July 18, 1939. G. E. ROEDER 2,166,372

FORMULA-FINDING DEVICE

Filed June 16, 1938

FIG. 1.

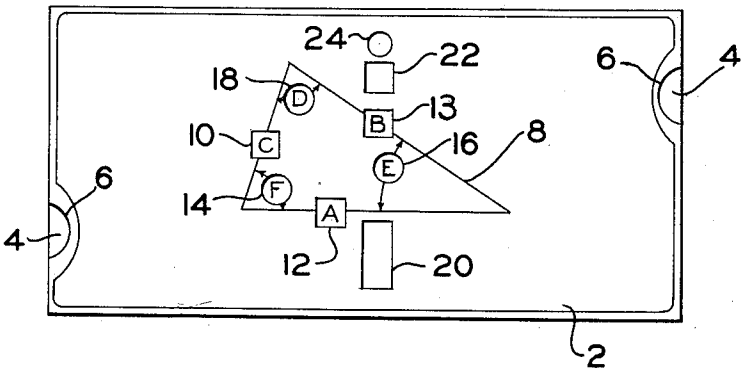


FIG. 2.

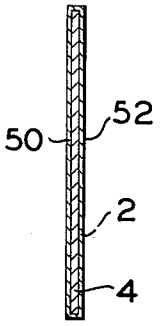


FIG. 3.

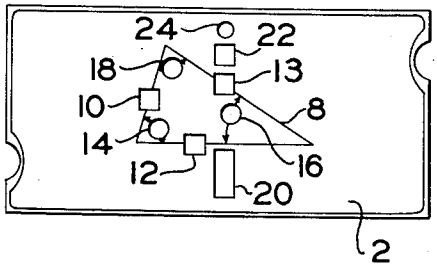


FIG. 4.

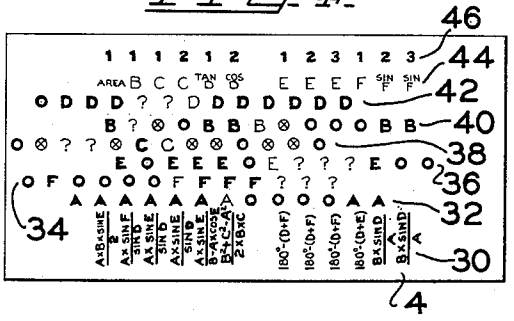
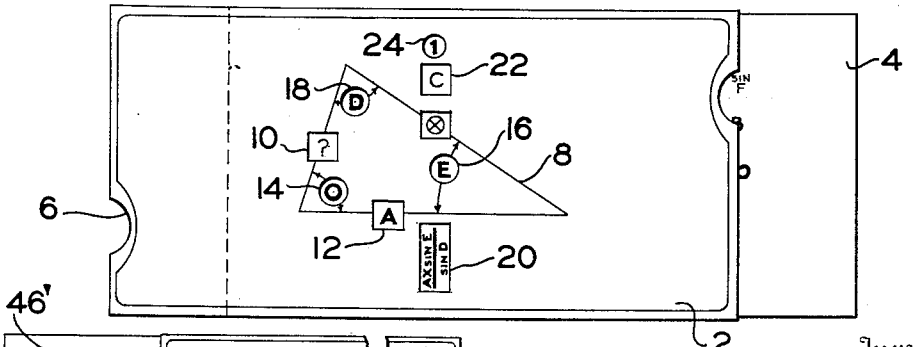


FIG. 5.



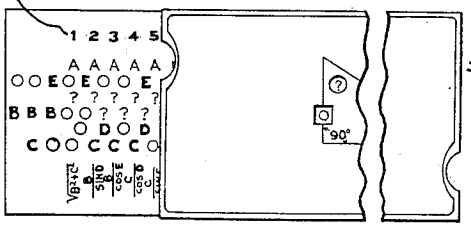


FIG. 6.

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FORMULA-FINDING DEVICE

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3 Claims. (Cl. 35—75)

This invention relates to a device for finding formulas for solving triangles and other geometrical figures.

An object of the invention is to find a formula for the solution of a problem, the known and unknown quantities of which are indicated in their proper positions upon a geometrical figure representing the elements of the problem.

Another object of the invention is to make a device in which known and unknown values can be made to appear in their respective positions upon a geometrical figure, and the formula for finding the solution for the unknown values from such known values is simultaneously given.

A further object of my invention is to produce a device in which the values of the elements of a geometrical figure can be made to appear upon said figure while corresponding formulae can be made to appear adjacent said figure.

A still further object of my invention is to provide a device which will quickly and accurately show the method of solution of a problem without the necessity of referring to tables, and/or separated figures, and gives a selection of formula to find an unknown value.

Generally, these objects are obtained by providing two members, one of which is slidable with respect to the other. One of said members has thereon a geometrical figure with apertures, or windows, in the various legs and angles of the figures, and also other windows through which various other information may appear. The second member, which is slidable with respect to the first, has thereon values marked so that when it is displaced with respect to the first member, the various elements of the geometrical figure appear designated by symbols through the windows as known and unknown values, and the formula for finding any unknown value from corresponding known values appears through another window. Still other windows simultaneously show the character for the unknown value and an identifying numeral for that particular formula.

The means to achieve these results may be more fully understood by the following description of a device, taken in connection with the accompanying drawing, in which:

Fig. 1 is a plan view of my device.

Fig. 2 is a side view of the device shown in Fig. 1.

Fig. 3 is a plan view of the outer member of the device.

Fig. 4 is a plan view of the inner member of the device.

Fig. 5 is a view showing the inner member partially displaced with respect to the other member to indicate the proper formula for the solution of a problem; and

Fig. 6 is a view similar to Fig. 5 showing a right triangle.

In Figs. 1 and 2, the outer member is shown at 2, and the inner member at 4. These members may be made of paper, wood, Celluloid, or any other natural or synthetic material. Outer member 2 has at the transverse edges thereof cut out portions 6 to enable an operator's fingers to engage the inner member.

Upon the surface of outer member 2 is printed, or otherwise marked, a geometrical figure 8 which, for purposes of illustration, has been shown to be a triangle. Windows corresponding to the various sides and angles are cut in the outer member, and, as shown, these windows may be cut in the various legs and angles themselves, which windows or apertures extend through the outer member to make visible therethrough the inner member. For example, note Fig. 3, the window 10 designates the upright side of the triangle; the window 12, the horizontal side; the window 13, the inclined side. The angles are also denoted by windows 14, 16, and 18, respectively.

Other windows are also cut which will be briefly referred to and described in detail later. For example, window 20 is cut for the purpose of showing the formula therethrough from the inner member; window 22 is cut for denoting the side to be sought; and window 24 is cut for identifying the particular formula being used.

Upon Fig. 4 a plurality of rows of symbols are shown. These symbols are arranged as follows: With the inner member placed coincidently with the outer member as shown in Fig. 1, each leg and angle of the triangle is given a symbol, and these symbols are preferably marked in a distinct color, as, for example, a red color. Thus, as shown, the horizontal side of the triangle is given the symbol A, which symbol A marked upon inner member 4 appears through the window 12 of the outer member 2 as shown in Fig. 1. Similarly, the inclined side is given the symbol B; the substantially vertical side, the symbol C; and the angles are given the symbols D, F, and E, all of these being of the same color, preferably red, as the symbol A in this position.

No values appear in the windows 20, 22, and 24 inasmuch as in the position shown in Fig. 1, the various elements of the geometrical figure are merely designated through the windows.

Again referring to Fig. 4, the lowermost row of symbols indicate various formulae for the

solution of the triangle for the examples shown when various sides and angles of the triangle are known. This row of formulae is shown at **30**, and appears through the window **20** of the outer member. The next row **32** shows the symbols A, and certain zero marks which indicate in use that the value of the leg A of the triangle is not known or needed in the solution of the problem. The next row of symbols **34** shows symbols for the angle F. In addition to the letter F and the zero symbols, this row also has certain question marks. These question marks are to appear through the window **14** when the angle F is being sought. It is noted that for the particular row, three question marks are shown, and thus three different formulae exist for determining the value of the angle F.

The next row of symbols **36** are for the purpose of showing the values for the angle E through the window **16**, and correspondingly, row **38** shows values for the leg C; row **40**, symbols for the leg B through window **13**; and row **42**, symbols for the angle D. Row **44** indicates the unknown quantities, the value of which is sought, these symbols to appear through window **22** in the outer member. For example, the left-hand symbol states that the area of the triangle is to be shown; and with reference to Fig. 5, the symbol C indicates through window **22** that the substantially vertical leg C is being sought.

The uppermost row of figures **46** are to appear through window **24** of the outer member, and are to be used in connection with the row of formulae **30** and the row **44**. For example, in row **44**, the symbol D appears twice, once to indicate the tangent of the angle D by one formula which is to appear in the window **20** of the outer member; and secondly, to find the cosine of the angle D which is to be shown in another formula in the window **20**. The tangent appears in connection with the numeral 1 in row **46**. Consequently, where different formulae appear for the same element, the proper formulae, or the formula desired, can be quickly checked by observing the numeral through the window **24** after the operator of the instrument has learned the association between the numerals appearing in row **44**, and the formula appearing in row **30**.

In Fig. 6, a right triangle is shown, and the values for the side A indicate in row **46'** that five formulae are available for finding side A.

It is noted that the windows on outer member **2** are vertically separated to correspond with the rows of symbols appearing on inner member **4**. The device can be easily constructed by first placing the inner and outer members in a position shown in Fig. 1 and marking through the windows upon the inner member the symbols designating the various elements of the triangle. The inner member is then displaced with respect to the outer member until the symbols have disappeared, and then an unknown value is marked on either a side or angle by means of a question mark, preferably in a distinct color, such as red, upon one of the elements of the triangle, and the symbol for said unknown value sought marked through window **22**, also in red. The known values are marked in black through the other windows, with the unneeded values marked as zeros through the remaining windows, and the formula obtaining the unknown values is marked upon the inner member through window **20**. As the inner member is successively displaced, other formulae and values are marked upon the inner member, and when the inner member is completely marked, it takes the appearance shown in Fig. 4.

The above description has been made for the marking of one side of the inner member **4** to be used in connection with the figure delineated upon the surface of the outer member **4**. However, the outer member **2** is conveniently made with two sides, **50** and **52**, as shown in Fig. 2, with the inner member **4** slidable between the two sides. Therefore, in such construction, one figure, such as shown by the triangle in Fig. 1, can be marked on one surface of the outer member **2**, and another figure, which may be as shown in Fig. 6, or any other geometrical figure, may be marked on the other surface of the outer member **2**. Of course, in such a case, the inner member **4** has the appropriate symbols for such figures placed on each respective side of member **4**.

Fig. 5 is an illustration of how the device is used. Thus, in Fig. 5 the operator seeks to find a formula by means of which he can determine the value of side C from certain other known values. Consequently, inner member **4** has been displaced with respect to outer member **2** until a question mark appears through window **10** for side C, and the symbol C appears through window **22**, thus showing that C in window **22** corresponds to the side upon which the question mark appears. In window **24**, the numeral 1 appears to show that this is the first formula for determining a value for leg C. The unknown values appearing through windows **10** and **22** are, as before stated, preferably marked in red. The known values, namely, the values for side A and angles E and D, appear through windows **12**, **16**, and **18**, respectively, and these symbols are preferably in a black color. The formula for finding the leg C appears in window **20**, the values for A, D, and E having been given. It thus appears that when it is desired to find the value of one element of a geometrical figure, the formula therefor, or a choice of formulae therefor, can be determined by displacing one member with respect to another and having the sought-for value appear as a question mark upon the corresponding element of the geometrical figure, while a succession of known values can be made to appear in their corresponding places on the other elements of the geometrical figure, and that for each displacement a formula appears in another place for showing how the sought, or unknown value can be obtained by use of the known values.

This device provides many advantages over prior devices, as, first of all, the various elements are made to appear visually upon the corresponding elements of a geometrical figure, thus enabling the operator to see immediately the relation between the corresponding parts of the geometrical figure in the device, and the elements of the problem which he is attempting to solve. It is further noted that the various question marks or sought-for values marked upon the rows of Fig. 4 have been marked successively so that the operator of the device need only move the inner member **4** to two or three successive positions in order to determine all the various formula available for the solution of that particular unknown value. Through experience, the operator is able to remember that certain formula correspond to the numbers appearing through window **24**, and thus, for example, he may remember that a certain formula for finding the value C corresponds to the numeral 1 which

would appear in window 24, and the operator would then directly slide member 4 until the numerals 1 and C appeared in windows 24 and 22, respectively, and find the formula expected in window 20. Such a correlation between these three numbers provides an additional advantage in that it stimulates the memorization of certain formula by related objects.

Having now described the means by which I obtain the objects of my invention, what I claim is:

1. A device for indicating the solution of geometrical problems comprising an outer member having marked thereon a geometrical figure composed of sides and angles, windows arranged in the outlines of said sides and angles and adapted to disclose figure indicating indicia, windows located adjacent said figure and adapted to disclose formula and unknown value indicating indicia, an inner member displaceable with respect to said outer member, rows of symbols on said inner member, certain of said symbols in respective rows indicating an unknown value for either a side or an angle through one of said windows arranged in the outlines of said figure, and certain other symbols indicating known values through at least one of the other of the same windows, certain other symbols forming another row of formulae for appearing in said window arranged to disclose formula in dependence upon the symbols appearing in said windows arranged in the outlines of said figure, and other symbols indicative of the side or angle of unknown value appearing in said window arranged to disclose unknown value indicia in dependence upon the appearance of an unknown value symbol through one of said figure windows arranged in the outlines of said figure.

2. A device as in claim 1 further comprising an additional window in said outer member, an additional row of symbols upon said inner member arranged for appearance through said additional window, said additional row of symbols indicating in association with the symbol appearing through said window arranged to disclose unknown value indicia, a particular formula appearing simultaneously through said window arranged to disclose formula.

3. A device for indicating the solution of a geometrical problem comprising a first member having the elements of a geometrical figure delineated thereon, a plurality of windows cut in said first member, each window corresponding to an element of, and opening through a side or angle of said figure, and at least one other window, said windows being vertically displaced with respect to each other across said first member; a second member slidable with respect to said first member, rows of symbols upon said second member corresponding to each of said windows on said first member, the symbols of certain of said rows indicating through said plurality of windows a character for one of said elements of said figure as either a known or unknown value, the symbols of another row indicating a formula through said other window in dependence upon known value characters simultaneously shown through said plurality of windows, the symbols formed of characters and formulae in said rows presenting through said windows various solutions of geometrical problems relating to said figure.

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