Feb. 5, 1963 A. F. SCHOTT 3,076,272

ABACUS

Original Filed May 11, 1953

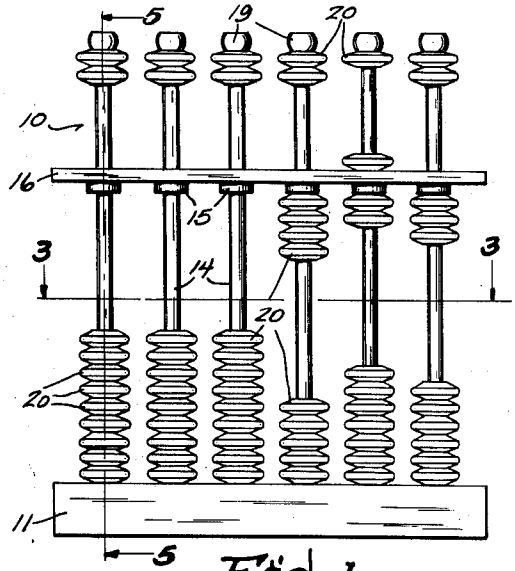


Fig. 1

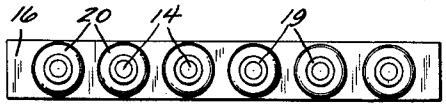


Fig. 2

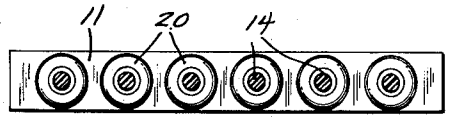


Fig. 3

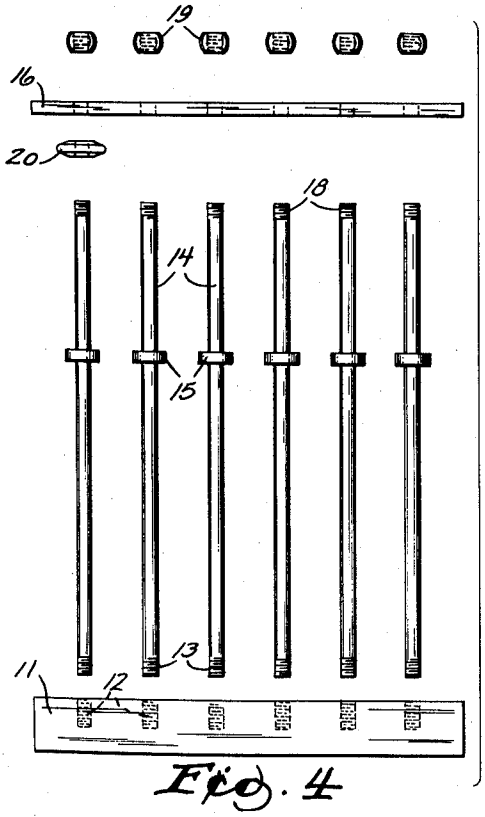


Fig. 4

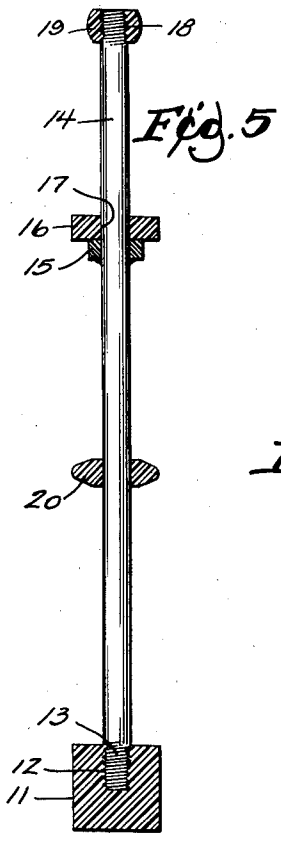


Fig. 5

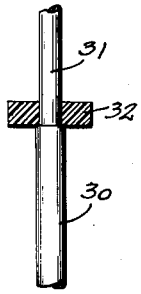


Fig. 6

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ABACUS

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Continuation of application Ser. No. 354,113, May 11, 1953. This application May 28, 1959, Ser. No. 816,558
6 Claims. (Cl. 35—33)

This invention relates to an improved abacus, and this application is a continuation of my copending application Serial Number 354,113 filed May 11, 1953, and now abandoned. The broad object of the invention is to provide an abacus to be used as a tool in teaching and in learning the practice and the arithmetic of the number system, base ten.

In accord with this invention, abacus counters are in multiple vertical columnar arrangement corresponding to columns of figures in accord with mathematical practices. The counters are movable toward and away from a stop which is applicable to each column and there are nine counters on one side of the stop in each column while two counters are movable along each column on the other side of the stop, thus making it possible by ascribing a numerical sequence of numbers to each of the nine counters below the stop and a proportionate relationship of 5:1 to each of the counters above the stop in each column, and to proceed by transformation from column to column in elementary mathematical exercise which visually and tactually describes and explains arithmetic. The invention therefore relates to an abacus making possible the physical portrayal, in any one column, of the serial numbers beyond our numbers system to 19. Other known abaci have an upper limit of 15.

A further object of the invention is to provide an abacus formed of elements such as transparent plastic which may be readily assembled by a student as a part of the instruction relative to the construction and use of the instrument or tool, and it will be understood that the abacus of the present invention may involve a number of construction principles but is shown in the form of a plastic tool having rods and bars assembled as described below.

In the drawings:

FIG. 1 is a view in elevation of this device;

FIG. 2 is an end view, in elevation of the abacus shown in FIG. 1 as viewed from the right;

FIG. 3 is a section on line 3—3 of FIG. 1;

FIG. 4 is an exploded view of the assembly;

FIG. 5 is a section on line 5—5 of FIG. 1;

FIG. 6 is a fragmentary view partly in elevation and partly in section of a modified form of the invention.

Referring more particularly to the drawings, the numeral **10** refers to the device generally having an elongated bar or column **11**, rectangular in cross section, which in the preferred form is transparent. The bar **11** is laterally and spacedly bored and tapped as at **12** to receive the threaded ends **13** of the several rod elements **14**. A collar **15** is fixed to each rod **14** at a predetermined point adjacent one end thereof.

A bar element **16** to act as a stop and as a clear visible separation of portions of the rods has a plurality of apertures as at **17** spaced to accommodate the rod elements **14** and sized to receive said rods with a driving fit.

The outer end of each rod element **14** is threaded as at **18** to receive an internally bored and tapped knob **19**, and when the device **10** is properly assembled, there are nine counters **20** to reciprocate on each rod element **14** to one side of the bar **16** and two of the counters **20** to reciprocate on the other side thereof.

In FIG. 6, a modified form of the invention is shown in which each rod element **30** has one end portion **31** reduced 1,000th of an inch and the bar **32** is apertured for a driving fit on said reduced portions, it being understood that in this construction the bar **32** takes the place of bar **16**.

In use, the device alternatively may be positioned with the bar element **16** disposed to the user's right hand, with the rods **14** in a horizontal position, but when used in arithmetic instruction and practice according to the numbers system, this abacus is placed with the bar **11** at the bottom or crosswise immediately in front of the user with the rods **14** extending away from the user. Thus the column represented by the rod **14** on the extreme right is in position to represent with its nine counters **20** below the stop **16** and the two counters above the stop, values which would normally appear in the unit column of an arithmetic problem involving counting, addition, multiplication, subtraction or division.

To initiate any exercise in the use of this abacus, all of the nine counters "below" the stop **16** are moved to the extreme position away from the stop and all of the pairs of counters on the other side of the stop **16** are moved as far away from the stop **16** as is possible within the limits prescribed by the knobs **19**. This operation may be termed clearing the abacus. It is now ready for any exercise, the number zero being then represented on the abacus.

Each of the counters below the stop **16** in the first column represent the number one and there are nine of them so that it is simple for the user to count ordinally to nine below the stop and to visually indicate the count by moving as many counters as desired toward the stop just as the three counters are shown in FIG. 1. To indicate a cardinal number greater than nine in the right hand or unit column for purposes of transformation, as will be described below, each counter in the pair of counters on the top side of the stop on that rod, or in that column has the numerical value five.

The arrangement of the counters above and below the stop in this fashion makes it possible to transform or change five counters below the stop for one counter above the stop equal to the numerical value of the five single counters below the stop. In turn, two five counters above the stop or one five counter above the stop in combination with five of the counters below it can be transformed or changed for one counter in the next adjacent column to the left.

In this manner, the transformation of the numerical values represented by the counters in any column can be visibly and tactually changed to combined numerical values in any column and also transformed or changed to the numerical value of one of the counters in the adjacent column to the left.

This process of change or transformation within and between columns is of vital importance in the understanding of the number system, base ten, and a basis to understanding the law of likeness of mathematics.

The process as explained, operating from right to left in addition can also proceed from left to right in subtraction.

Basic to an understanding of the base ten number system and an explanation of the law of likeness is the construction of this abacus with nine counters below the stop and two above. In the first place, the nine counters below the stop, in combination with all counters moved away from the stop affords the representation of the number system, base ten, below the stop, or five counters below the stop in combination with one of the counters above the stop and four below to also afford this representation.

Transformation or change between columns necessitates that the sum of any two digits in any column be represented in that column, before being transformed or changed into their numerical value, if their sum is ten or greater, in the adjacent column to the left. This requires

the structure of the abacus as shown in FIG. 1 and makes it unique in the art.

The process of subtraction of a number from a smaller number in the same column which has a digit in any adjacent column, such as 1998 minus 999, requires transformation proceeding across columns from left to right. This again requires the structure of the abacus as indicated in FIG. 1 for the numerical value eighteen is needed in every column to demonstrate and understand this process.

Both of these processes for the first time can be clearly demonstrated and even self-learned by children in the primary grades, using this new abacus as a tool for learning, a feat practically impossible without the use of addition and subtraction principles.

This type of explanation and its direct application to teaching and learning the processes of addition, multiplication, subtraction and division for which all the counters on the abacus are needed, is made possible, at the level of young children, through the use of this abacus and its unique characteristics.

In addition, the presentation of the ordinal system of numbers, base ten, is also possible on this abacus because of the arrangement of nine counters below the stop and zero as the counters are pushed away from it.

It is the new combination of the nine counters below the stop, with the addition of two counters above it which makes this compact, simple tool for teaching mathematics unique, in its teaching and learning application to the base ten system of ordinal and cardinal number and process used in schools throughout the world.

Ordinal Numbers

When used for ordinal numbers and process in a vertical position, each of the five rods of the abacus, beginning at the right, represent the units, tens, hundreds, thousands and ten thousands columns in the written notation of the number system, base ten. On each rod, one of the nine counters below the stop expresses a numerical value of one tenth of the numerical value of one of the nine counters on the next rod to the left. Thus it is possible to count ordinally from zero to 99999 or to record in visual form any whole number by properly moving selected counters of the group of nine counters "below" the stop.

Cardinal Numbers

When used to teach cardinal number and process, five counters in any column below the stop can be changed or transformed as needed into one counter above the stop which is equal to the numerical value of five single counters below the stop. The two counters above the stop in addition to the nine counters below the stop, can represent the sum of the addition of any two numbers in that column without changing them to larger unlike numerical values in the adjacent column to the left. This makes it possible to represent the addition of any two numbers in a column in a simple, comprehensible manner with an understanding of the base principle of likeness. This new arrangement makes it possible to clearly illustrate the process of transforming across adjacent columns, when the sum of the digits are greater than ten in that column and necessitates their change into a unit of higher denomination in the adjacent column to the left. This process of transformation proceeds in the opposite direction in the process of subtraction. These transformations make it possible to teach the "law of likeness" of mathematics which relates to the transformation from column to column.

In an addition problem such as 9 and 9, the sum 18 can be represented in the unit column by means of two five counters above the stop and eight unit counters below the stop. This immediately results in a concrete visualization of the addition of 9 units and 9 units to make 18 units in that column. The two five unit counters above the stop can then be transformed into one ten counter in the tens column, demonstrably by moving the two five unit counters to the top of the rod (thus clearing them) and by moving a tens counter on the second rod up against the stop or as far as possible in an upward direction. This clearly illustrates the principle of transformation across columns and the equivalents of ten units in one column to 1 ten in the next in the number system, base ten. The principle applies to additions in a column in any number in the number system.

The reverse process, illustrated by the subtraction of 8 from 17, would be visually demonstrated by first showing the number 17 on the abacus as 1 ten counter on the second rod from the right and one five unit counter down to the stop from above the stop and two unit counters up to the stop from below to the first rod. The 1 ten counter is then transformed or changed into ten unit counters by pushing one five unit counter down to the stop and five single counters on the first rod up toward the stop while moving the ten counter down as far as possible from it. Seventeen unit counters are therefore in the unit column, 8 unit counters can be subtracted in the form of one five unit counter above the stop and three single counters below it leaving a difference of 9 unit counters against a stop. This clearly illustrates again the equivalents of 1 ten to 10 units and the subtraction of 8 units from 17 units to arrive at the difference of 9 units.

Both visualizations are not demonstrable either in the Chinese or Japanese abacus or in any other abacus heretofore provided. The principles of subtraction illustrated are applicable to any columns in the number system and are essential to basic understanding of elementary mathematics and the laws of mathematics on which much subsequent mathematic learning is built.

I claim:

1. A device of the character described comprising a column having spaced parallel tapped borings, a plurality of rods endedly threaded for assembly within said borings, a plurality of collars one fixed on each rod, a bar having apertures to receive said rods for abutment against said collars, internally threaded knobs for attachment to the free ends of said rods, and counters mounted for reciprocation on the rods.

2. A device of the character described comprising a column having spaced parallel tapped borings, a plurality of rods endedly threaded for assembly within said borings, a collar fixed on each rod, a bar having apertures to receive said rods for abutment against said collars, knobs for attachment to the free ends of said rods, and counters mounted for reciprocation on the rods.

3. A device of the character described comprising a column having spaced parallel laterally disposed tapped borings, a plurality of rods endedly threaded for assembly within said borings, a collar fixed on each rod, a bar having apertures to receive said rods for abutment against said collars, knobs for attachment to the free ends of said rods, and counters mounted for reciprocation on the rods.

4. A device of the character described comprising a column having spaced parallel laterally disposed tapped borings, a plurality of rods endedly threaded for assembly within said borings, a plurality of collars fixed on said rod, a bar having apertures to receive said rods for abutment against said collars, knobs internally bored and threaded for attachment to the free ends of said rods, and a plurality of counters freely slidable on each rod.

5. A device of the character described having a column with spaced parallel laterally disposed borings, a plurality of rods for assembly within said borings, said rods having reduced end portions, a bar having apertures to receive the reduced rod portions with a driving fit, knobs for attachment to the free ends of said rods, and counters respectively bored appropriately to reciprocate upon the reduced and unreduced portions of said rods.

6. In a device of the character described a plurality of rods having counters slidable thereon and having a fixed

bar at the end of said rods, each of the rods having nine individual counters, a divider positively fixed on the rods and positioned to hold said nine counters on one portion of each rod between the bar and the divider, and two counters are positioned on each rod on the other side of the divider.

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