventing relative transverse displacement of said two strips.

In testimony whereof I affix my signature.

HANS SEEHASE.