N° 3685 A.D. 1907

Date of Application, 14th Feb., 1907
Complete Specification Left, 14th Sept., 1907—Accepted, 12th Dec., 1907

PROVISIONAL SPECIFICATION.

"Improvements in and relating to Calculating and the like Devices."

I, JOHN VERNON PUGH, of Guiting House, Allesley, near Coventry, in the County of Warwick, Engineer, do hereby declare the nature of this invention to be as follows:—

The invention relates to calculating devices and particularly to those of the "slide rule" type, in which one or more logarithmic scales are used.

In order to secure a long and consequently open scale without unduly increasing the bulk of the instrument, such slide rules have been given various forms, and the object of the present invention is to provide a new type of slide rule having similar advantages.

To these ends the invention consists in a calculating device having one or more complete logarithmic scales, each such scale being separated into a set of discontinuous lengths adjacently disposed in combination with mechanical means for definitely indicating the position of the result of a given calculation.

Such indicating means consist in essence of an arrangement whereby two pointers, indicating marks or the like, may be placed at given points of the logarithmic scale and whereby subsequently an appropriate relative displacement may be caused between such marks and the scale but without disturbing their own relative position.

Where the lengths of the divided logarithmic scale are arranged in one plane the indicating means preferably include some form of parallel motion.

In order to meet the difficulty experienced when one of the above mentioned pointers or indicating marks passes off the scale, in some cases additional pointers or marks may be employed, but I preferably overcome this difficulty by providing a special scale.

This part of my invention consists essentially of a fundamental complete logarithmic scale divided into a set of adjacently disposed lengths, such lengths being continued or repeated both in the end-wise and lateral directions in such a manner as to ensure correct readings for a pointer passing on to such scale continuation or repetition from the fundamental scale or *vice versa*.

In carrying the invention into effect according to one form the complete logarithmic scale may be divided into say ten equal parts arranged side by side in a plane with their ends registering. This scale together with a pointer plate may then be pivoted to a base plate by suitable parallel links so that a pointer or indicating mark carried on the pointer plate may be brought to any given part of the scale.

In some cases, however, the scale itself or the pointer plate may be rigidly attached to or be one with the base plate.

The pointer plate carries suitable links on one of which a second pointer or indicating mark is arranged which can be given any desired relative position with regard to the first mentioned pointer. By means of the parallel motion or motions provided a relative displacement may then be caused between the scale and the pointers without, however, disturbing the relative position of the latter.

Instead of using a parallel motion I may mark the indicating points

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temporarily on sectional tracing paper and subsequently move this to the required points of the scale.

Those parts of the apparatus which pass in front of the scale are preferably constructed of some transparent material such as celluloid.

In order to provide for the case where one of the pointers passes off the scale, these pointers may be repeated one or more times either on the pointer plate or on the links attached thereto in which latter case suitable means are provided to preserve the correct relationship of the pointers among themselves.

As stated above, however, I prefer to dispense with such additional pointers by using a special scale.

According to one form, a fundamental complete logarithmic scale is divided as before into say ten equal lengths arranged side by side in a plane with their ends registering. Each scale length is then continued its own length to the right, the effect being to repeat the fundamental scale but in such a manner that the repetition is displaced with regard thereto by the lateral space between adjacent lengths, the last line of the repetition being the same as the first of the fundamental.

The fundamental scale with its repetition are then duplicated below the originals in such a manner that the ends of the different lengths register and the same lateral spaces between adjacent lengths are preserved throughout.

In some cases, moreover, I may extend the fundamental scale to the left and arrange the duplicate above the originals or I may arrange the scales three, three and three instead of two and two, or two, three and two.

It will be understood that I have used the term "fundamental scale" merely as a convenient way of explaining how the complete scale or diagram is derived since in reality no break occurs between this part of the scale and the remaining parts nor are its mathematical properties in any way different.

I wish it also to be understood that my invention may be embodied in many different forms and that those forms described above are intended merely as illustrative examples without limitation of the broad scope of my invention as defined in the earlier part of this specification.

Dated this 14th day of February, 1907.

MARKS & CLERK,
18, Southampton Buildings, London, W.C.,
13, Temple Street, Birmingham, and
30, Cross Street, Manchester.
Agents.

COMPLETE SPECIFICATION.

"Improvements in and relating to Calculating and the like Devices".

I, JOHN VERNON PUGH, of Guiting House, Allesley, near Coventry, in the County of Warwick, Engineer; 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:—

The invention relates to calculating devices and particularly to those of the "slide rule" type, in which a logarithmic scale having four or more "unity" points is used in conjunction with an indicating plate or the like having similar points marked thereon.

In order to secure a long and consequently open scale without unduly

increasing the bulk of the instrument, such slide rules have been given various forms, and the object of the present invention is to provide a new type of slide rule having similar advantages.

To these ends the invention consists in the improved calculating devices hereinafter described.

Referring to the accompanying drawings which illustrate my invention and form part of this specification;

Figure 1 shows a view of one form of the invention, the various parts of the instrument being displaced from their working positions so that they may be the more readily seen;

Figure 2 shows a modified form of scale which may be substituted for that shown in Figure 1;

Figures 3 and 4 show forms of ruled pointer plates for use with the scale of Figure 1, the interconnecting mechanism being omitted, while

Figure 5 shows a modification of such pointer plate in which a metal frame is adopted.

Where desirable corresponding parts in the different figures are denoted by the same reference symbols.

In carrying the invention into effect according to the form shown in Figure 1, the complete logarithmic scale, *a*, is divided in a known manner into twenty equal parts arranged side by side in a plane with their ends registering.

The scale, *a*, is connected by the parallel links, *b*, *b*, to the member, *c*, which is in turn connected to the base plate, *d*, by the parallel links, *e*, *e*, the various elements of the mechanism being pivoted as indicated in the drawing.

I further provide a pointer plate, *f*, rigidly secured to the base plate along an edge, *h*, and pivotally mounted on this pointer plate two arms, *i*, each jointed at *k*, and provided at its free ends with an indicating mark *m*.

The scale being conveniently disposed with regard to the pointer plate, the indicating marks, *m*, are set as required and subsequently the pointer plate carrying them and the scale are relatively displaced by means of the parallel motion, the relative positions of the indicating marks remaining unaltered.

Thus to multiply 3.2 by 5.7, set the left hand mark, *m*, to the lower left hand "unity" of the scale (*i.e.*, to the beginning of the twenty-first line of the scale, which may be imagined to repeat indefinitely) and set the right hand mark, *m*, to the number 3.2. By means of the parallel motion move the pointer plate over the scale until the left hand mark is at the number 5.7 when the result sought, *viz.*, 18.24, will be found under the right hand mark.

The scale shown has four "unity" points which are indicated by small circles in the figure.

Those parts of the apparatus which pass in front of the scale are preferably constructed of some transparent material such as celluloid.

In some cases I prefer to use only one jointed arm, *i*, and to provide a second indicating mark on the pointer plate itself, or I may use four indicating marks on the pointer plate corresponding in position with the four "unity" points on the scale.

Again, I may vary the scale by dividing the complete logarithmic scale into a certain number of equal lengths plus a fraction of a length, instead of into an integral number of equal lengths as shown.

Further, in order to enable logarithms or anti-logarithms to be found, I may provide the usual uniform scale in conjunction with the logarithmic scale which is then conveniently divided into ten equal parts.

As certain calculations cannot be conveniently performed with the scale shown, owing to the fact that one of the pointers passes off the scale, these pointers may be repeated one or more times either on the pointer plate or on the links attached thereto in which latter case suitable means are provided to preserve the correct relationship of the pointers themselves.

Or, I may dispense with additional pointers by adopting as an element of my improved combination, the known scale shown in Figure 2.

According to the specific form shown, a fundamental complete logarithmic scale, *i.e.*, from "unity" to "unity", is divided into ten equal lengths, A B, arranged side by side in a plan with their ends registering so as to form the rectangle, B C.

The fundamental scale is then repeated to the right but in such a manner that the repetition, D E, is displaced upwards with regard thereto by the lateral space between adjacent lengths, thus causing the co-linear scale lengths of the fundamental scale and repetition to read continuously.

Finally the fundamental scale, B C, with its repetition, D E, are duplicated below the originals to form the scales, C F and E G, the ends of the different lengths registering and the same lateral spaces between adjacent lengths being preserved throughout.

In the complete diagram shown in Figure 2, nine "unity" points occur which are indicated as before by small circles.

I may in some cases vary the above by arranging the scales three, three and three or two, three and two, for example, instead of two and two.

It will be understood that I have used the term "fundamental scale" merely for convenience in explaining how the complete scale or diagram is derived since it will be clear from the above description taken in conjunction with Figure 2 that in reality no break occurs between this part of the scale and the remaining parts nor are its mathematical properties in any way different.

According to a modification of my invention I may omit the parallel motion shown in Figure 1, and provide a pointer plate such as that shown in Figure 3 for use in conjunction with the scale shown.

Such a pointer plate, *n*, I construct of a suitable transparent material to which I may paste or otherwise fix a sheet of sectional tracing paper of appropriate size; or I may rule on the plate a series of lines, *o*, corresponding to the lines of the scale.

Pivoted to this plate I provide a jointed arm, *i*, of a type already proposed in connection with pointer plates for calculating devices having logarithmic scales, this arm being provided with an indicating mark, *m*, as above or I may provide more than one such arm as shown in Figure 4.

Special marks are shown on the pointer plate indicating the ratios π and M, the latter being the ratio between an inch and a millimeter, but any other ratios might be marked in a similar manner or a number of different plates might be provided each marked with a series of different ratios.

Marks corresponding to the four "unity" points of the scale are also provided on the plate as shown.

The complete device consisting of scale and pointer plate is used in a manner similar to that indicated with reference to the form of my invention above described, the necessary parallelism between scale and plate being maintained by eye by aid of the rulings, *o*.

Again, instead of such a ruled pointer plate of transparent material, I may modify the device by adopting a metal frame, *r*, (see Figure 5) the inner edge, *s*, of which, preferably bevelled, acts as a guide in place of the ruled lines, *o*, for parallelising the plate and scale, this frame corresponding in size with the scale and being provided with one or more arms, *i*, as above and with four indicating marks, *t*, corresponding with the "unity" points on the scale.

A pointer plate of the type described I believe to be an improvement on similar devices before proposed, since all the advantages of the "unity" points are secured without the confusion arising from a second logarithmic scale.

I wish it also to be understood that I do not intend to confine myself to the precise structural details described above by way of example, since it will be evident that I may for instance, substitute another form of parallel motion or I may use my ruled or metal pointer plates in conjunction with scales of the

repeating type described with reference to Figure 2 without departing from the spirit of my invention.

In such a latter case, the provision of marks on the pointer plate corresponding to the "unity" points on the scale is specially advantageous since, so long as parallelism is maintained, the marks always point to the same number on the fundamental scale and its adjacent repetitions.

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 calculating device having one or more complete logarithmic scales, each scale being separated into a set of discontinuous lengths adjacently disposed, together with marks, pointers or the like for indicating the position of the result of a given calculation, such indicating means being connected by mechanism to the scale or scales so as to be movable relatively thereto, substantially as and for the purpose described.

2. In a calculating device the combination of a logarithmic scale of the type indicated; a plate or frame having at least four unity points marked thereon; means for parallelising said scale and plate or frame together with hinged pointer arms pivotally mounted on said plate or frame, substantially as described.

3. Improved calculating devices substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 14th day of September, 1907.

MARKS & CLERK,
18, Southampton Buildings, London, W.C.,
13, Temple Street, Birmingham, and
30, Cross Street, Manchester.
Agents.

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PUGH'S Complete Specification.

[3 SHEETS;

SHEET 1

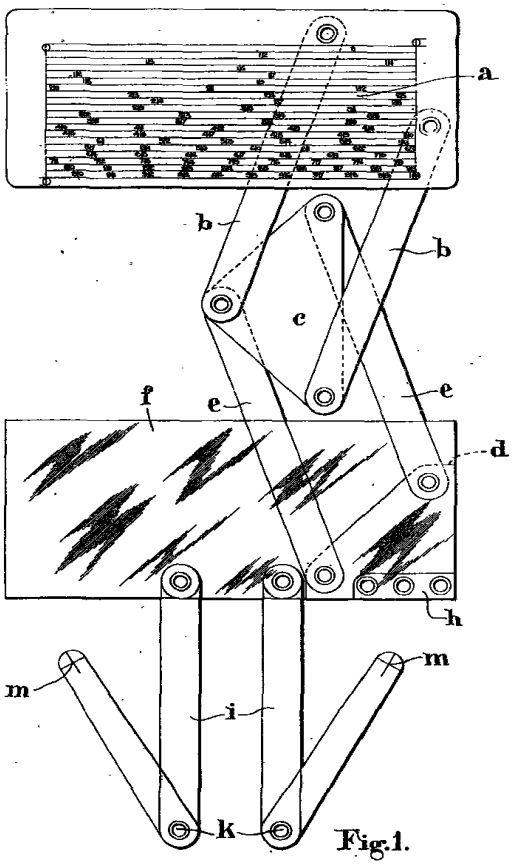

Fig.1.

SHEET 2

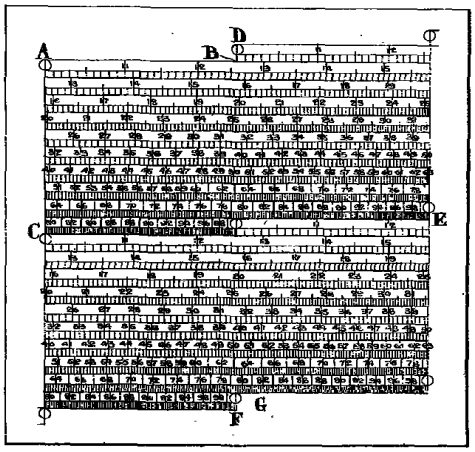

Fig.2.

[This Drawing is a reproduction of the Original on a reduced scale]

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SHEET

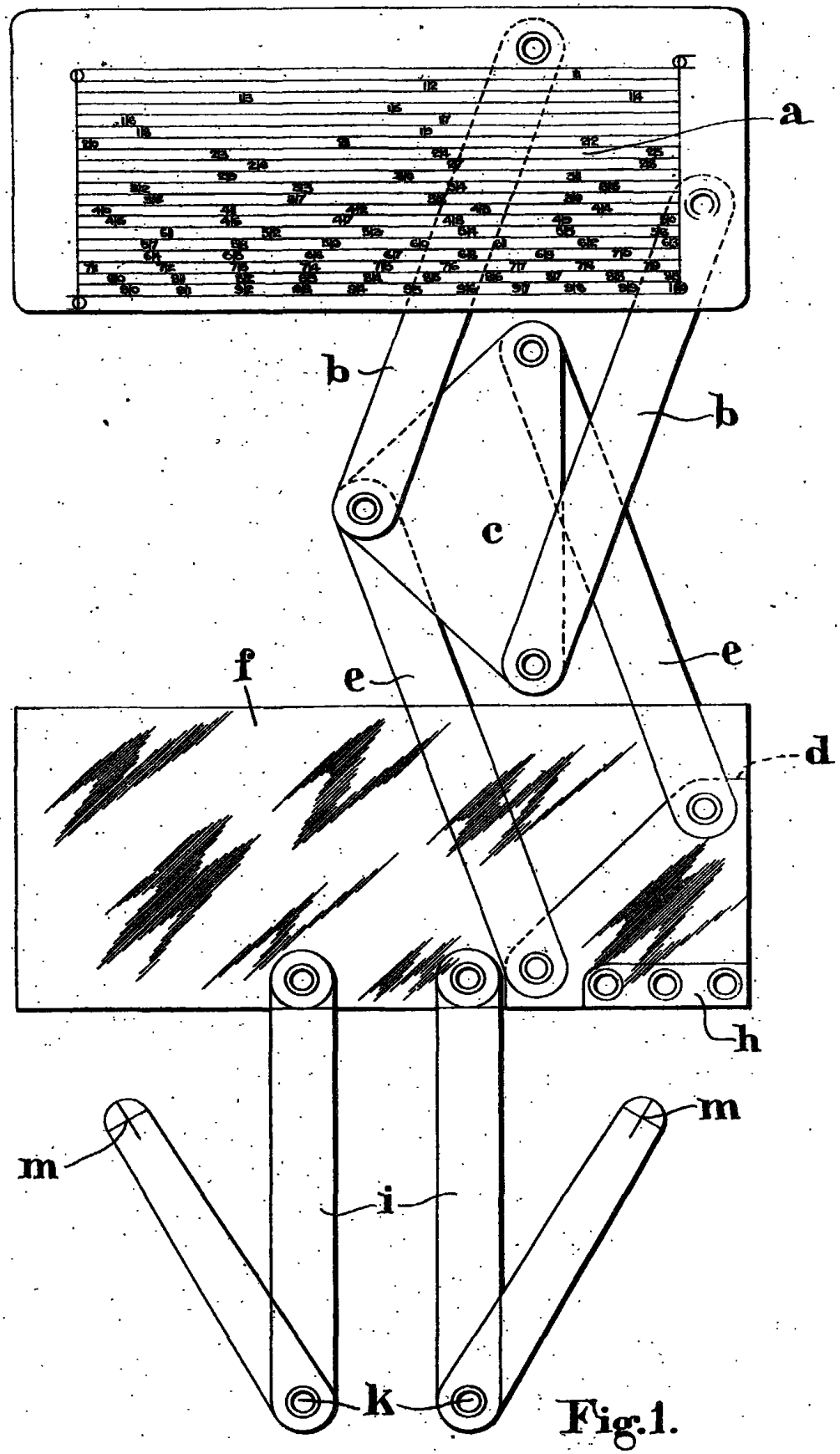

Fig.1.

[This Drawing is a reproduction of the Original on a reduced scale.]

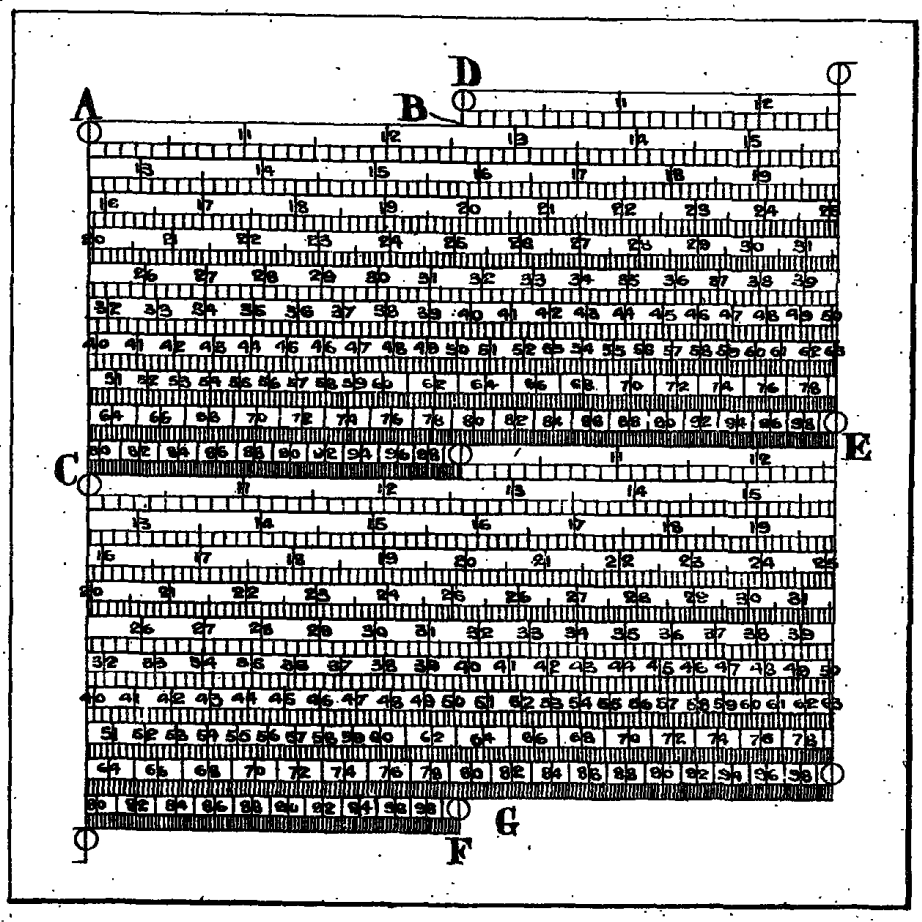

Fig. 2.

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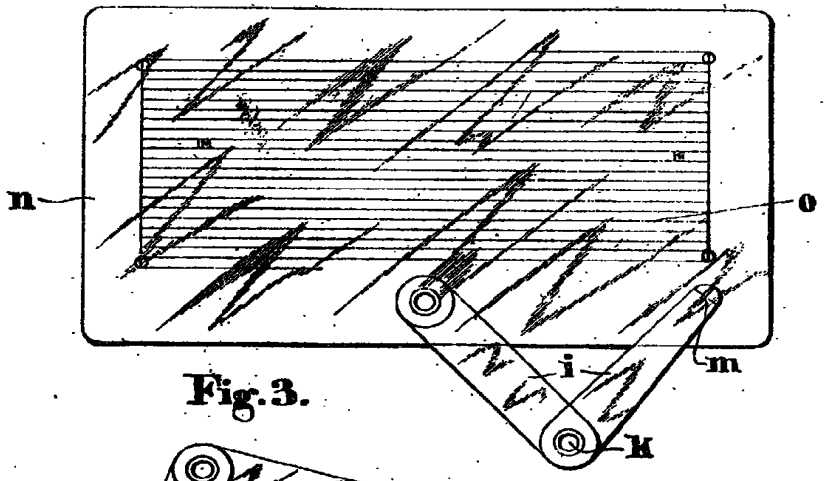

Fig. 3.

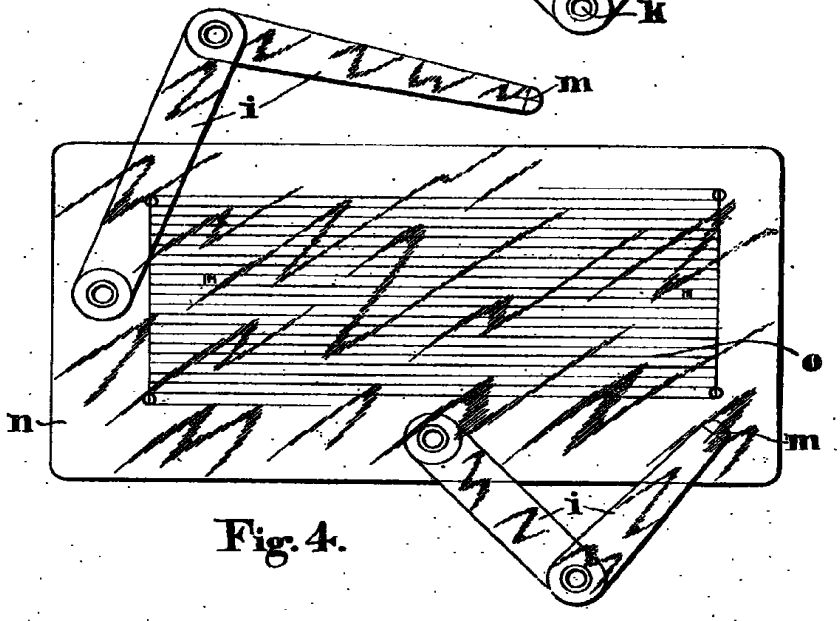

Fig. 4.

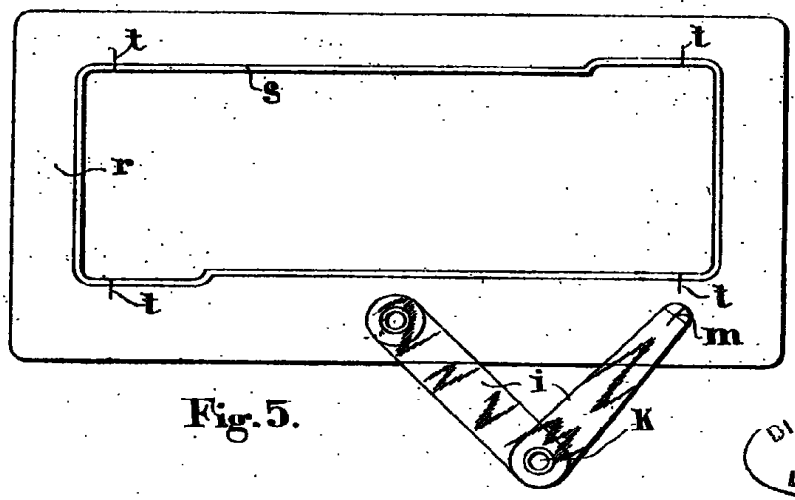

Fig. 5.

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