No. 637,964. Patented Nov. 28, 1899.

J. P. JOHNSEN.

ABACUS.

(Application filed June 12, 1899.)

(No Model.)

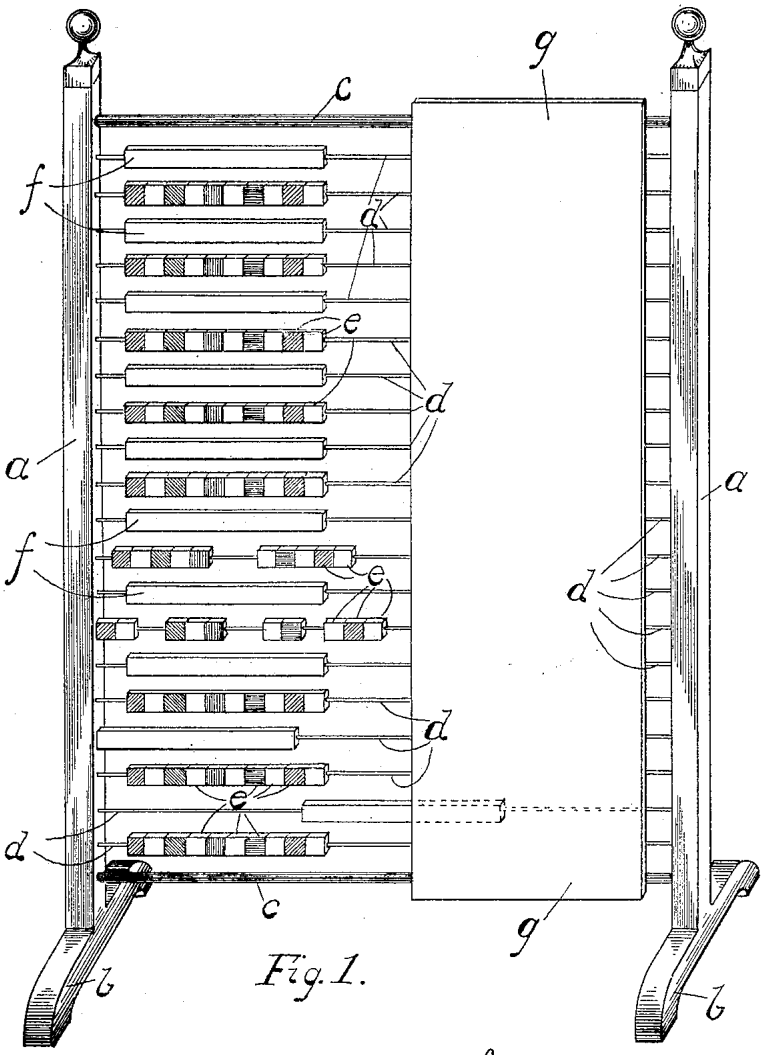

Fig. 1.

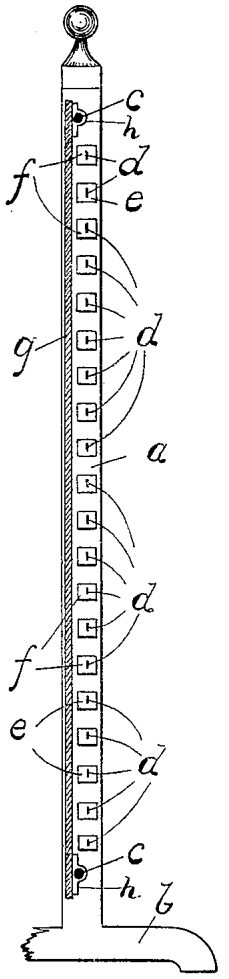

Fig. 2.

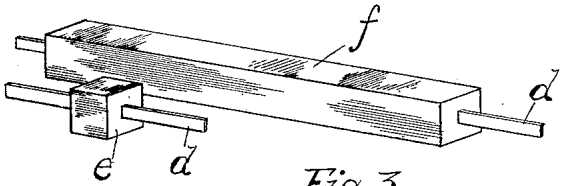

Fig. 3.

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ABACUS.

SPECIFICATION forming part of Letters Patent No. 637,964, dated November 28, 1899.

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To all whom it may concern:

Be it known that I, JOHN P. JOHNSEN, a citizen of the United States, residing in the city of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Abaci, of which the following is a specification.

My invention relates to improvements in abaci of the class used in teaching arithmetic; and the objects of my invention are, first, to provide, in connection with the usual features of an abacus, means for demonstrating the principles underlying the structure and composition of numbers in the Arabic decimal system of notation, or what might be termed the principles of "number-building;" second, to provide means for illustrating the methods known as "borrowing" and "increasing" in the arithmetical operations in said system. I attain these objects by the mechanism illustrated in the accompaning drawings, in which—

Figure 1 is a front view, in perspective, of the entire device. Fig. 2 is a sectional view of the device, taken transversely through the screen. Fig. 3 is a perspective view of a long and a short block, showing the relative lengths thereof.

Similar letters refer to similar parts throughout the several views.

The side standards *a a*, consisting, preferably, of wood, are supported on the feet *b b* or in any other suitable manner and are securely held in their proper relative positions by means of the cross-rods *c c*. Within the frame thus formed by said standards *a* and cross-rods *c* are the supporting rods or wires *d d d*, extending horizontally across the frame and at equal distances apart and supported by said standards. Said wires *d* are mutually parallel to said rods *c* and are preferably twenty in number. Upon every alternate one of said wires *d* are carried ten small blocks, some of which are marked *e*. Said blocks *e* are right prisms of equal size and shape and slide easily upon said wires *d*. For convenience in distinguishing them one from another said blocks *e* may be variously colored. Upon the remaining wires *d*, alternating with such of said wires as support the small blocks *e*, are the long blocks, some of which are marked *f*. Said blocks *f* are the same in cross-section as the small blocks *e* and are supported upon the wires *d* in the same manner as said small blocks are supported. Said blocks *f* are also right prisms, the length whereof is equal to the total length of ten of said small blocks *e*. Said wires *d* are preferably flat, and for the purpose of better supporting the weight of the blocks *e* and *f* are placed with their greatest dimension in a vertical position. By means of supporting-wires *d* of a cross-section other than circular the corresponding faces of the small blocks *e* upon the same wire may always lie in the same plane, thus giving to said blocks *e*, when ten thereof are grouped closely together, the appearance in form of a single block equal to one long block *f*. It is evident, however, that right cylinders may be substituted for the prisms above described, in which case said cylinders may be supported by round wires passing through their axes.

The screen *g* consists of a sheet of wood or other suitable material supported upon the cross-rods *c c* by means of the bracket or eyes *h h* in such a manner that said screen may travel freely in the direction of the length of said rods *c c*. Said screen *g* is suspended a sufficient distance in front of the wires *d* to permit the blocks *e* and *f* upon said wires to pass behind said screen. Said screen extends vertically above the highest and below the lowest of said wires *d* and has a width somewhat less than half the distance between the uprights *a a*, but somewhat greater than the length of one of the long blocks *f* or ten of the short blocks *e*. Therefore all of said blocks *e* and *f* may at one time be behind said screen and hidden from the view of a person in front of the apparatus. As said screen *g* may be easily moved toward either of the standards *a*, the apparatus may be operated in either direction.

It is preferable to so prepare the surface of the screen *g* that said screen may be used as a blackboard.

In operation the instructor stands behind the apparatus and moves the blocks *e* and *f* upon the strings *d*, so that said blocks may be seen by the pupil or may be hidden from view behind the screen *g*.

The apparatus possesses all of the usual features of an abacus, but is particularly

adapted to demonstrate the principles of number-building, the value of an integer due to the place it occupies in a number, and also the methods of borrowing and increasing in the fundamental operations of arithmetic. These novel features may be illustrated by the following simple problems: Express fourteen single things of any kind or units in the form of a number. The small blocks *e* are single things of a kind and may therefore be denominated "units." The instructor shows that ten of the small blocks *e* equal one of the large blocks *f*, which is then denominated a "ten." It is then stated to the pupils that to be in its proper form a number must be represented by the fewest possible blocks, whether units, tens, or both must be employed so to do. Commencing with all of the blocks behind the screen, the instructor moves out into the view of the pupil one of the said units at a time until the pupil has counted up to the number fourteen. This has brought out ten units upon one wire, and for this group of ten units one ten, preferably the one upon the next adjacent wire, may be substituted. The ten is then brought into view, while the ten units are moved behind the screen. Thus it is shown that the number fourteen is composed of a ten and four units. Conversely show the quantity of units in the number "36," three tens and six units being in view of the pupil. For each of the tens are substituted a group of ten units, making three complete groups of ten units, and one group having six units. The pupil is then made to count the number of blocks by units up to thirty-six.

Again, the operation of subtraction may be advantageously illustrated. Let eight be subtracted from fifty-three. Five tens and three units are placed in view. One by one the units are subtracted—that is, passed behind the screen; but when three have been thus subtracted there is nothing left in view but tens. For one of these tens substitute or borrow ten units, and from these the remaining five units of the subtrahend may be subtracted. Conversely, in adding seventeen to thirty-five seventeen units may be added, one by one, to thirty-five; but when five of the seventeen units have been added one of the groups of ten units will be complete, and for this group a ten on the next adjacent wire may be substituted. There are still to be added twelve to the four tens thus obtained, and when ten more units, one by one, have been added another ten may be similarly substituted. There are still two units to be added, which will complete the problem. It will thus be seen that the sum of thirty-five and seventeen is not three tens and twenty-two units, but is five tens and two units, it having been stated that a number to be in its proper form must be represented in its fewest possible blocks.

By means of my device may be easily illustrated the principle that a written integer representing any quantity of tens is the same *per se* as the integer representing the same quantity of units, but that when a number is written the integer representing the quantity of tens will occupy a place, one removed to the left of the integer representing the quantity of units. For example, express in written figures the number twenty-four. Two tens and four units are placed in view. The instructor calls attention to the fact that this quantity contains two kinds of blocks. Commencing with the small blocks *e*, write the figure expressing the units. This is the figure "4." Then express the quantity of tens. The figure "2" is written; but as the two figures represent different kinds of blocks the number expressing "24" must be so written—that is, the figures "2" and "4" must be so combined that neither of said figures loses its identity in the written expression. The figure representing the quantity of the large blocks *f* is therefore placed to the left of the figure representing the quantity of small blocks or tens to the left of units. Further, the quantity of unit-blocks may be changed, showing that the corresponding change in the written number is confined to the unit or right-hand place, while the figures in the ten place remain unchanged. The quantity of tens may be similarly varied, showing that the corresponding variations in the written number are confined to the left or ten place.

Although ordinarily the device is provided with but ten large and one hundred small blocks, the higher numbers may be illustrated by their analogy to the lower. The denominations of the blocks may also be changed for the higher numbers to "tens and hundreds," "hundreds and thousands," &c.

In order to impress upon the pupil the equivalence of ten units to a ten and the propriety of substituting one for the other, it is necessary that a ten and a group of ten units should be on adjacent wires and this construction maintained throughout the device.

I am aware that abaci have been constructed in which there were groups of blocks representing different aliquot divisions of a long block, and I do not claim such broadly.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an abacus, the combination of wires placed horizontally in an upright frame, and sliding blocks of two different lengths placed alternately on the adjacent wires; one of said blocks on one wire being equal in length to ten blocks on the adjacent wire.

2. In an abacus, the combination of wires placed horizontally in an upright frame, and sliding blocks of two different lengths placed alternately on the adjacent wires; one of said blocks on one wire being equal in length to ten blocks on the adjacent wire, in combination with a sliding screen supported upon said

frame, in front of said wires and free therefrom, leaving a space behind said screen for the free passage of said blocks.

3. In an abacus the combination of wires placed horizontally in an upright frame; sliding blocks of two different lengths placed alternately on the adjacent wires; one of said blocks on one wire being equal in length to ten blocks on the adjacent wire; and a sliding blackboard forming a screen and supported upon said frame at a distance from said wires sufficient for the free passage of said blocks upon said wires.

4. In an abacus, the combination of twenty wires placed horizontally in an upright frame, and one hundred and ten blocks of two different lengths, a block of one of said lengths being placed on each alternate wire, and blocks of the other of said lengths being placed in groups of ten on the remaining wires; the total length of one of said groups being equal to the length of the block on the adjacent wire.

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