No. 674,261. Patented May 14, 1901.

# W. DOHM.

## SECTION GAGE FOR JOISTS, COLUMNS, &c.

(Application filed Mar. 1, 1900.)

(No Model.)

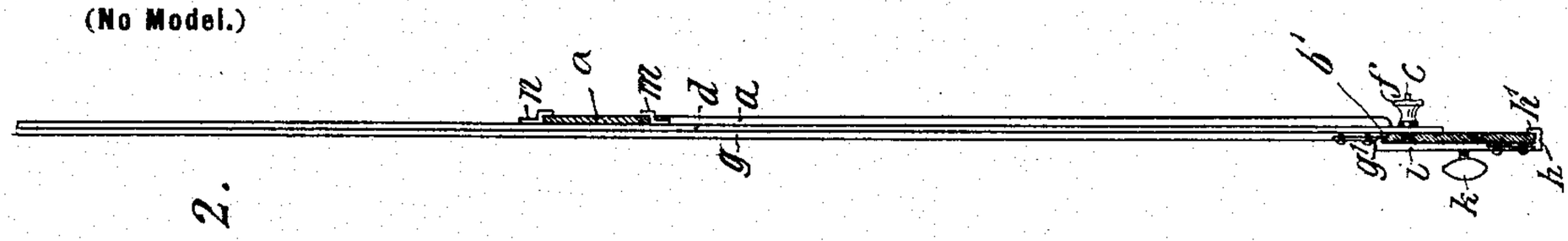



Fig. 2.

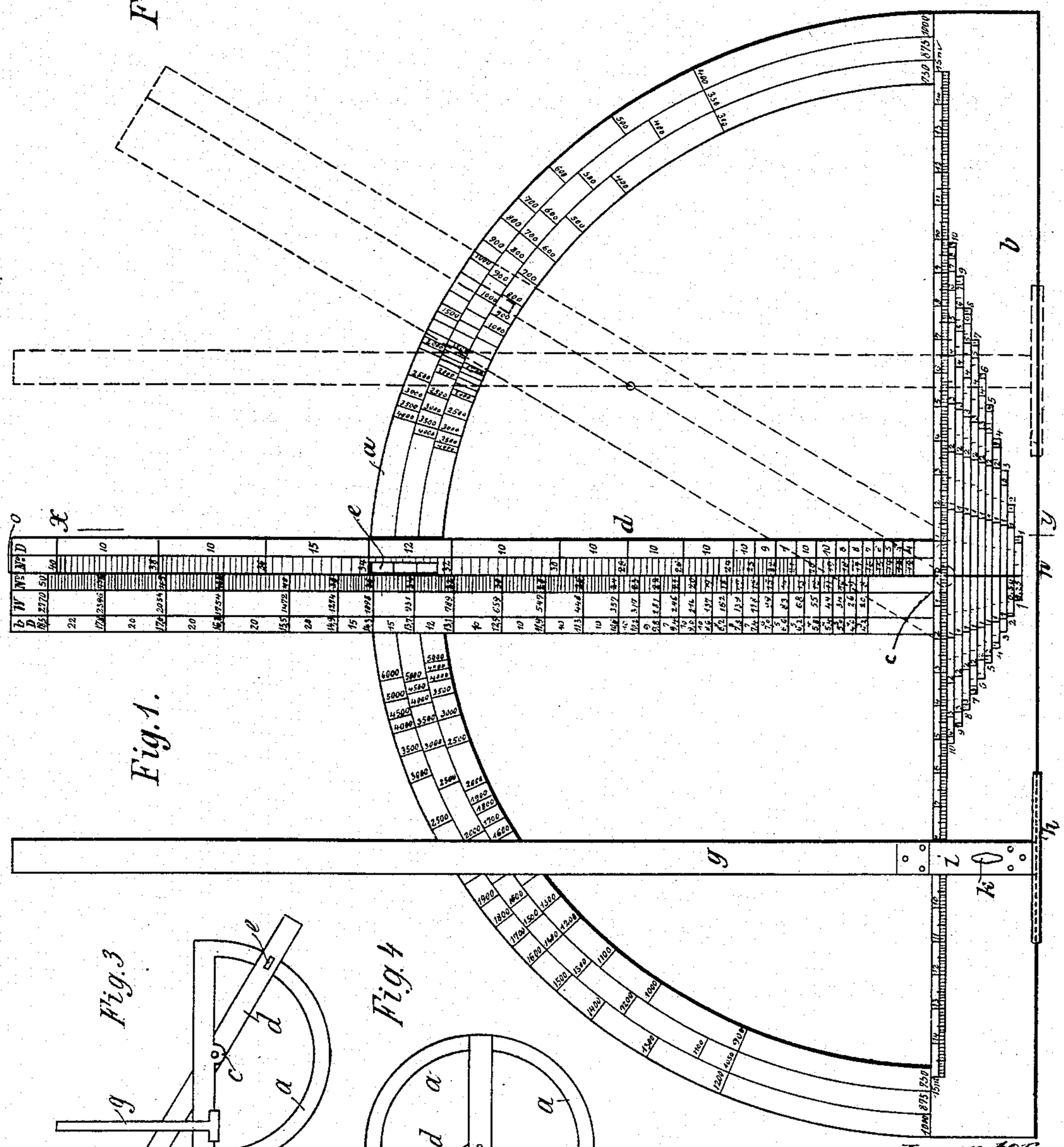
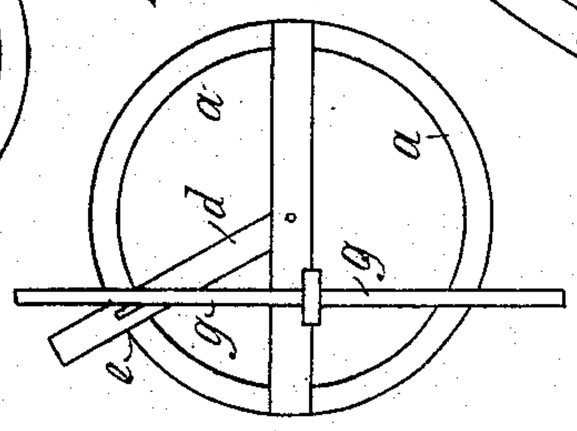



Fig. 1.

Fig. 3




Fig. 4

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# UNITED STATES PATENT OFFICE.

WILHELM DOHM, OF BIELEFELD, GERMANY.

## SECTION-GAGE FOR JOISTS, COLUMNS, &c.

SPECIFICATION forming part of Letters Patent No. 674,261, dated May 14, 1901.

Application filed March 1, 1900. Serial No. 6,940. (No model.)

*To all whom it may concern:*

Be it known that I, WILHELM DOHM, a subject of the Emperor of Germany, residing at Bielefeld, in the Kingdom of Prussia, Empire of Germany, have invented a new and useful Section-Gage for Joists, Columns, and the Like, of which the following is a specification.

My invention consists in a gage or slide-rule, as defined in the claims, for ascertaining the size of the section required for a joist, column, or the like designed to sustain a certain load. The joists or beams as they are used in buildings, bridges, and so on may be supported at both ends and the load may be placed on or suspended from some point of the joist between the supports, or the load may be distributed equally over the whole length or part of the length. The joists may also be fixed at the one end, while the load is placed on or suspended from the other end, or it may be distributed equally over the whole length. In any of these cases the gage or slide-rule will show the size of the required section of the joist for any load, length of joist, and safe limit of stress. In a similar manner the slide-rule may be employed for ascertaining the section of a column or other structure part subjected to a certain load under certain conditions.

The gage is illustrated in the accompanying drawings, in which—

Figure 1 is a view of the whole gage, and Fig. 2 is a vertical cross-section of the same on the line $x\ y$ in Fig. 1. Fig. 3 is a view of a modification of the gage, and Fig. 4 is a view of another modification of the gage.

Similar characters refer to similar parts throughout the several views.

The semicircular part $a$ is rigidly connected with the base part $b$, so as to form therewith a frame. To the base part $b$ in its middle is secured a bolt $c$, which serves as a center for the semicircular part $a$. On the bolt $c$ a lever $d$ is mounted to revolve, while it may be affixed in any position to the frame $a\ b$ by screwing tight the nut $f$. The lever $d$ is provided with suitable guides $m$ and $n$, which overlap the semicircular part $a$. Where it is so preferred, the guides $m$ and $n$ may be extended over the semicircular part, so as to form a single bridge-like part, and in the bridge so formed a screw with a curled head (similar to the nut $f$) or other-shaped head may be placed for the purpose of securing the lever $d$ in any position to the semicircular part $a$. Since the lever $d$ is arranged between the base part $b$ and the semicircular part $a$, (see Fig. 2,) the latter requires to be depressed with regard to the base part $b$ to allow of the lever $d$ revolving nearly through an angle of one hundred and eighty degrees. For this reason the semicircular part $a$ in case it is made in one piece with the base part $b$, as shown, requires to be bent backward at the places where it adjoins to the base part $b$. A rule $g$ is arranged to slide on the base part $b$, it being rigidly connected to the slide $i\ h$, which is shaped like a ⊥ and grasps the base part $b$ with the overlap $h'$, while the inner end $g'$ of the rule engages in a recess $b'$ at the back of the base part $b$. The rule $g$ is always rectangular to the base part $b$ and may be secured in any position thereto by means of the screw $k$. Of course where it is so preferred the rule $g$ may be made in one piece with the slide $i\ h$. When it is shifted to either end of the base part $b$, it may be taken off.

The gage shown is arranged in accordance with the metrical measures and weights; but it is obvious that it may be arranged for any other measures and weights—for example, for the English measures and weights. The gage is further assumed to be designed for iron I-beams.

The semicircular part $a$ is provided with three concentrical scales, showing various loads in kilograms for the safe limits of stress of seven hundred and fifty, eight hundred and seventy-five, and one thousand kilograms per square centimeter, respectively. (See the figures above the upper line of the base part $b$.) The lever $d$ serves as an indicator for these three scales, it being provided with a slot $e$. In the drawings the scales on the right hand of the initial line $p\ o$ are arranged for loads distributed equally over a length of one meter and running from three hundred, three hundred and fifty, and four hundred kilograms, respectively, to four thousand kilograms, while the scales on the left hand of the initial line $p\ o$ are arranged for single loads running from nine hundred, one thousand and fifty,

and twelve hundred kilograms, respectively, to five thousand and six thousand kilograms, respectively.

The base part *b* is provided with several parallel scales for various lengths of the joist up to fifteen meters. The upper scale on the right hand of the initial line *p o* is arranged for loads distributed equally over the whole length of the joist. The upper scale on the left hand is for single loads in the middle of the joist supported at both ends. The ten lower scales on the right hand are for joists of the length of ten, nine, eight, seven, six, five, four, three, two, and one meter, respectively, and for loads distributed equally over a part of the joist extending from one support. The ten lower scales on the left hand are for joists of similar lengths and for single loads on any point of the joist supported at both ends.

The lever *d* is provided with several vertical scales for I-beams classified after the German fashion. The first scale on the right hand from the line *p o* contains the German-standard sections Nos. 12 to 40 for single loads, and the second scale (marked with "D" at the top) shows certain coefficients. The first scale on the left hand contains the German-standard sections Nos. 8 to 50 for loads distributed equally over the whole length and part of same. The second scale (marked with "W" at the top) contains the corresponding values W of the moment of inertia divided by the distance of neutral axis from bottom of section. (Such values are preferably used in German calculations.) The third scale (marked with "b" at the top) refers to the breadths of the flanges of the joists and contains at the same time certain coefficients.

The rule *g* has no scale, since it serves simply as an indicator.

In order to better explain the use of the gage, I will make several examples.

First. An I-beam 5.6 meters long between the supports is loaded with one thousand kilograms per meter distributed equally—*i. e.*, with $5.6\times1000=5600$ kilograms in all distributed equally over the whole length. What size should be the section? First adjust the lever *d* on the right-hand side of the semicircular part *a*, as indicated by the dotted lines, and so that the line *p o* in the slot *e* coincides with the division-line for one thousand kilograms in the respective scale—for example, that for the safe limit of stress of eight hundred and seventy-five kilograms per square centimeter. Then move the rule *g* on the base part *b* and adjust it so that its one edge coincides with the division-line for 5.6 meters in the upper scale on base part *b*. The crossing-point of the edge of the rule *g* and of the line *p o* will show the German standard No. 28 and the value of W as three hundred and ninety-two.

Second. A joist seven meters long supported on both ends is for a length of four meters from the one support loaded with two thousand five hundred kilograms per meter—*i. e.*, in all $4\times2500=10000$ kilograms—equally distributed, and the iron allows a safe limit of stress of seven hundred and fifty kilograms per square centimeter. What size should the section be? Adjust the lever *d* on the right-hand side so that the line *p o* coincides with the division-line for two thousand five hundred kilograms in the scale for the safe limit of stress of seven hundred and fifty and adjust the rule *g* so that its edge coincides with the division-line 4 in the horizontal scale marked with "7." The crossing-point of rule *g* and lever *d* will then give the value of W as thirteen hundred and sixty (it being $1274+4\frac{1}{3}$ division-lines $\times20=1274+86=1360$.) At the same time the German-standard size and the breadth may be read off. If the joist be supported on both ends and loaded with a single load either in the middle or at any distance from one support, the lever *d* should be adjusted on the left-hand side and the rule *g* adjusted to the respective division-line in one of the scales on base part *b*, when the crossing-point of lever and rule will show the size of section, which should be read off the first scale on the right hand of the line *p o* on lever *d*.

Third. A joist 5.5 meters long supported on both ends is loaded in the middle with a single load of three thousand five hundred kilograms, and the safe limit of stress should be eight hundred and seventy-five kilograms per square centimeter. Adjust lever and rule in the indicated manner and the crossing-point will show W as five hundred and fifty.

Fourth. A joist six meters long supported on both ends is loaded at a distance of 2.5 meters from one support with a single load of four thousand five hundred kilograms, and the safe limit of stress is seven hundred and fifty kilograms per square centimeter. The gage will give W as eight hundred and sixty-five.

Fifth. A joist 1.5 meters long is fixed at one end and loaded at the other end with eighteen hundred kilograms, and the safe limit of stress is one thousand kilograms per square centimeter. Adjust the lever *d* as usual and the rule *g* to double the length—*i. e.*, three meters—when the crossing-piont will show W as two hundred and seventy.

Sixth. The same joist, as before, is loaded with fifteen hundred kilograms per meter distributed equally—*i. e.*, with $1.5\times1500=2250$ kilograms in all distributed equally over the whole length—and the safe limit of stress is one thousand kilograms per square centimeter. Adjust the lever, as usual, on the right-hand side and the rule *g* to double the length—*i.e.*, three meters—when the crossing-point will show W as 162+1 division-line $\times8=162+8=170$.

It is obvious that the gage may be arranged for any load and for any section of the joist, also for any material of same, and consequently for any safe limit of stress. If it is desired to arrange the gage not only for iron I-beams, as above, but also for wooden beams of any section, all that is required is to add further suitable scales to those on the semicircular part *a* and on the lever *d*. Instead of the values W used above other values, such as moments of inertia and the like, may be adopted. The numbers of the scales on parts *a* and *b* and on lever *d* may be chosen at pleasure.

The gage may also be used for ascertaining the section of a column of a certain height under a given load and according to the manner in which the column is fixed at the bottom and also at the top. In these cases additional scales on the semicircular part *a* may be used, while the lever is replaced by another one provided with suitable scales containing the moments of inertia, the sizes of section, and so on; also, the lever may be retained and a slide containing the respective values may be introduced in a recess of the lever in some known manner; also, several slides may be used instead of the one slide arranged on the lever *d*. The construction of such slides and of the lever is immaterial, since the slides form a rigid whole with the lever and the lever is adjusted by simply turning around the pivot *c*, as explained above. The gage may also be arranged for columns exclusively. In a similar manner the gage may be arranged for other structure parts, since it remains the same, while only the scales require to be altered.

The gage may further be modified in the manner shown in Fig. 3, the lever *d* being extended beyond its axis. Thereby the advantage is obtained that the slot *e* need not be in the scales, because the latter are placed on the other arm of the lever. The rule *g* requires, of course, to be placed on the side opposite to the semicircular part *a*.

Where it is desired to employ distinct scales on the semicircular part—say, for example, a series of scales for joists and another series for columns—this may be done by d ubling the semicircular part *a*—*i. e.*, by converting the semicircular part *a* into a circular part, as shown in Fig. 4. One and the same lever *d* may be used for both semicircular parts, or the lever *d* may have two arms, as shown in Fig. 3. Where it is so preferred, the semicircular part may be a full disk or plate with concentric scales around the edge.

The gage may be made of any material—for example, wood, brass, board, and so on.

Having described my invention, I declare that what I claim as my invention, and desire to secure by Letters Patent, is—

1. A gage for ascertaining the section of a structure part, consisting in a semicircular part provided with concentric load-scales for certain safe limits of stress, a base part to which the ends of the said semicircular part are secured, the said base part carrying at the center of same a pivot and provided with a series of straight parallel scales for lengths of the structure part, a lever mounted to revolve around said pivot to serve as an indicator to said concentric scales and provided with a series of straight scales for sizes and moments of inertia or similar values of the section to be ascertained, said scales extending throughout the width of the lever, and a rule rectangular to said base part and attached thereto to slide thereon and to serve as an indicator to the scales on said base part and on said lever, substantially as set forth.

2. A gage for ascertaining the section of a structure part under a certain load, consisting in a semicircular part provided on the front side with concentric load-scales for certain safe limits of stress, a base part to which the ends of the said semicircular part are secured, the said base part carrying at the center of same on the back side a pivot, and provided on the front side with a series of scales for lengths of the structure part and distances of the loads acting thereon, a lever mounted on said pivot to revolve and provided with a slot to serve as an indicator to said concentric scales, said lever being also provided on the front side with a series of straight scales for sizes, moments of inertia and the like of various sections of the structure part, said scales extending from edge to edge of the lever, guides arranged at the back side of said lever for grasping said semicircular part, means for securing said lever in any position to said semicircular part, and a rule rectangular to said base part and arranged to slide thereon and to serve as an indicator to the scales on said base part and on said lever, substantially as set forth.

3. A gage for ascertaining the required section of a structure part under a certain load, consisting in a semicircular part provided on the front side with concentric load-scales for certain safe limits of stress, a base part to which the ends of the said semicircular part are secured, the said base part carrying at the center of same on the back side a pivot and provided on the front side with a series of scales for lengths of the structure part and distances of the loads acting thereon, the scales being arranged one below the other and gradually decreasing in length from the top to the bottom, a lever mounted on said pivot to revolve and provided with a slot to serve as an indicator to said concentric scales, said lever being provided on the front side with a series of straight scales for sizes, moments of inertia and the like of various sections of the structure part, the scales extending from edge to edge of the lever, the said semicircular part and the said base part being so arranged as

to leave sufficient room for said lever to revolve, guides provided at the back side of said lever for grasping said semicircular part, means for securing said lever in any position to said semicircular part, a rule rectangular to said base part and arranged to slide thereon and to serve as an indicator to the scales on said base part and on said lever, and means for securing said rule in any position, substantially as set forth.

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