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B. E. WINSLOW.

ARCHITECT'S SLIDE RULE FOR STEEL BEAMS.

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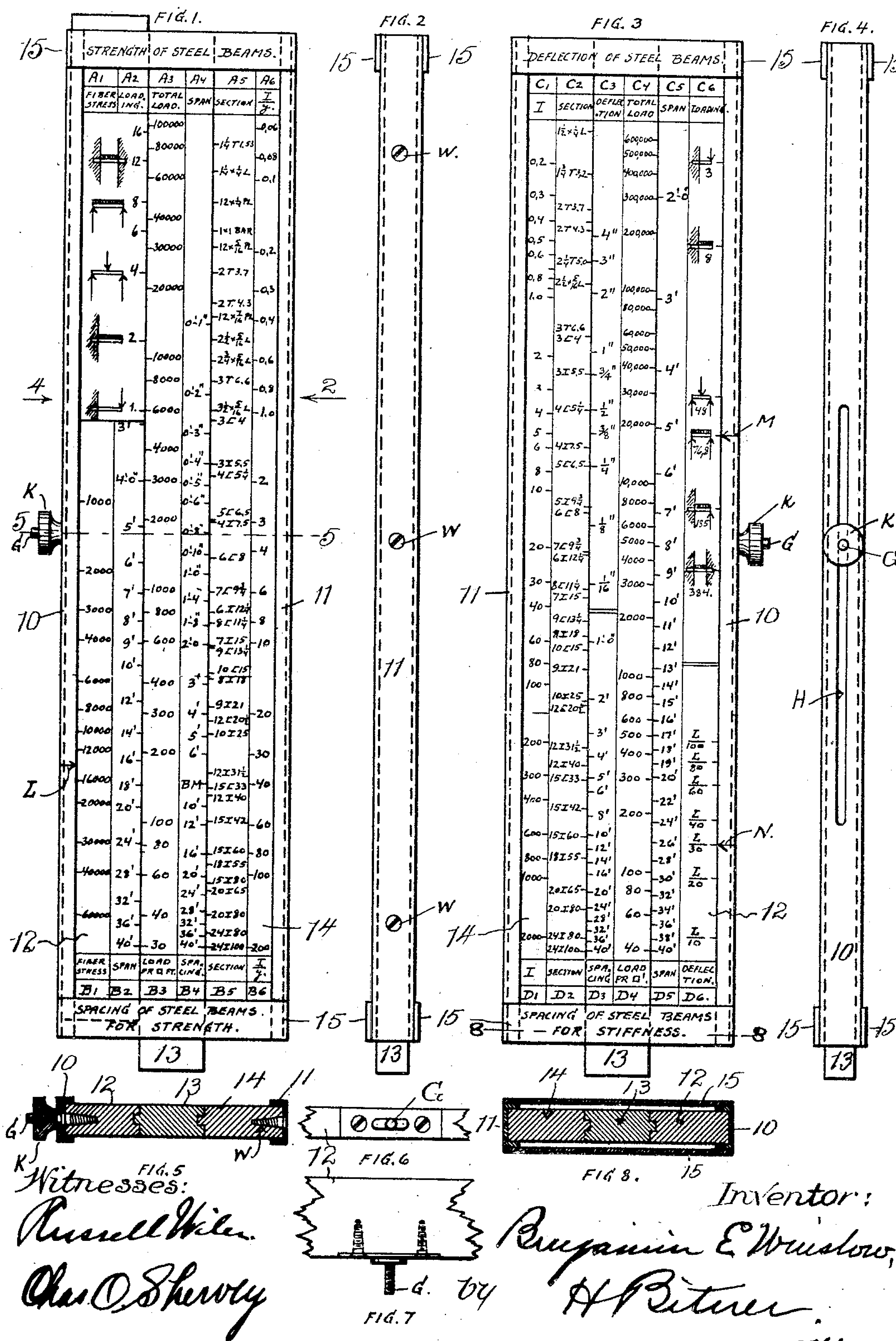
NO MODEL.



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UNITED STATES PATENT OFFICE.

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ARCHITECT'S SLIDE-RULE FOR STEEL BEAMS.

SPECIFICATION forming part of Letters Patent No. 766,009, dated July 26, 1904.

Application filed February 10, 1904. Serial No. 192,927. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN E. WINSLOW, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Architects' Slide-Rules for Steel Beams, of which the following is a specification.

My invention relates to certain new and useful improvements in architects' slide-rules for steel beams; and its object is to produce a device of this class which shall have certain advantages, which will appear more fully and at large in the course of this specification.

To this end my invention consists in certain novel features of construction, which are clearly illustrated in the accompanying drawings and described in this specification.

In the aforesaid drawings, Figure 1 is a face view of one side of my improved slide-rule. Fig. 2 is a side view of the same looking in the direction of the arrow 2 in Fig. 1. Fig. 3 is a face view of the opposite side of the rule from that illustrated in Fig. 1. Fig. 4 is an edge view of the opposite edge of the rule from that seen in Fig. 2. Fig. 5 is a section in the line 5 5 of Fig. 1. Fig. 6 is a detailed edge view of a portion of one of the movable members of the rule. Fig. 7 is a detailed front view of the parts illustrated in Fig. 6, and Fig. 8 is a section in the line 8 8 of Fig. 3.

Referring to the drawings, it will be seen that my improved slide-rule consists of a metal frame having two channeled side bars 10 11, connected together at the ends by cross-bars 15, preferably in the form of metal plates. Within the frame thus formed are three relatively movable members 12 13 14. The member 14, which is at the right-hand side of the frame, as seen in Fig. 1, is secured to the channeled side bar 11 of the frame by means of screws W. The member 12, which is at the left-hand side of the frame, is provided with a projecting screw G, which runs in a slot H in the channeled side bar 10. A thumb-nut K screws up on the screw G, and by this means the member 12 can be clamped in any desired position. The member 14, it will be seen, is provided with a tongue on its inner edge, and the member 12 is provided with a corresponding groove, and the member 13 is tongued on one edge and grooved on the opposite edge to engage with the corresponding tongues and grooves on the members 14 12.

Having described above the mechanical construction of my improved rule, I will now set forth the arrangement of the scales on the various parts and the method of using the rule to make the various calculations necessary in architectural work. The rule herein illustrated is designed for calculating the strength and stiffness of steel beams commonly used for building construction. It is to be understood that in ordinary architectural work two sets of calculations are often made for any one beam, the first to determine what beam shall be used under given conditions to have the required strength to support the weight which it will be called upon to sustain and the second to determine what beam must be used to have the requisite stiffness. These two calculations are entirely separate and independent and are based upon different factors. For convenience I arrange the scales necessary to make the calculations for stiffness upon one side of my improved rule and the scales necessary to calculate the strength upon the opposite side. It will be understood that rules embodying the same principle of operation can be made for calculating the strength or stiffness of wooden beams.

Fig. 1 illustrates that side of the rule which is used for calculating the strength of steel beams, and with this side of the rule two entirely different sets of calculations can be made, the first to determine the cross-section of a single beam necessary to support a given load and the second to determine the spacing necessary with beams of a given cross-section and span or the size of beams necessary with a given spacing and span. It is to be understood that in pointing out in this way the certain possible calculations which can be made with this rule no attempt is made to give all the possible calculations, this rule being, like most slide-rules, capable of determining any one of several factors when the remainder are known. For these two sets of calculations two sets of scales are provided, the first set being at the top of the rule and being indicated by the characters A′, A^2, A^3, A^4, A^5, and A^6, and the second set being at the bottom of the rule and being indicated by the characters B′ B^2 B^3 B^4 B^5 B^6. It will be seen that certain of the scales extend continuously from the top to the bottom of the rule and have different characterizations at the bottom and at the top—as, for instance, the scale which is designated by A^3 at the top and B^3 at the bottom. These scales are used in making both sets of calculations made on the same side of the rule; but the meaning of the figures in the scales depends upon which set of calculations is being made. For example, when working with the top of the rule—that is, with the scales designated A′ to A^6—the column marked A^3 indicates the total load supported, while when working from the bottom of the rule with the scales marked B′ to B^6 the same scale (designated B^3 in this case) indicates the load per square foot. This double utilization of certain of the scales is a very valuable feature of my invention. After these preliminary remarks the arrangement and operation of my rule will be readily apparent. In the first instance the scales A′, A^2, A^3, A^4, A^5, and A^6 and their use will be described—that is to say, the scales which are used in determining the strength of single steel beams. It will be seen that an arrow L is provided on the left-hand channel member 10 of the rule. This forms the first reckoning device from which calculations are made. The first scale used (indicated by A′) will be found at the bottom of the member 12, at the left-hand side thereof, this scale indicating fiber stress. The second scale A^2 indicates the manner of loading and supporting of the beam in question. This is found at the top of the member 12 of the rule and occupies the total width thereof. This scale, it will be noted, has at its right-hand side numbers, which indicate various constants for determining the strength of beams, and on its left-hand side graphic representations of the manner of loading corresponding to certain of these constants. The constants for loading in other ways can be determined in the well-known way, and the scales can be used therefor without the graphic illustrations. These illustrations, however, show the commonest way of loading beams and make these scales very convenient. The scale A^3, which is the next scale to the right, indicates the total load to be supported in pounds. The scale A^4 indicates the span. The scale A^5 indicates the cross-section of the beam, and the scale A^6 indicates the corresponding section-modulus.

In making calculations from the scales A′ to A^6 the following process is adopted: The desired fiber stress on the scale A′ is placed opposite the arrow L, and the clamping-nut K is screwed up to lock the movable section 12 in position. Although it is to be understood that ordinary architectural steel generally is figured for a certain fiber stress, still it is frequently desired to figure with another fiber stress, the only difference in result being in the margin of safety resulting in the construction. The commonest assumed fiber stress is sixteen thousand pounds per square inch. The figure representing the total load in scale A^3 is then placed opposite the manner of loading in scale A^2 and then opposite the figure representing the span in scale A^4. The cross-section of the beam is read off in scale A^5 or the corresponding section-modulus in scale A^6. It will be seen that in this calculation there are five factors—fiber stress, manner of loading, total load, span, and section—and knowing any four of these the fifth can readily be deduced. When a beam is loaded in a way not indicated in the scale A^2, the following procedure can be adopted: Set the desired fiber stress opposite the arrow L. Then calculate the bending movement of the beam in foot-pounds in the ordinary way and slide the figure corresponding thereto on the scale A^3 opposite the figure "8" in the scale A^2. Then opposite the mark "B. M." on scale A^4 read off the section of the beam on scale A^5.

Referring now to the lower end of the same side of the rule—that is, to the scales B′ to B^6—it will be seen that one new scale is now introduced—that is, the scale B^2—which represents the span and that two of the scales—that is, the scales B^3 and B^4—have different meanings for these calculations than when used as already set forth with the scales A′ to A^6. The scale B^3 represents the load per square foot, and the scale B^4 indicates the spacing of the beams, whereas these scales when designated A^3 and A^4 represent, respectively, total load and span. In using these rules the procedure is as follows: The desired fiber stress in the scale B′ is placed opposite the arrow L, and the desired load per square foot to be supported by the floor is placed opposite the span. Then opposite the desired spacing can be read off the section of beam which must be used. Conversely, if the size of the beam which will be used is known the necessary spacing can be read off. In making calculations for the necessary spacing of steel beams in floors for strength there are five factors—fiber stress, span, load per square foot, spacing, and section—and it will be obvious that when any four of these factors are known the fifth can be readily be determined. It will thus be seen that upon this side of the rule all the calculations necessary for strength can be made and that to make these calculations this peculiar arrangement of scales whereby certain ones have different terms and different meaning when used with the different sets of scales is necessary.

Referring now to Fig. 3, it will be seen that a similar dual arrangement is provided. In this instance two sets of calculations can also be made, the first being to determine the cross-section of a single beam which will be necessary to support a given total load with a given amount of bend or deflection and the second to determine the size of beams necessary in a floor construction to support a given load per square foot on the floor with a given span, spacing, and deflection. The scales for making the first set of calculations are at the top of the rule and are indicated by the characters C' C^2 C^3 C^4 C^5 C^6, and the scales for making the second set of calculations are at the bottom of the rule and are indicated by the characters D', D^2, D^3, D^4, D^5, and D^6.

Referring to the scales C' to C^6, it will be seen in the first place that an arrow M is provided on the channel member 10 of the rule. The scale C^6 to the left of the channel member 10 and on the right of the member 12 indicates the manner of loading. The next scale, C^5, indicates the span; the next scale, C^4, the total load; the next scale, C^3, the deflection—that is, the total amount of bend which will be permitted; the next scale, C^2, the section of the beam, and the next scale, C', the moment of inertia. In utilizing this set of scales the representation of the manner of loading on the scale C^6 is placed opposite the arrow M, the total load on scale C^4 is placed opposite the figure indicating the span, and then opposite the figure representing the total permissible deflection on scale C^3 is read off on scale C^2 the section of the beam or the corresponding moment of inertia on scale C'. It will be understood, of course, that, knowing any four of the five factors—that is, loading and supporting of beam, span, load, deflection, and cross-section—the remaining one can be determined.

Referring now to the rules at the bottom part of Fig. 3—that is, the scales D' to D^6—it will be seen in the first instance that an arrow N is provided on the side bar 10. The next scale to this side part is the scale D^6, which indicates the deflection in proportion to the length of the beam. The next scale, D^5, indicates span; the next scale, D^4, load per square foot. The next scale, D^3, indicates spacing; the next scale, D^2, section, and the next scale, D', the moment of inertia corresponding to the given section. In using this rule the desired deflection is placed opposite the arrow N, and the desired load per square foot is then placed opposite the desired span in the scale D^5, and then opposite the desired spacing is read off the desired section. It will be obvious that when any four of these five factors—deflection, span, load per square foot, spacing, and section—is known the fifth can be determined. It will be seen that on this side of the rule, as on the strength side, certain of the scales are twice utilized, this being notably the case with the rule C^4 D^4, which is in one case indexed "Total load" and in the other case "Load per square foot."

It will be apparent from the description herein given that the positions of certain of the scales herein shown can be changed without departing from the spirit of my invention, and it may be laid down as a general proposition that in these slide-rules any two adjacent scales relatively movable with respect to each other can be changed one for the other without making the devices any the less operative.

I realize that considerable variation is possible in the details of this construction without departing from the spirit of the invention, and I therefore do not intend to limit myself to the specific form herein shown and described.

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

1. In a device of the class described, the combination with a suitable frame, of three scale members, secured therein, each of said scale members having scales reading from opposite ends, and the scales at one end representing fiber stress and manner of loading, the scales at the end of the second member, indicating total load and span, the scales at the end of the third member representing section, the scales at the opposite end of the first member representing fiber stress and span, the scales at the opposite end of the second member representing load per square foot and spacing, and the scales at the opposite end of the third member representing section, the scales upon the second member, being continuous from one end to the other of the rule, and representing respectively, at one end, total load and span, and at the other end, load per square foot and spacing.

2. In a device of the class described, the combination with three members, of a scale at one end of one of the lateral members representing manner of loading, a scale at the opposite end, representing span, two continuous scales upon the intermediate member, running from top to bottom thereof, one of which represents when read from one end, total load, and from the other, load per square foot, and the other one of which reads from one end, span, and from the other end, spacing, and a continuous scale upon the third member, representing section.

3. In a device of the class described, the combination with a suitable frame, comprising channel members, and connecting end pieces, of a lateral member within the frame, suitable indices upon the adjacent side of the frame, a scale upon said lateral member, representing fiber stress, means for clamping said lateral member with respect to the index on the frame, two other scales upon said first member, the upper scale representing manner of loading, and the lower scale, span, an intermediate member having two continuous

scales, one of which, when read from the top, represents, total load, and when read from the bottom, represents, load per square foot, the other of which when read from the top, represents, span, and when read from the bottom, represents, spacing, and a second lateral member rigidly secured in the frame, and having a continuous scale from top to bottom, representing, size of beams.

4. In a device of the class described, the combination with a suitable frame, of a lateral member having a continuous scale, representing, span, a second lateral member, having a scale, representing, size of beams, and an intermediate member, having adjacent to the first lateral member, a continuous scale, representing, total load, when read from the top, and load per square foot, when read from the bottom, and two separate scales on said intermediate member, adjacent to the second lateral member, the upper scale representing, deflection, and the lower scale representing, spacing.

5. In a device of the class described, the combination with a suitable frame having channeled side bars, and connecting end pieces, of indices upon the frame, a lateral member having scales adjacent to said indices, the upper scale, representing, manner of loading, and the lower scale representing deflection, means for clamping said scales opposite the indices, a continuous scale at the inner edge of said lateral member, representing, span, a second lateral member rigidly secured to the frame and having continuous scales, representing the size of beams, and an intermediate member, movable between said lateral members and having adjacent to the first lateral member, a continuous scale, representing total load, when read from the top, and load per square foot, when read from the bottom, and two scales upon said movable member, adjacent to the second lateral member, the upper scale representing, deflection, and the lower, representing, spacing.

In witness whereof I have signed the above application for Letters Patent, at Chicago, in the county of Cook and State of Illinois, this 6th day of February, A. D. 1904.

BENJAMIN E. WINSLOW.

Witnesses:
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