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San Antonio

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[54] **NETMAKING SLIDE RULE**

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Dec. 17, 1969 Philippines 10990

[52] **U.S. Cl.** **235/78**

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

[58] **Field of Search** 235/78, 84, 88; 35/74; 116/133

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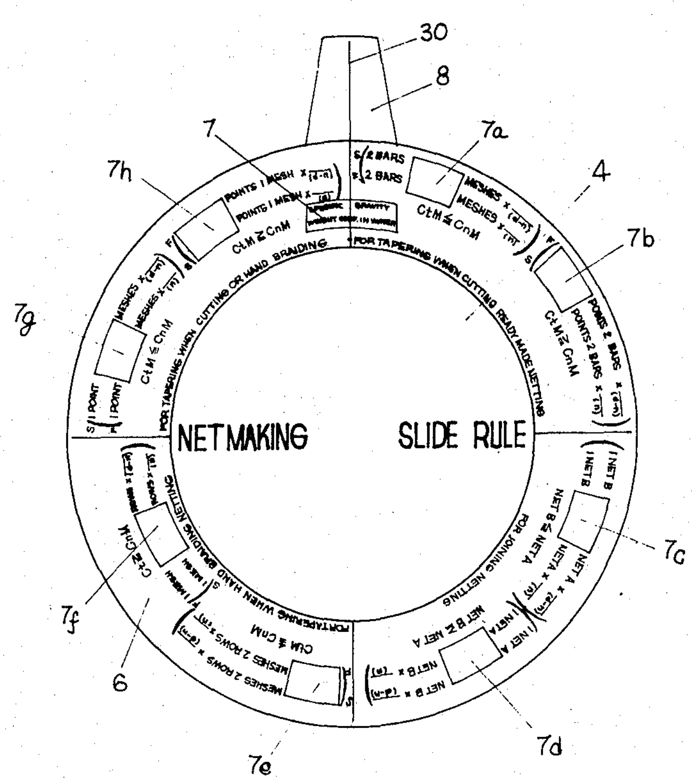
[57] **ABSTRACT**

This novel slide rule is a circular calculating device which satisfactorily facilitates the mechanical application of the processes and formulas relevant to the netmaking industry. It expedites computation for such quantities like tuck-in or take up rate for actual joining of strips of netting to determine the taper angle, bar angle, half-mesh angle, line length netting dimensions, hanging coefficients in water, estimates the desired patterns for the actual cutting and braiding of netting to shape, and converts linear measures, yarn thickness numbers, etc.

10 Claims, 6 Drawing Figures



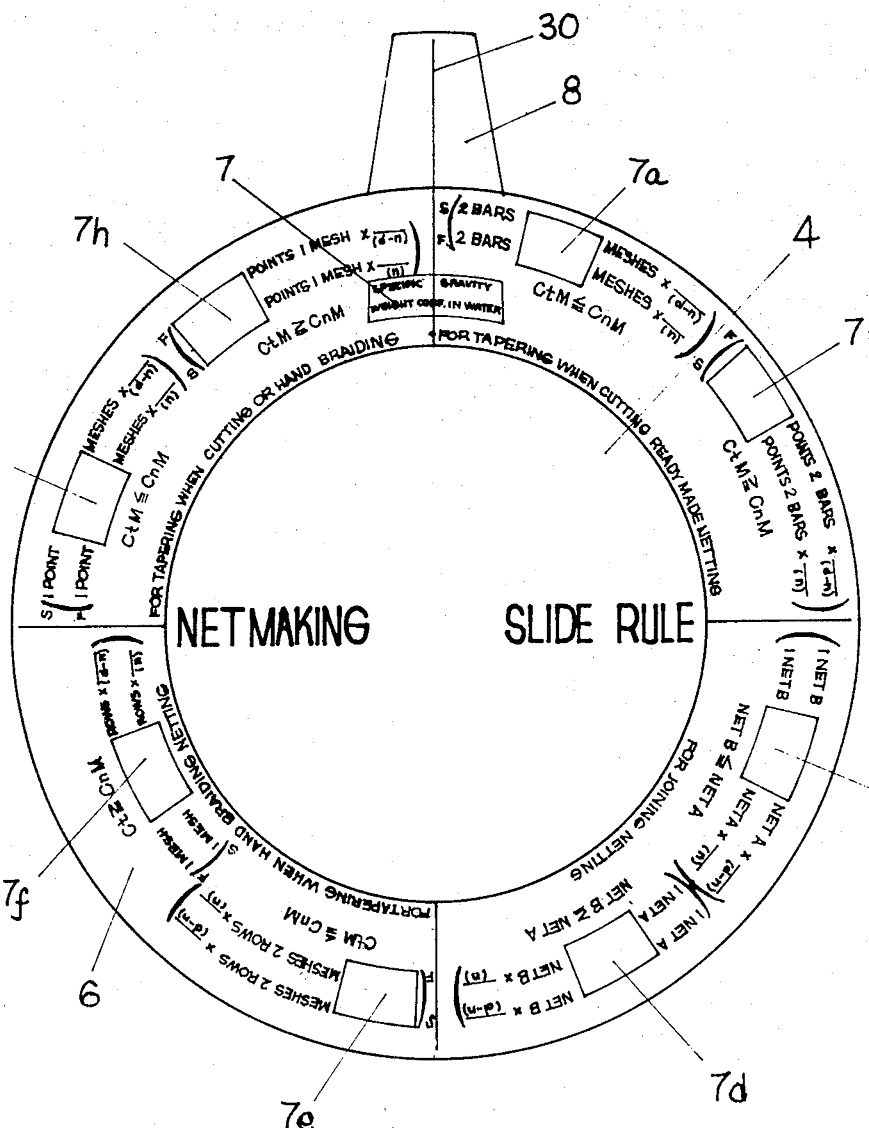


Fig. 1

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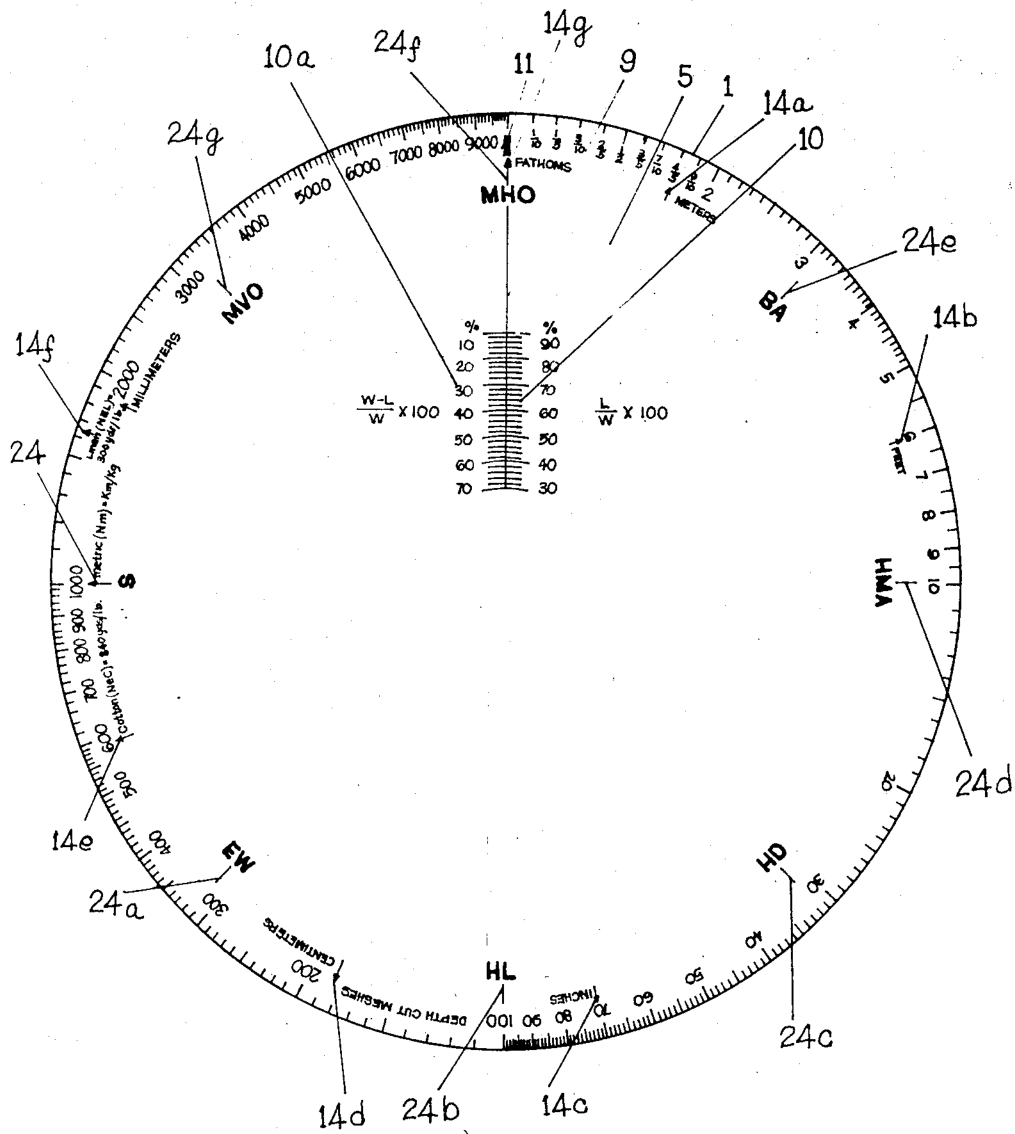

Fig. 2

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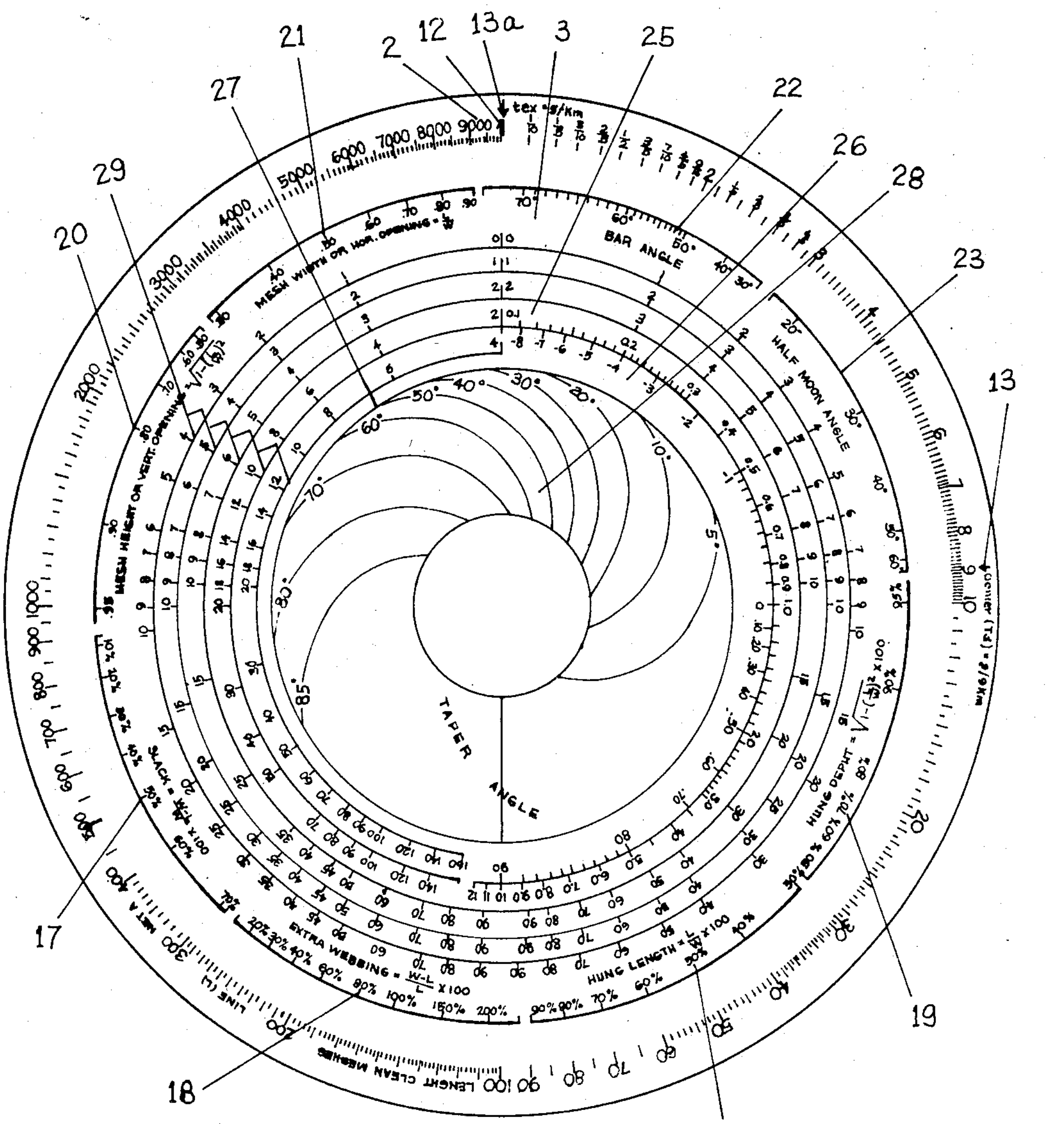

Fig. 3

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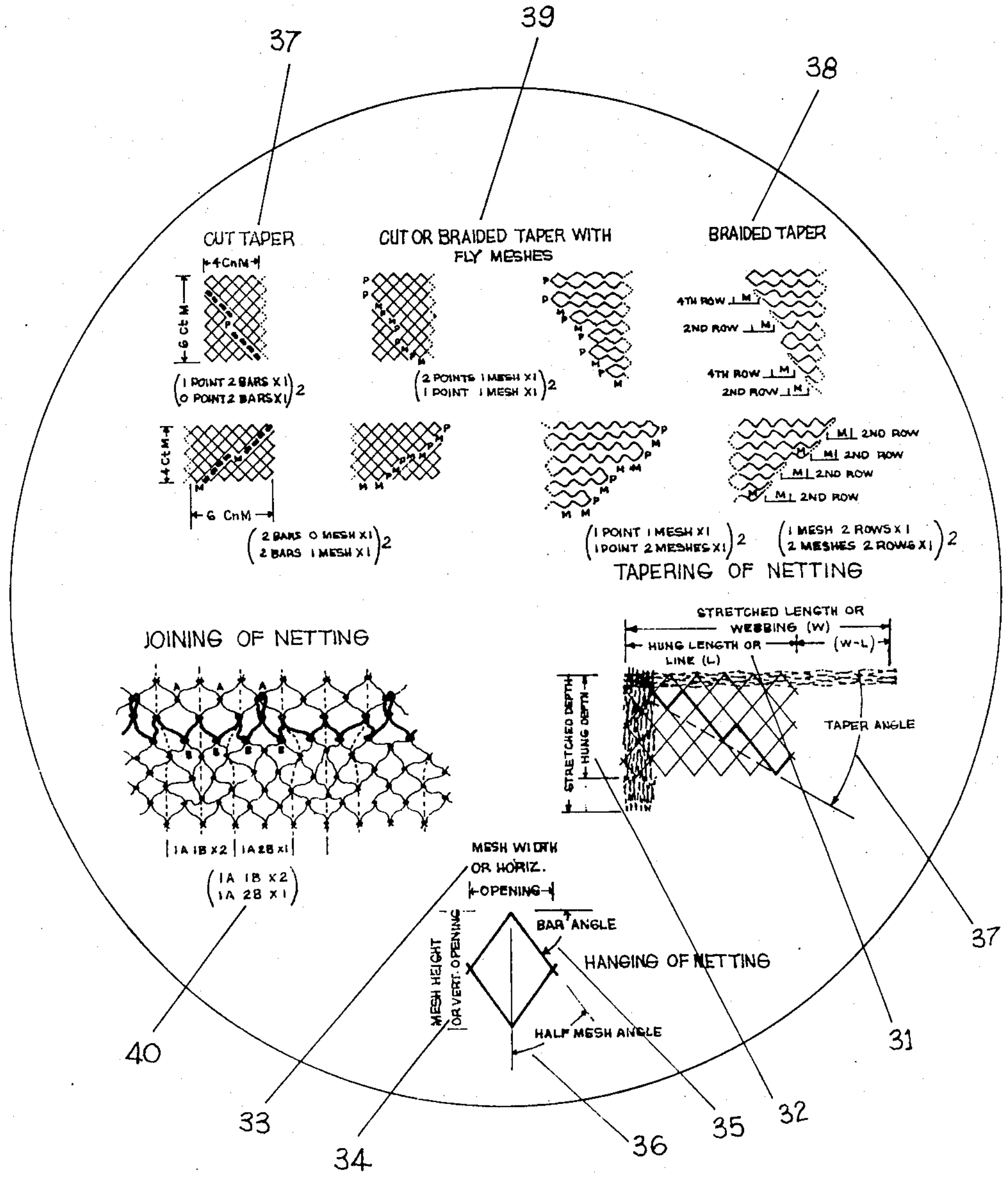

Fig. 4

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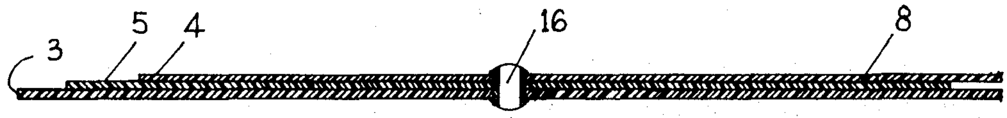

Fig. 5

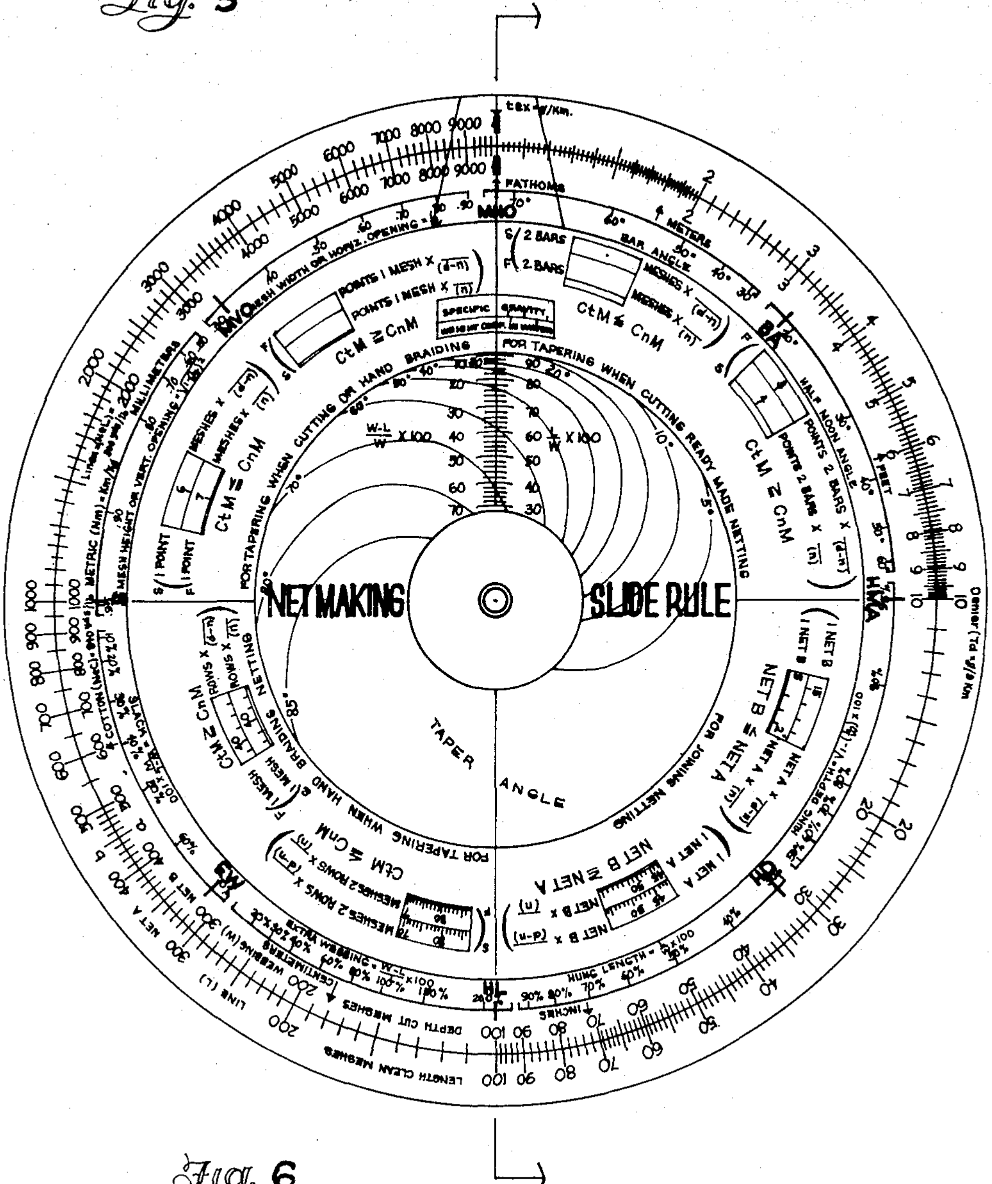

Fig. 6

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NETMAKING SLIDE RULE

This invention relates in general to a novel calculating device and, in particular, to a circular slide rule intended for the fishnet industry.

Various types of slide rules are now in use and they vary in sizes, shapes and structures. All of them are used to facilitate mathematical computations. They perform operations involving multiplication, division and other related mathematical computations with the use of the proper scales intended for the specific use. However, no slide rule so far satisfies the needs of fishery technologists and fishermen engaged in the netmaking industry.

It is, therefore, the primary object of this invention to provide a slide rule which will satisfy the needs of fishery technologists and fishermen in the netmaking industry.

It is also an object of this invention to provide a slide rule by which the user directly reads the figures without the additional mental work of determining the position of the decimal point.

A further object of the invention is to provide a novel slide rule which facilitates computations for netmaking industry which is not possible on an ordinary bar or circular slide rule.

Still, a further object of this invention is to provide a slide rule for use in the netmaking industry featuring the simple and easy mechanical application of the processes and formulas for computing the desired patterns for the actual cutting and braiding of netting to shape, tuck-in or take up rate for actual joining of strips of netting for determining the taper angle, bar angle, half-mesh angle, line length netting dimensions, hanging coefficients, weight coefficients in water, and for converting linear measures and yarn thickness numbers, etc.

Other objects and advantages of the invention will become apparent during the course of the following description.

The present invention, in general, consist of a circular stationary base and one or more circular slides rotatable thereon.

Essentially, there are three flat circular disks of varying diameters containing scales and various notations useful in the netmaking industry, said three disks being arranged concentrically, one on top of the other; the smallest or top disk being at the top, the biggest or bottom disk being at the bottom and the medium size or intermediate disk being in-between the biggest and the smallest disks; said three disks being fastened at the center by a suitable fastening means which allows the smallest and medium size disks to move freely and independently from one another; said smallest disk having as an integral part thereof an indicator means extending from a portion of its periphery, said indicator having a hairline at its center, said smallest disk having also an opaque annulus at its outer portion and said annulus having a plurality of windows to facilitate reading of pertinent scales in the bottom disk.

Although the characteristic features of my invention are described with particularity in the appended claims, the invention itself may be better understood and appreciated from the following description taken in connection with the accompanying drawings forming a part hereof wherein

FIGS. **3** and **4** are the face portion and back portion respectively of the biggest or bottom disk of my slide rule.

FIG. **1** is the face portion of the smallest or top disk.

FIG. **2** is the face portion of the medium size or intermediate disk.

FIG. **5** is an elevational view of the assembled slide rule shown in FIG. **5**.

FIG. **6** is a general view of the assembled circular slide rule.

The biggest or bottom disk **3** is generally made of a hard, flat, circular, laminated cardboard having a thickness of about one-sixteenth of an inch. However, it may be also made of any suitable material such as aluminum or polymer or polymer-laminated wood or bronze. It contains numerous scales on the face portion and some patterns and notations useful in the netmaking industry at its back portion.

The smallest disk **4** which is on top of the medium size disk **5** is generally made of hard transparent flat plastic or polymer sheet. It has an annulus **6** at its outermost portion which is coated from the underside with a suitable opaqueing material preferably a white paint which will not flake off nor stain the medium size disk **5** directly underneath. The annulus **6** as shown by FIG. **1** contains a plurality of windows ***7a–7h*** for reading pertinent scales underneath. Said windows are arranged in pairs for every quarter of the annulus **6**. In addition, there is also a window **7** for specific gavity and weight in water readings which is located at a distance below the indicator means **8**, and which is symmetrical with the fourth and first quarter of the annulus **6**. Further, the annulus **6** also contains on its face portion various notations useful in the netmaking industry as shown in FIG. **1**.

The medium size disk **5** which is in-between the biggest **3** and the smallest **4** disks is also made of hard transparent, flat plastic or polymer sheet. It contains logarithmic scales **2** along its outermost portion; also the vertical line **9** and hanging vertical scales **10** and ***10a*** opposed to each other and disposed at a distance under its index **11** as shown in FIG. **2**.

Disks **3**, **4** and **5** as shown in FIG. **6** are secured by a suitable fastening means **16** which permits disks **4** and **5** to move freely and independently from one another.

With regard to the scales of my slide rule, it will be noted that there are two peripheral scales which are similar with each other. These are the marginal or main scale of the bottom disk **3** and scales **1** of the middle disk **5**. Both scales are four cycle logarithms whose main indices **11** and **12** are in bold type. Aside from said indices, they also have secondary indices which are marked by arrow. The arrow **13** and ***13a*** of the bottom disk are centrally directed while those ***14a–14g*** of the middle disk are radially directed. These scales (**1** and **2**) are used primarily for converting linear measures such as fathoms, feet, meters, inches, centimeters and millimeters into one another. The conversion relationship are as follows: 1 Fathom = 1.825 m; 182.8 cm; 1,828 mm; 6 ft; 72 inches. The two scales are also used for converting yarn thickness numbers or yarn count system into one another such as Td (International denier system for twines made of synthetic continuous filament); NeC (English cotton number for twines made of cotton and sythetic staple); NeL (English linen number for twines made of linen, ramie, hemp, jute); Nm (metric number for all twines); Tex (Tex system for all twines). The conversion factors for changing one system to another are as follows: 9 Tex = 1 Denier; 1 Tex × 1 NeC=590.5; 1 Tex × 1 NeL = 1,654.00; 1 Tex × 1 Nm = 1,000. The main scales **1** and **2** can also be designated as respective scale of length and depth, clean meshes and cut meshes, line (L) and webbing (W), Net A and Net B and other designations the user may assign thereof.

Fishnetting is made of twine which is composed of strands. These strands in turn are made of yarn which are a number of fibers twisted together.

Twine sizes are specified by stating the counts or thickness numbers of a single yarn per number of yarn in a strand per number of strands to produce the final twine.

There are different count systems for yarn used according to the kinds of raw material. In view of this, difficulties are encountered in the indication of the thickness number of the yarn because of the varying customs and traditions of the various processors and/or users. Various systems of measurement exist so that even in small sector of the textile industry and net manufacturers, there are plenty of confusing count systems in use. This practice offers difficulties in finding the equivalent of one measure into another.

However, with my novel slide rule, those difficulties and confusions are lessened by the use of the above-referred main scales **1** and **2** on the bottom and middle disk. With the main scales, the equivalent of one measure in another can be read directly without the burden of determining the location of the decimal point.

The correct hanging of the netting or webbing to the supporting line is an important factor in all nets. In practice, a straight sheet of netting or webbing is never hung to a hanging rope of the same length. The hanging rope must always be shorter than the stretched length of the netting. Because of this practice, it is important to know the hanging coefficient of any netting.

However, at present, there are three methods of expressing the hanging coefficient which cause confusion when constructing nets, and more especially when computing the quantity of netting materials to be used. The first is to express the length of the line, to which the webbing is hung in a percentage of the total stretched webbing:

$$\frac{\text{Length of line} \times 100}{\text{Length of stretched webbing}} = \text{Percent hanging or hung length}$$

This is directly read as percentages in the proper scale **15** on the bottom disk **3**.

The second method is to express the amount of slack or loose webbing (total webbing minus line length) as a percentage of total webbing which is generally termed slack (S):

$$\frac{\text{Slack excess webbing} \times 100}{\text{Total webbing}} = \text{Percent of hang-in or slack}$$

Slack is also directly read in percentages in proper scale **17** in the bottom disk.

The third method uses the extra webbing system which expresses hanging coefficient in terms of extra webbing to be hang in. The extra webbing coefficient is the difference between the total webbing and line length per hundred of line length;

$$\frac{\text{Webbing} - \text{line length} \times 100}{\text{Line length}} = \text{Percent hang-in or extra webbing}$$

Extra webbing is directly read in percentages in proper scale **18** on the bottom disk.

With the use of my slide rule, the user can convert with ease the hanging coefficient of one system into any of the two other systems. The slack mark S is given reference numeral **24**; the extra webbing mark EW, **24*a*;** and the hung length mark HL, **24*b***.

Knowing the correct amount of webbing or netting required of a given piece of equipment is important in the construction of any net. And the amount of webbing required is determined by the hung depth coefficient (HD). That is, by knowing the coefficient for hung length and hung depth, the amount of webbing needed for a given piece of equipment can be computed. The theoretical hung depth **32** of nets can be read directly from the hung depth scale **19** of the bottom disk once the hung length coefficient of the net is known. The hung depth scale **19** of my invention is similar with the MVO or mesh vertical opening scale **20**. They differ only in that the MVO scale is expressed in decimal while that of the hung depth scale is expressed in percentages.

Good nets must have the correct distribution or looseness after having the nettings or webbings to the supporting lines or ropes. However, the question of hanging the netting to ropes with the correct distribution or degree of looseness can be studied carefully from the formations of a mesh when hung to different hanging coefficients. The formation of a mesh is described or measured in terms of either mesh width or MHO or mesh horizontal opening **33**, mesh heights or MVO or mesh vertical opening **34**, bar angle **35** and half mesh angles **26**. Values of these labels for mesh formations are read directly in the proper scales on the bottom disk **3**.

The MHO scale **21** is similar to the hung length coefficient scale. They differ only in that the MHO is expressed in decimals while hung length coefficient is expressed in percentages.

Any point in the MHO scale is actually the cosine value of the corresponding bar angle in the bar angle scale **22** while any point in the MVO scale is the sine value of the corresponding half mesh angle in the half mesh angle scale **23**.

The total weight in water or sinking power of all the materials and accessories suspended to the floats such as nettings, ropes chain weights, purse rings, ring briddles or legs, purse lines, etc. are likewise necessary in the determination of total buoyancy requirement which is the sum of the initial float buoyancy and the extra float buoyancy. The initial float buoyany serves to counterbalance the total weight in water or sinking power of the gear materials and accessories and the extra float buoyancy serves to counterbalance the effects of water current, pulling the purse line when pursing and the movement and weight of the fish caught and other sea products hauled.

The buoyance of the constructed nets is a function of the specific gravity of the net which determines the behavior of the net in water. It determines what weight of float is needed to bring the net to equilibrium at the water surface or what amount of lead sinkers is required to bring it to set down to the sea bottom.

The specific gravity of the netting and other materials for net construction is read directly on scale **25** through the window **7** disposed at a distance under the indicator means **8** of the smallest disk **4**.

Juxtaposed thereon is the weight coefficient in water of the netting and construction materials or its weight in water per hundred weight of air dry sample which is readable on scale **26**. Note that the weight coefficient in water can have a negative value. If this is the case, it means that the material will float in water.

My slide rule can also determine the taper angle of webbing at any hanging coefficient. This taper angle is directly read on scale **27** consisting of suitably numbered curves **28**. The points in this scale move into curved line patterns due to the flexibility of the nettings. Because of this flexibility, the depth of netting increases when it is shrinked horizontally and decreases when it is stretched. Consequently, the angle of taper changes accordingly at the hanging coefficient of the webbing or netting.

At any setting or position of the slide rule, the values of *a* and *b* which are stretched measurements representing the altitude and base respectively are always set together in the inner **1** and **2** main scales. This likewise enables the user to read directly the taper angle **37** against hanging coefficient.

Once the taper angle **37** at a certain hanging coefficient is known, the user will be able to determine the taper patterns of the nettings. The taper patterns can be read directly through the proper windows in the annulus **6** of the smallest disk **4** of the slide rule. Note that the annulus of the smallest disk is divided into four quadrants. Three of these quadrants give the user an idea of the taper patterns of the netting under three situations which are: (on a clockwise direction)

first quadrant — when cutting ready made nettings;
third quadrant — when hand braiding nettings; and
fourth quadrant — when cutting or hand braiding netting.

The numbers read through the windows of the annulus are contained in the cut and braided taper pattern scales **29** of the biggest or bottom disk, and they work hand in hand with the main scales **1** and **2** of my slide rule.

These scales **29** are also called take-up or tuck-in rate scales which are used when joining nettings. The numbers of these scales are read through the windows in the second quadrant of the top disk **4** labeled "FOR JOINING NETTING." The term take-up is used when joining horizontal strips of netting, while the term tuck-in used when joining vertical strips of netting.

Nets are fashioned by the assembly of shaped webbing sections such as those of trap nets, pound nets, trawl nets, most bag nets, etc. It is possible to cut or braid webbing to any shape, even curves. But curves gives rise to many difficulties in hanging the webbing to its supporting lines, so that curves are made as a series of straight lines. When webbing sections are shaped by braiding, the taper at a certain bating rate, i.e. the rate by which the width decreases at a certain row is effected simultaneously as the webbing is being hand braided. The taper produced in this case is called braided taper **38**. But when webbing sections are cut to shape from machine made strips of webbing or ready-made webbing, the taper is effected by cutting at the equivalent bating rate. The taper produced in this case is called cut taper **37**. In general, all shapes of webbing sections are obtained by decreasing the width of sections at certain bating rate.

There are three basic cutting patterns, viz:

1. All Points in which the resulting cut edge is with the run or with the knot, wherein the edge is usually straight down.
2. All Meshes in which the resulting cut edge is across the run or across the knot, wherein the edge is usually across.
3. All Bars in which the resulting cut edge is diagonally straight.

All other cutting patterns are combinations of these three basic cutting patterns. If the taper required is less rapid than all Bars, then the Point and Bar cutting pattern is used. This means that the path of the cut is between those of all Points and all Bars. But if the taper required is more rapid or in-between the paths of all Meshes and all Bars, then the Mesh and Bar cutting pattern is used.

Braided netting with flymeshes **39** is easily duplicated in machine-made netting by cutting Points and Meshes or Mesh and Points. The cutting of Points and Meshes in equal numbers one after another gives the same general direction of cutting All Bars but a smoother edge is obtained by cutting alternately only one of each of the meshes and points, resulting in fly-meshes on the cut edge.

The cutting rate to decrease one mesh in seven rows is five Points, four Bars. However, in practice, this would make an uneven taper. One improved cut giving the same result is two Points, two Bars, followed by three Points, two Bars. This improved cut system is adopted for both braided taper and cut taper in my slide rule.

The opaque annulus **6** of my slide rule contains several notations or symbols. Whenever my slide rule is used, these symbols always refer to the following:

CtM means cut meshes;
CnM means clean meshes;
s means start;
f means finish;
n means the numerator of a fraction in its lowest term; and
d means the denominator of a fraction in its lowest term.

The following are instructions on how to use my slide rule. These instructions are given only to illustrate the various uses of my invention and are not intended to limit its use thereon. Other uses which are obvious to those skilled in the art but which do not depart from the spirit of my invention are also within the scope of my invention.

1. Conversion of linear measures

A. Fathom to meters

Set the hairline **30** of the indicator **8** on the number of fathoms on scale **2**. Move or rotate scale **1** until the arrow **24*f*** marked fathom is directly under the hairline **30**. Then move the indicator **8** until the heirline **30** coincide with the arrow **14*a*** marked meter in scale **1**. The number on scale **2** which is directly under the hairline **30** is the equivalent number of meters.

B. Meters to fathoms

Set the hairline **30** of the indicator on the given number of meter on scale **2**. Then bring the arrow **14*a*** marked meter directly under the hairline **30**. Afterwards, move the hairline **30** of the indicator **8** so that it coincides with the arrow **14*g*** marked fathoms in scale **1**. The required number of fathoms is the number on scale **2** which is directly under the hairline **30**.

The above manipulations of the slide exemplifies the general procedures followed in the conversion of linear measures into another, say, feet to fathoms, meter to inches, centimeters, etc. However, if the manipulation of the slide rule produces answers which has exceeded one revolution, the observed answer should be multiplied by 10^{-4} or 10^{4} per one revolution if the revolution is counterclockwise or clockwise, respectively.

2. Conversion of yarn thickness

A. Tex to Denier

Set the hairline **30** of the indicator **8** at the arrow **13** marked Denier on scale **2**. Then move scale **1** so that its index **11** coincides with the hairline **30**. Afterwards, move and set the hairline **30** of the indicator **8** to any number of Tex on scale **2** to be converted into Denier. The required number of Denier is the number on scale **1** which is now beneath the hairline **30**.

B. Tex to NeC

Set the hairline **30** of the indicator **8** at the index **12** of or at the arrow **13*a*** marked Tex on scale **2**.

Set given number of Tex in scale **1** beneath hairline **30**. Then move the hairline **30** to the arrow **14*e*** marked NeC on scale **1**. The required number of NeC will be read beneath the hairline **30** on scale **2**.

For converting Tex to NeL or Nm, the same manner of setting and reading the scales is used, but the arrows for the needed units are used instead of that for NeC.

C. Denier to NeC

Set directly beneath the hairline **30** of the indicator **8** both the arrow **13** marked Denier on scale **2** and given number of Denier on scale **1**. The move the indicator **8** so that its hairline **30** coincides with the arrow **14*e*** marked NeC on scale **1**. The required number of NeC units is read on scale **2** which is now directly under the hairline **30**.

3. Determination of hanging coefficients, viz. Hung Length, Slack and Extra Webbing from the Line Length and Webbing Length

Set the hairline **30** of the indicator **8** at the given line length on scale **2**. Then move scale **1** so that the given webbing length in said scale is beneath the hairline **30**. The required slack S, extra webbing (EW) and hung length (HL) coefficients are read on the proper scales **17, 18, 15** as indicated by the indicators **24, 24*a* & 24*b*** of S, EW and HL marks respectively.

4. Determination of Mesh Horizontal Opening, Mesh Vertical Opening, Hung Depth, Bar Angle, and Half Mesh Angle When the Hung Length Coefficient is given

Set the mark HL (**24*b***) of the middle disk on the required number of hung length on the hung length scale (**15**). The required mesh horizontal opening is below the mark MHO, (**24*f***), the bar angle is below the mark BA, (**24*e***), the half mesh angle is below the mark HMA (**24*d***), the hung depth is below the mark HD (**24*c***), while the mesh vertical opening is below the mark MVO (**24*g***).

5. Determination of weight coefficient if the specific gravity is given

Set the hairline **30** of the indicator **8** on the given specific gravity on the specific gravity scale **25**. The required weight coefficient is the number beneath the hairline **30** on the weight in water scale **26**. Specific readings can be made through the windor **7** directly below the indicator **8** in the annulus **6** of the top disk **4**.

6. Determination of taper angle when slack or hung length or extra webbing coefficient is known

A. When slack (W–L/W × 100) is known

Set the mark S (**24**) on the required number of slack on the slack scale **17** on the bottom disk **3**. The curve intersecting the given slack on the hanging scale **10*a*** of the middle disk **5**, represents the required taper angle.

B. When hung length (L/W × 100) is known

Set the mark HL (**24*b***) on the given number of hung length on the hung length scale **15** of the bottom disk **3**. The curve intersecting the given hung length on the hanging scale **10** of the intermediate disk **5** represents the taper angle.

C. When extra webbing

$$\left(\frac{W-L}{L}\times 100\right)$$

is known

Set the mark EW (**24*a***) on the given number of extra webbing on the extra webbing scale **18** of the bottom disk **3**. Note the equivalent number on slack scale **17** or hung length scale **15**. The curve intersecting the equivalent slack or hung length represents the taper angle.

7. Determination of Take-up rates and Tuck-in Rates

Set hairline **30** of the indicator **8** to the number of meshes of Net A on scale **2**. Rotate scale **1** and bring the number of meshes of Net B under the hairline **30**. Now, that number on the scale bearing the higher number of meshes opposite the index of the scale bearing the lower number of meshes represents the whole number R and the denominator *d* and the numerator n of the fraction in its lowest term.

Then, using the proper window for the given condition for joining the netting, rotate the top disk **4** and observe the two pairs of numbers immediately left and right of the vertical line which is directly below the index 1 (**11**) of scale **1**. Then set the same window over that pair of numbers of lower numerical values. The number appearing in the upper portion of the window is the value of *R* and that in the lower portion is the value of R ≠ 1. Afterwards, the values of the quantities (*d–n*) and *n* are written on the corresponding blank spaces of given situation on the top disk. Lastly, the multiplier Net A/*s* or Net B/*d* whichever is smaller is multiplied by the whole quantity enclosed in parenthesis in the given situation.

To appreciate the above operations, a more concrete example is hereby presented.

Suppose it is desired to find out the take-up rate to join **30** meshes of Net A to **40** meshes of Net B. Note that this is under the condition Net B is greater than or equal to Net A in the second quadrant of the annulus **6**. See also the diagram **40** in FIG. **4**.

First, set the hairline **30** to 30 on Net A or on scale **2**. Rotate scale **1** so that 40 meshes of Net B falls underneath the hairline **30**. Then read opposite the index **12** of scale **2** bearing the lower value, **30** the number on scale **1** bearing the higher value **40**. This number is 1.33 or 1 ⅓. The whole number *R* therefore is 1 while the required fraction is ⅓. From this fraction which is in its lowest term, it is obvious that the denominator d is 3 while numerator n is 1. The value of $(d-n)$ is $(3-1)$ or 2. Now, rotate the top disk **4** a little to the left and right of the vertical line **9** of the middle disk **5** so that the lower of the two numerical values of R and $(R \neq 1)$ which is ½ appears through the window (**7***d*) of the condition for joining the netting, i.e. Net B is greater than or equal to Net A. Then write the values of $(d-n)$ and n on the corresponding blank spaces of the given situation. Finally, calculate the multiplier which is 30/3 or 10. This value of 10 is written outside of the parenthesis and the whole formula represents the required take-up rate which is:

$$\left(\frac{1 \text{ Net } A1 \text{ Net } B\times2}{1 \text{ Net } A2 \text{ Net } B\times1}\right)10$$

The above expression means that 1 mesh of Net A is joined with 1 mesh of Net B twice, followed by 1 mesh of Net A joined with 2 meshes of Net B once. The two horizontal strips of netting will be joined completely together by repeating that sequence **10** times.

8. Determination of taper patterns

Set the number of clean meshes on scale **2** of the rule. Bring the hairline **30** of the rule to this number and rotate the middle disk **5** so that the number of cut meshes on scale **1** is directly beneath the hairline **30**. Rotate the top disk **4** so that a vertical line **9** appears through the window of the required taper pattern condition. Then rotate the top disk **4** clockwise until a figure appears through the window. Note this figure. Now rotate the top dosk **4** counterclockwise until a figure appears through the window. Note again the figure that appears through the window. The true figure that should appear through the window is the one which is smaller. The values of d and n are of course obtained in a manner similar to the procedure in illustration number 7. The multiplier is either CtM/d or CnM/d whichever is smaller.

For a more concrete illustration, hereunder is the procedure followed in determining the taper pattern for a 4 × 6 netting when cutting or hand braiding under such a condition that cut meshes are equal to or greater than meshes.

First, locate 4 in scale **2**. Bring the hairline **30** over it. Locate 6 in scale **1** and rotate the middle disk **5** so that it is directly under the hairline **30**. Note the number on scale **1** opposite the index **12** of scale **2**. This number is 1½. Therefore, the value of d is 2, that of n is 1, and that of R is 1. The value of $(d-n)$ is 2–1 of 1. Then place the values of n and $d-n$ on the corresponding blank spaces of the top disk for the given situation of cutting and hand braiding when CtM is equal to or greater than CnM, which situation is in the fourth quadrant of the annulus **6**. Rotate the top disk **4** until a vertical line **9** appears through the window **7***h* of the given situation. With this line as reference, rotate it further to the right and then to the left, noting down the sets of figures first appearing through the window during the rotation. The pair of numbers which is smaller is the one which should fill in the window **7***h* for the given situation. In this case, the numbers are 1 over and 2 under. Then, compute the multiplier which is the smaller number of meshes, i.e. CnM divided by d or 4/2. Therefore, the required taper pattern for the given situation or condition is:

$$\frac{F}{S}\left(\frac{1 \text{ Point } 1 \text{ Mesh}\times1}{2 \text{ Points } 1 \text{ Mesh}\times1}\right)2$$

This procedure is applicable when determining the taper patterns for other conditions.

Like in illustration number 7, the value of the numbers appearing through the window are given as follows:

I. For cut taper **37** when cutting ready-made netting
a. when CtM = CnM, $(R-1)/R$
b. when CtM = CnM, $(R-1)/R$

II. For braided taper **38** when hand braiding
a. when CtM = CnM, $R/(R\neq1)$
b. when CtM = CnM, $2R/(2R\neq2)$

III. For cut taper or braided taper **30** pattern when cutting or hand braiding netting
a. when CtM = CnM, $R/(R\neq1)$
b. when CtM = CnM, $R\,(R\neq1)$

From the foregoing, it is apparent that there is provided a novel circular slide rule useful in the netmaking industry which comprises of a bottom disk, a smaller intermediate disk and a still smaller top disk pivotally fastened at their centers by a suitable fastening means; said top disk having an opaque annulus containing a pair of windows in each quadrant, and indicator means integrally attached to the periphery of the annulus and extending outwardly therefrom and a window symmetrical with the first and fourth quadrant of the annulus and disposed at a distance below the indicator means, said annulus including various notations useful in the netmaking industry on its front face, said intermediate disk having as a first scale a circular four cycle logarithmic scale adjacent its periphery and two vertical hanging scales in opposition with each other and disposed at a distance below the main index of the said first scale, said bottom disk having various notations and diagrams useful in the netmaking industry on its back face and curves, various scales and notations on its front face which includes: as the first scale a circular four cycle logarithmic scale adjacent to the periphery of the bottom disk; as a second scale, a series of arcuate logarithmic scales concentric with and disposed inwardly of the first scale; as third, fourth and fifth scales, concentric logarithmic scales disposed inwardly of the second scale and adjacent to each other; as sixth and seventh scales, concentric semicircular logarithmic scales juxtaposed with each other and disposed inwardly of the fifth scale and to the right half of the bottom disk; as eight and ninth scales, concentric semicircular logarithmic scale adjacent to each other and disposed inwardly of the fifth scale and to the left half of the bottom disk; and as tenth scale, tangent-cotangent curves disposed inwardly of the seventh and ninth scales.

The above examples are given only to illustrate the invention and are not intended to limit the invention to said examples. Many modifications of the present invention are obvious to those skilled in the art. However, such modifications or variations are also within the scope of the present invention as long as they do not depart from the meaning and spirit of the appended claims.

Having fully described my invention, what I claim is:

1. A circular slide rule useful in the net making industry comprising a plurality of concentric disks arranged one on top of the other and pivotally fastened at their centers with suitable fastening means, the topmost

disk including an opaque annulus having a plurality of windows, at least two of the other disks each having in the region of the outer periphery thereof at least one logarithmic scale; and indicator means integral with said topmost disk and outwardly projecting therefrom for being positioned over the logarithmic scales on said other two disks and for cooperating therewith.

2. A circular slide rule according to claim **1** wherein the said top disk includes a pair of windows in each quarter of the annulus and a window which is symmetrical with the first and fourth quadrant of the annulus and disposed at a distance below the indicator means.

3. A circular slide rule useful in the net making industry comprising a plurality of disks arranged one on top of the other and pivotally fastened at their centers with suitable fastening means, the topmost disk including a transparent inner portion, an intermediate disk including at least one logarithmic scale adjacent its periphery, and two radially extending scales in opposition with each other and disposed radially inwardly of said peripheral logarithmic scale and arranged in a predetermined angular position with respect thereto adjacent said transparent inner portion for being observable therethrough.

4. A slide rule as defined in claim **3**, wherein said logarithmic scale comprises a four cycle logarithmic scale.

5. A slide rule as defined in claim **1**, wherein three disks are provided and wherein the bottommost disk includes the following scales: as a first scale, a circular four cycle logarithmic scale adjacent to the periphery of the said disk; as a second scale, a series of arcuate logarithmic scales concentric with and disposed inwardly of the first scale; as third, fourth and fifth scales, concentric logarithmic scales disposed inwardly of the second scale and adjacent to each other; as sixth and seventh scales, concentric semicircular logarithmic scales juxtaposed with each other and disposed with each other and disposed inwardly of the fifth scale and to the right half of the bottom disk; as eight and ninth scales, concentric semicircular logarithmic scale adjacent to each other and disposed inwardly of the fifth scale, and to the left half of the bottom disk; and as tenth scale, tangent-cotangent curves disposed inwardly of the seventh and ninth scales.

6. A circular slide rule useful in the netmaking industry comprising of a bottom disk, a smaller intermediate disk and a still smaller top disk pivotally fastened at their centers by a suitable fastening means; and said top disk having an opaque annulus containing a pair of windows in each quadrant; and indicator means integrally attached to the periphery of the annulus and extending outwardly therefrom and a window symmetrical with the first and fourth quadrant of the annulus and disposed at a distance below the indicator means; said intermediate disk having as a first scale a circular four cycle logarithmic scale adjacent its periphery and two radially extending scales in opposition with each other and disposed radially inwardly of said four cycle logarithmic scale; said bottom disk having scales on its front face which include: as the first scale, a circular four cycle logarithmic scale adjacent to the periphery of the bottom disk; as a second scale, a series of arcuate logarithmic scales concentric with a disposed inwardly of the first scale; as third, fourth, and fifth scales, concentric logarithmic scales disposed inwardly of the second scale and adjacent to each other; as sixth and seventh scales, concentric semi-circular juxtaposed with each other and disposed inwardly of the fifth scale and to the right half of the bottom disk; as eight and ninth scales, concentric semicircular logarithmic scale adjacent to each other and disposed inwardly of the fifth scale and to the left half of the bottom disk; and as tenth scale, tangent-cotangent curves disposed inwardly of the seventh and ninth scales.

7. A slide rule as defined in claim **6**, wherein said bottom disk is made from a flat, rigid material, and said top and intermediate disks are flat and transparent.

8. A slide rule as defined in claim **7**, wherein said flat, rigid material is a laminated plastic, and said top and intermediate disks are made from transparent plastic.

9. A slide rule as defined in claim **1**, wherein mathematical relationships for at least one of the following is provided on said annulus: for tapering when cutting ready made netting, for joining netting, for tapering when hand braiding netting, and for tapering when cutting or hand braiding.

10. A circular slide rule useful in the netmaking industry comprising three concentric disks arranged one on top of the other and pivotally fastened at their centers with suitable fastening means, the topmost disk including an opaque annulus and a transparent inner portion, the intermediate disk being transparent and bearing two radially extending scales in opposition with each other and disposed adjacent to said inner portion for being observable therethrough, and the bottommost disk bearing taper angle curves disposed adjacent to said inner portion for being obsevable therethrough, whereby said radially extending scales and said taper angle curves are both observable through said inner transparent portion and are superimposed to cooperate with one another.

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