G. A. LUND.

I-BEAM AND THE LIKE.

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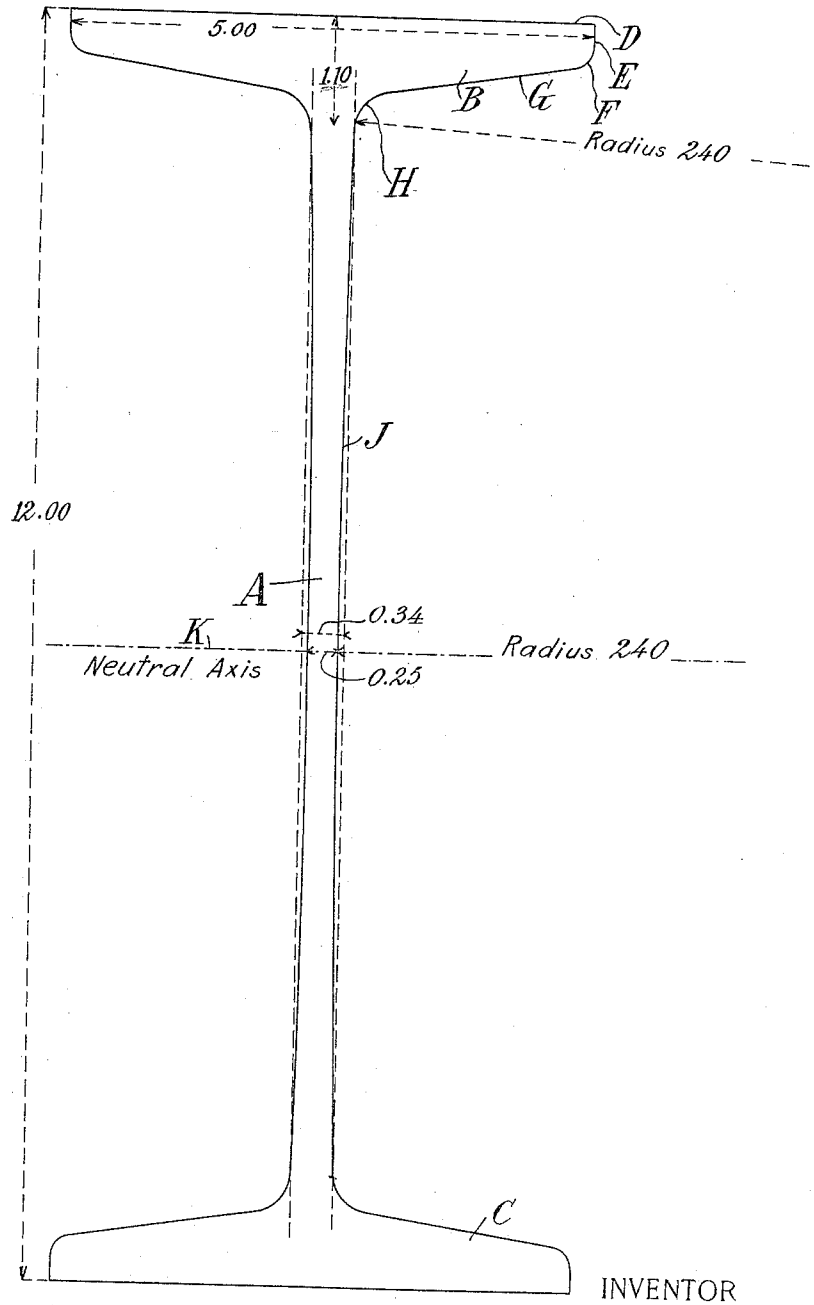

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I-BEAM AND THE LIKE.

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To all whom it may concern:

Be it known that I, GEORGE ALFRED LUND, a citizen of the United States, residing in the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in I-Beams and the Like, of which the following is a specification.

This invention aims to provide an improved I-beam, girder, channel, or similar shape of rolled steel or other metal, and especially to provide a more efficient distribution of the metal than has existed in previous shapes.

The accompanying drawing illustrates an embodiment of the invention, the figure showing in heavy lines the contour of a cross-section of the shape.

Referring to the embodiment of the invention illustrated, the figure represents an I-beam having a web A with a pair of top flanges B and a pair of identical bottom flanges C. The contour of the cross-section is made up of a flat outer face D of the flange, an edge of the flange having a flat portion E and a rounded corner F, a flat inner face G of the flange inclining slightly away from the opposite face D toward the inner edge of the flange to the concave curve H of the fillet between the flange and the web, and a line J extending from the fillet to the neutral axis K of the beam; the line J being a curve tangent at one end to the curve H of the fillet, and normal at its other end to the neutral axis K, and gradually approaching the central vertical line of the web as said line J extends from the fillet toward the neutral axis. The web A of the beam is thus reduced in thickness from its edges where it joins the flanges toward the neutral axis. This gives a most efficient distribution of the metal. With the present methods of manufacture it is essential to leave a substantial amount of metal at the ends of the web where it joins the flanges, that is to say, to provide for a substantial thickness of the web at these points. One reason for this necessity arises from the difficulty of securing a true rolling action in a sharp corner between the flange and web. The metal in this corner is rather dragged along by its cohesion with the adjacent lines which are properly rolled by intimate contact with the rolls; and in cooling there are strains set up in the metal at this point which tend to weaken it and call for the provision of a substantial quantity of metal in this part of the design. But the same considerations do not apply to the portion of the web which lies between the fillets. By reducing the thickness of this portion of the web I produce a shape which shows a minimum percentage of metal near the neutral axis, where it is least efficient or a maximum of metal at a distance from the neutral axis, where it is most efficient. Or conversely, for resisting a given stress I produce a beam of minimum cross-section and weight per unit of length, and of minimum cost, since the cost of manufacture of my improved beam is no greater than that of previous designs, involving only a very simple alteration in the shape of the rolls. The saving by my improvement as compared with a beam having the sides of the web straight from top to bottom, is from $2\frac{1}{2}$ to 5 per cent. in the weight of metal for a beam to resist a given stress, and approximately or substantially the same saving in expense.

The fillet is a quantity of metal which is retained at the junction of the flange and web for the purpose of reinforcing the beam at this point, and facilitating the rolling operations. The extent of the fillet in practice varies somewhat in accordance with the size of the beam. There is a gradual reduction in the relative size of the fillet in passing from the smallest to the largest beams. In a three-inch beam, for example, the fillet may extend to a distance of nearly three-fourths of an inch from the top of the beam, which is one-fourth of the total depth of the beam; while in a twenty-four inch beam the corresponding distance will be about one-twelfth of the total depth of the beam. That is to say, the curve or slope J will start at the center of the height of the beam, or at its neutral axis, and extend along the web to the distance stated from the top of the beam. The curve H of the fillet is of comparatively high degree (short radius) and the line J from the fillet to the neutral axis is a curve of comparatively low degree (long radius). In fact this curve may be so flat as to become practically a straight line or a curve of no degree (infinite radius). Or the line J may be a combination of straight lines or of curved lines or of both. Likewise, the line J is preferably of considerable length compared with the line H of the fillet. The several curves shown in the contour of the beam are usually arcs of circles or ap-

proximately so, though they may be arcs of other curves than circular or may be broken lines. The inner face of the flange is generally referred to as a flat face, because although partly composed of the curves F and H, a substantial portion of it consists of the straight line G. The ratio of width to thickness in the flanges and height to thickness in the webs may be considerably varied; though for economical distribution of material the flanges should be wide and thin and the web high and thin. The dimensions of the shape may be varied within a wide range while preserving the thickness of the web less at the neutral axis than at points removed therefrom. Any of the shapes now in use having a flat-faced web can be improved upon by tapering the web toward the neutral axis, leaving the fillet and the thickness of the web adjacent thereto substantially intact, these being the dimensions which determined the minimum thickness of the web in the old shape.

The improvement may be applied not only to the I-beam shown, but to various other shapes, symmetrical or unsymmetrical which are known in the art as equivalents or substitutes for I-beams in special circumstances.

By way of example the figure shown in the drawing represents to scale a symmetrical I-beam designed in accordance with this invention. The principal dimensions are indicated on the figure. The fillet is a substantially circular curve joining the flat inner face of the flange to the face of the web, and the direction of the radius of the curve J of the web is indicated by the lines marked "Radius 240" one of which is in line with the neutral axis K, though the length is too great to be indicated within the limits of the drawing, being about 20 feet for a 12-inch beam.

What I claim is:

1. An I-beam or the like having a flange with a flat inner face and a web tapering in thickness toward the neutral axis.

2. An I-beam or the like having a flange tapering in thickness toward its edge and with a flat inner face, a long web tapered in thickness toward the neutral axis and a short fillet joining the inner face of the flange and the face of the web.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

GEORGE ALFRED LUND.

Witnesses:

D. ANTHONY USINA,

FRED WHITE.