

N° 5158



A.D. 1915

Date of Application, 6th Apr., 1915

Complete Specification Left, 6th Oct., 1915—Accepted, 8th May, 1916

PROVISIONAL SPECIFICATION.

Improvements in Calculating Apparatus.

I, JOHN CECIL MATHER, "Crafnant", Stafford Road, Ellesmere Park, Eccles, Lancs., Technical Chemist, do hereby declare the nature of this invention to be as follows:—

5 The invention comprises a "lazy-tongs" of special form (to be described herein) or a helical spring of special form (to be described herein) or chain of springs (also herein described) so made that the whole combination can be extended at least ten times its length when closed.

10 Each member of the lazy-tongs, or each unit of the spring system is of equal size and of equal expansibility in one direction and numbered in order from 0 to 100 with consecutive or alternative numbers according to the accuracy required in the calculator, and if possible in any desired fraction of these numbers.

15 The space between the 0 and the 100 when the calculator is closed is such that the numbers coincide with the same numbers on a straight measure graduated from 0 to 1000 in equal divisions. Under these conditions the 100 of the calculator will coincide with the 1000 of the measure when the former is extended fully or nearly so, and of course each other number of the calculator with its own tenfold or tens multiple on the measure.

20 This will serve for calculations which depend on direct proportion, but for those dependent on proportions of squares, cubes, tangents, sines, logs *etc.*, slots are provided in the lazy-tongs so that one row of the outer hinges can be moved and clamped into fresh positions by winged nuts and washers, (the said positions being indicated by marks on the arms of the lazy-tongs), and thus forming lazy-tongs of a new shape in "plan", and such that each unit
25 will not expand equally as before but in proportion to the squares, cubes, tangents, sines, legs *etc.* as arranged the distances moved being shown on the measure placed opposite as in the former calculations, and showing the figure sought.

30 In the case of the springs the whole chain or combination is made of such shape and the units of varying extensibility that the above result is also obtained on stretching the calculator parallel to the measure. This condition can be attained by making the spring so that in front elevation the outer edges are curved instead of parallel and straight.

35 To use the calculator two clips are provided to grip quickly on the two numbered divisions having the numbers under consideration at the time, and with these the spring is stretched to the third "known quantity" of the problem on the measure when the fourth or the "unknown quantity" will be shown on the measure opposite to the first known quantity.

Dated the 3rd day of April, 1915.

J. CECIL MATHER.

[Price 6d.]



COMPLETE SPECIFICATION.

Improvements in Calculating Apparatus.

I, JOHN CECIL MATHER, "Crafnant", Ellesmere Park, Eccles, Lancs., Technical Chemist, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in calculators. 5

It depends upon the following principle:—

If a homogeneous strip of elastic substance such as rubber, and of constant thickness be extended horizontally, then any two short portions of equal length increase in length exactly at the same rate.

Likewise two unequal portions will increase in direct proportion to their original length, and will always bear the same ratio to each other, however much the strip is extended. 10

Hence a portion measured off from the left end will always bear the same ratio to a longer portion measured from the same end, at all possible extensions of the strip. 15

The above applies also to a lazy tongs of which the units or "crosses" are all equal in dimension when closed, and it applies to a long helical spring.

The invention consists in a calculator in the form of a lazy tongs, spring or other extensible device having numbers fixed at intervals thereon for the purpose of making calculations when stretched alongside a rule or measure. 20

The accompanying drawings illustrate the invention.

Fig. 1. A rule or scale.

Fig. 2. Calculator in form of lazy tongs (closed).

Fig. 3. Calculator in form of lazy tongs (opened).

Fig. 4. Calculator in form of spiral spring. 25

Fig. 5. Calculator in form of leaf springs.

Fig. 6. Calculator in form of lazy tongs for mathematical constants such as logarithms.

Fig. 7. Calculator in the form of a spring for same purpose.

Fig. 8. Clip for use with calculator. 30

The rule or measure R is divided into ten equal divisions each of which is subdivided into ten parts as shown each of which may be again subdivided. The measure may be made collapsible or telescopic or folding, or to roll into a spiral in a case, by means of a spring.

The lazy tongs *a* shown in Figs. 2 and 3 are provided with ten double arms and the points where these meet are numbered 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100. The numbers may be marked directly onto the lazy tongs or on celluloid affixed thereto. 35

As the spring *b* shown in Fig. 4 must stretch ten times its length each of the units is made of two spirals of preferably ten turns as shown with their apices meeting in the centre. The spring is made so that when in equilibrium under its own tension it is capable of being further closed. 40

To read the numbers on the rule or measure, R, I provide small clips *c* Fig. 8 with pointers, so made that they will grip on to the spring on a single turn at the top opposite the numbers required, and will thus travel with the spiral to the positions on the measure required. They are of such form as 45

Mather's Improvements in Calculating Apparatus.

to be used as handles for extending the spring. The clip *c* is pivoted about the centre and controlled by a spring *c*¹. In another form I use leaf springs *d* jointed together at the ends and middle as in Fig. 5.

The calculator operates as follows:—

- 5 Consecutive numbers from 0 upwards being placed along the strip lazy
tongs or spring from the left end corresponding to the distance from that
end, then, if the strip, lazy tongs or spring be extended the ratio of numbers
representing their new lengths will be the same as the ratio of the two numbers
representing their original length relaxed. In other words if the two numbers
10 representing their original length are the first two terms of proportion sum,
and the third term is the number representing the new length of one of the
portions, then the fourth term will be the number representing the new length
of the other portion.

To find these new numbers the strip is extended parallel to the straight rule
15 or measure R numbered from 0 to 100, (the spaces between two consecutive
numbers being the same length as in the numbered strip) and noting at what
point on the rule the original numbers stand after extension.

Let zero in the strip and the rule be called A, and points B and C be taken
in order along the strip, and let the strip be stretched so that B touches a
20 point B₂ and C touches a point C₂ on the rule after extension, then from
above

$$AB: AC:: AB_2: AC_2$$

therefore number at B: number at C:: number at B₂: number at C₂.

To take an example (described with reference to the lazy tongs *a*) of the
25 application of this:—

If it is wished to know how much of a salt there is in 750 lbs. of a solu-
tion of which 100 lbs. contain 12 lbs. of the salt, extend the "expander"
till point 100 touches point 75 on the measure, and opposite the point 12 on
the expander read the number 9 on the measure, the two zero points being
30 contiguous all the time. Then by adding the necessary 0 the number 90 is
obtained.

Likewise any other direct proportion sum can be solved, the decimal points
being fixed as in the slide rule *etc.*

To multiply 25 by 84 move point 100 to 84 on the measure and read on the
35 measure 21 opposite 25 on the expander. Then by adding the necessary 0's
the number 2100 is obtained.

If the spring or lazy tongs is made of varying width along its length so
that the distances between the points *e* and *f* of each pair of links are equal
(see Figs. 6 and 7), the part that is narrower will not expand as far as the
40 wider part and when the expander is extended along the measure it will
indicate mathematical constants. It is necessary that the expander should
be designed in such a manner that the central intersecting points of the links
are distant from the zero line by distances proportional to the *y*-ordinates of
the curve from which the expander is designed, when the abscissæ are given
45 the values represented by the numbers 1, 2, 3 *etc.*, at the central intersecting
points, which furnish a straight line for reading on the measure R.

Thus for instance if the expander is designed for logarithms it will when
extended and placed alongside the measure R indicate numbers thereon pro-
portional to logarithms of the numbers on the expander.

50 Having now particularly described and ascertained the nature of my said
invention and in what manner the same is to be performed, I declare that
what I claim is:—

1. A calculator in the form of a lazy tongs, spring or other extensible device
having numbers affixed at intervals thereon for the purpose of making calcu-
55 lations when stretched alongside a rule or measure.
2. A calculator in the form of a spring each unit of which is numbered and



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comprises a series of increasing and diminishing spirals to permit of it being stretched ten times its original length substantially as described.

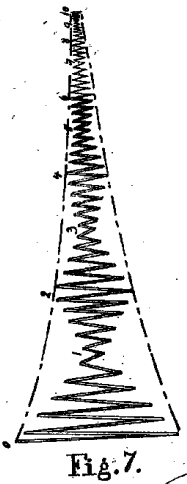
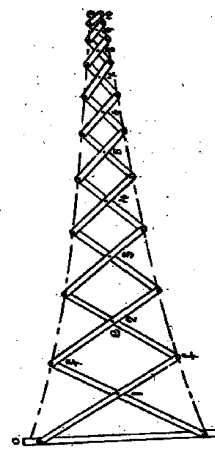
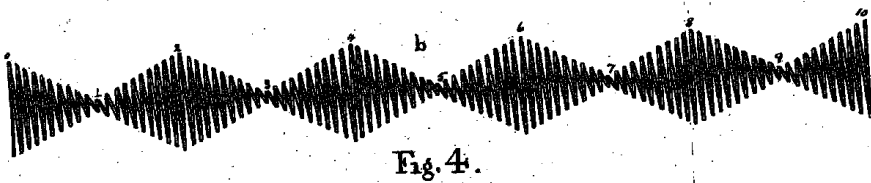
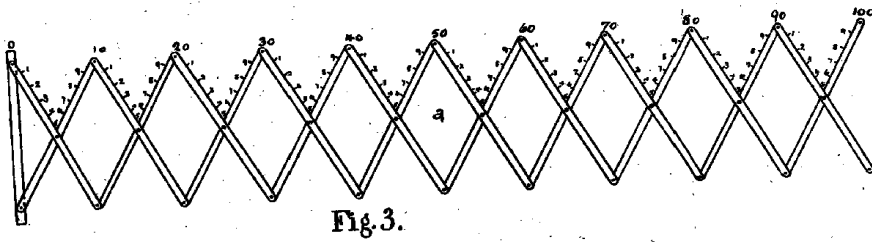
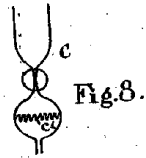
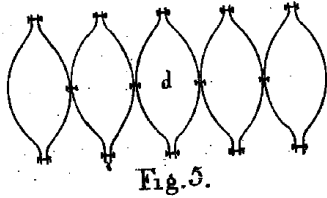
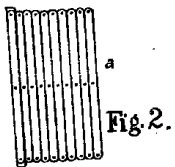
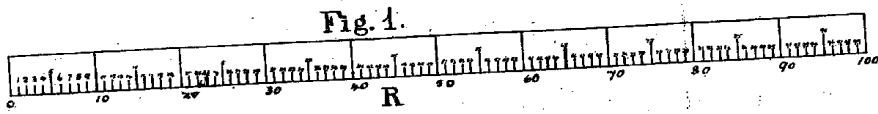
3. A calculator in the form of a spring made up of a number of leaf springs substantially as described.

3. A calculator as in Claim 1 curved in elevation to enable it to be employed for ascertaining mathematical constants substantially as described. 5

Dated the 4th day of October, 1915.

J. CECIL MATHER.

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Fig. 1.

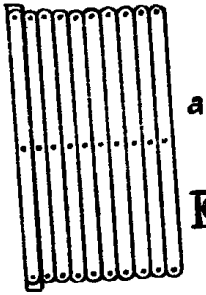
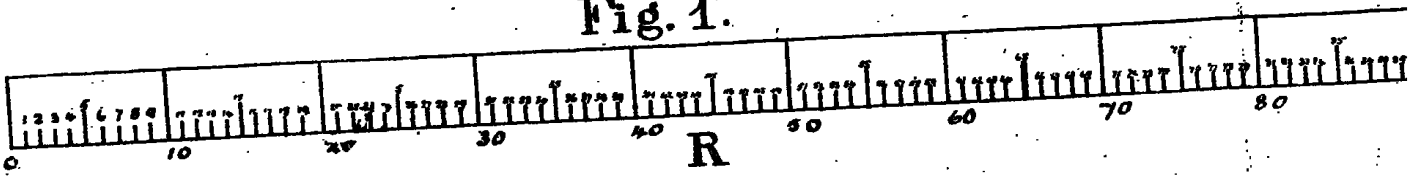


Fig. 2.

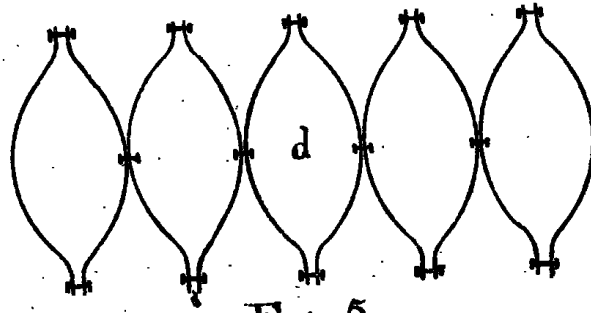


Fig. 5.

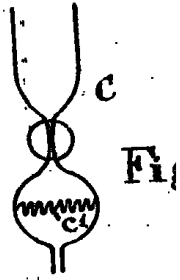


Fig. 6.

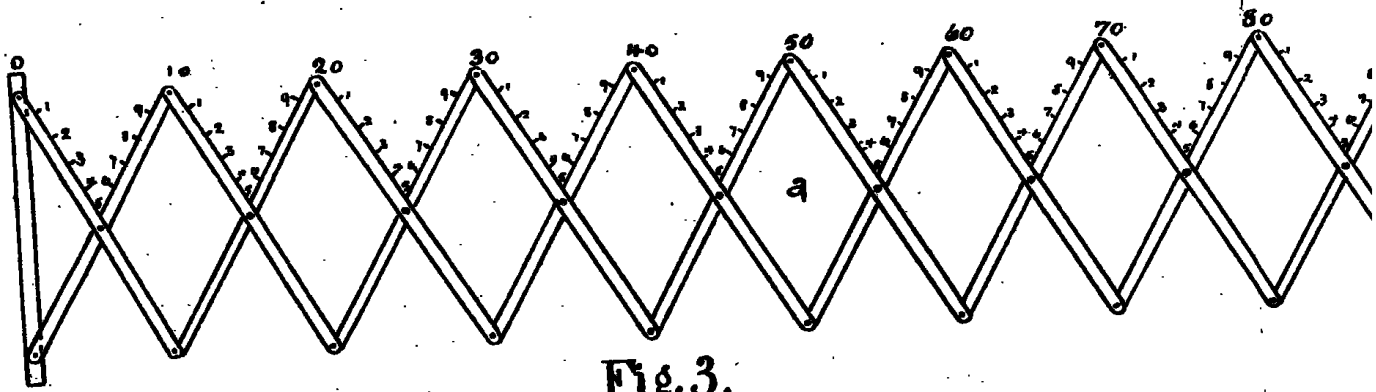


Fig. 3.

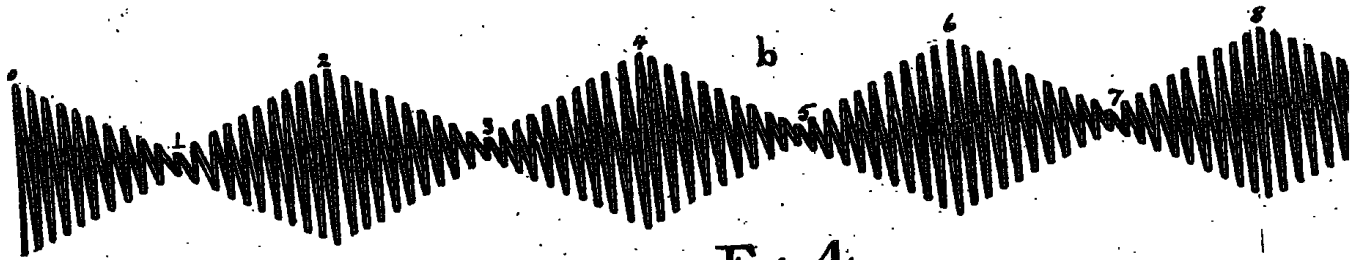
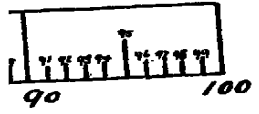


Fig. 4.

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g.8.

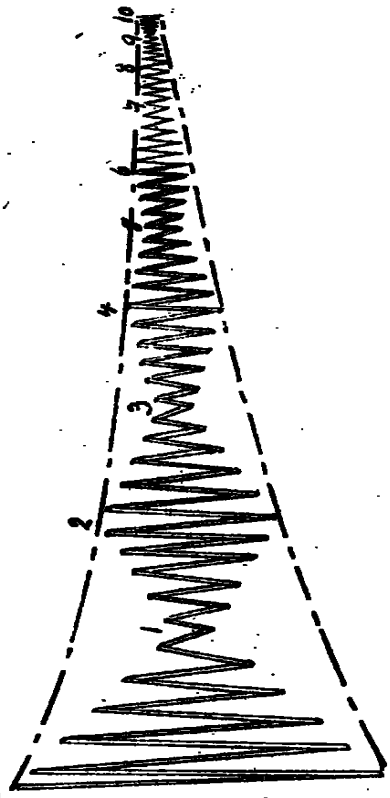
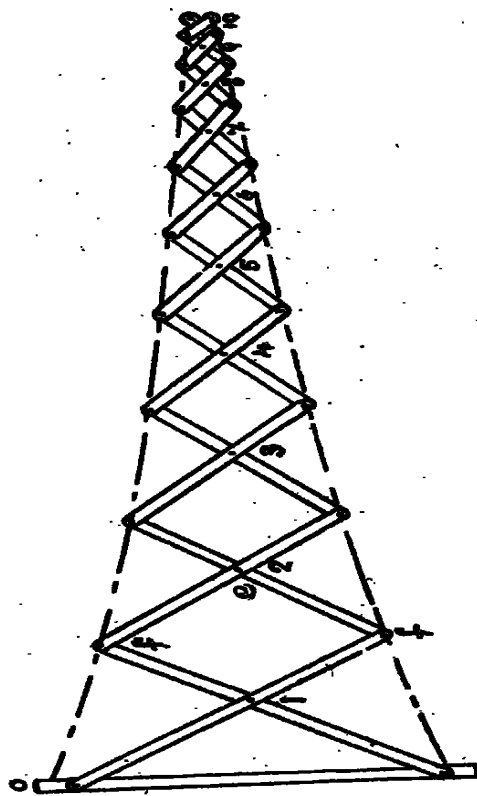
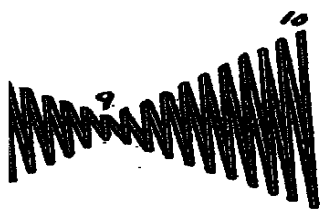
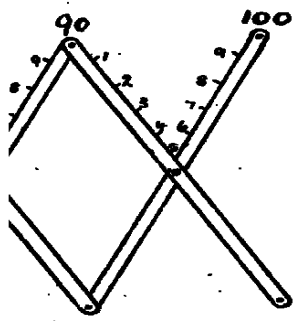


Fig. 6.

Fig. 7.

