

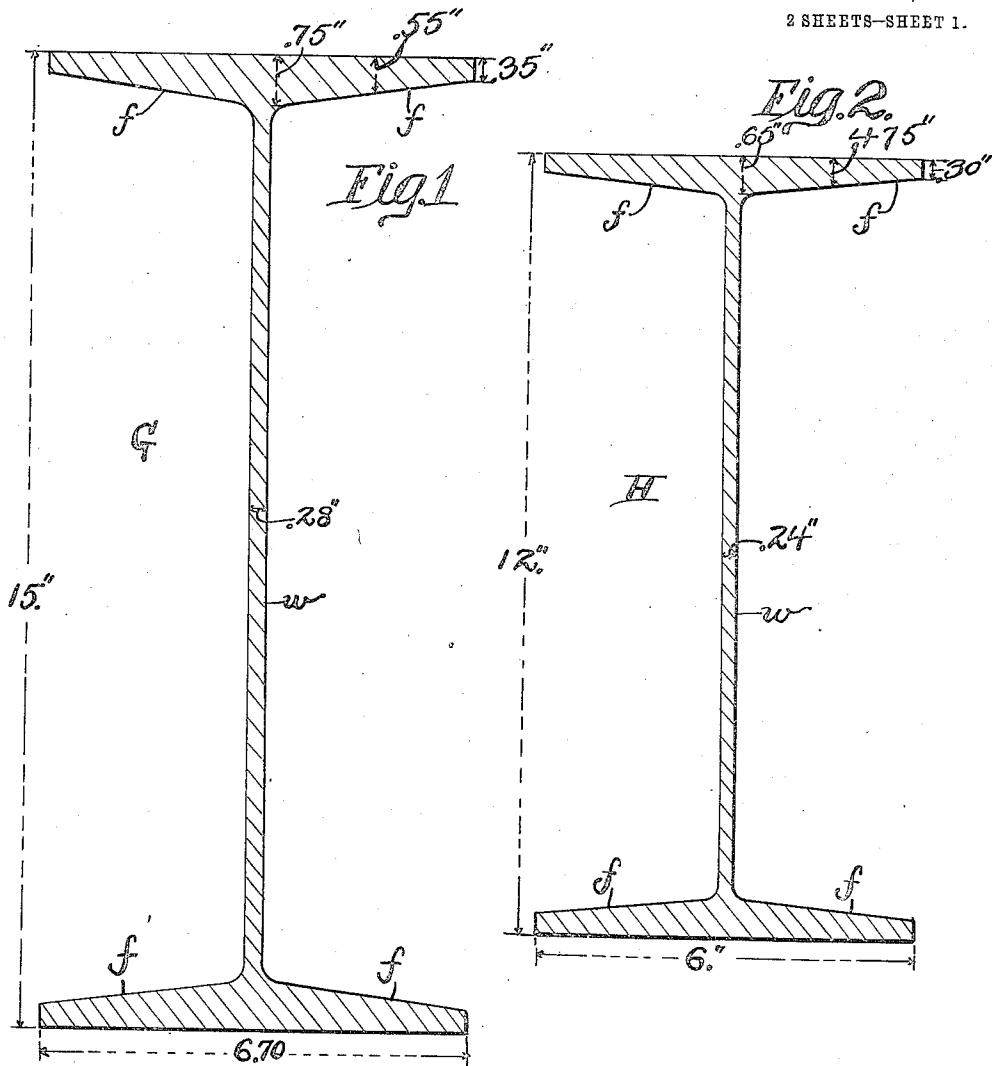
H. GREY.

SOLID ROLLED METAL I-BEAM OF TWELVE INCHES AND UNDER SIXTEEN INCHES IN HEIGHT.
APPLICATION FILED SEPT. 16, 1903.

1,013,652.

Patented Jan. 2, 1912.

2 SHEETS—SHEET 1.



WITNESSES:

Daniel E. Daly.
Jennie F. Ring.

INVENTOR

Henry Grey

BY

Archibald
his ATTORNEYS.

H. GREY.

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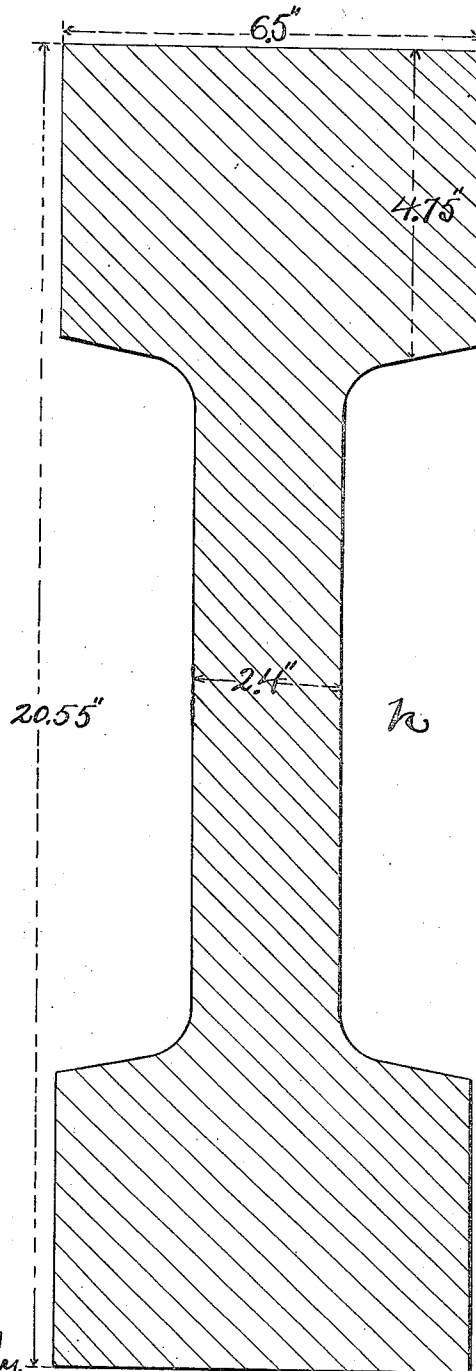
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2 SHEETS-SHEET 2.

Fig. 3.



WITNESSES:

Daniel E. Italy

Jennie F. Long

INVENTOR

Henry Grey

BY

Spencer Dorer
his ATTORNEYS

UNITED STATES PATENT OFFICE.

HENRY GREY, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN UNIVERSAL MILL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF WEST VIRGINIA.

SOLID ROLLED METAL I-BEAM OF TWELVE INCHES AND UNDER SIXTEEN INCHES IN HEIGHT.

1,013,652.

Specification of Letters Patent.

Patented Jan. 2, 1912.

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To all whom it may concern:

Be it known that I, HENRY GREY, a citizen of the United States of America, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Solid Rolled Metal I-Beams of Twelve Inches and Under Sixteen Inches in Height; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

This invention relates to improvements in solid rolled metal I-beams having a height of at least twelve and under sixteen inches.

The general object of this invention is to produce improved solid rolled steel or iron I-beams having a height of from twelve to fifteen inches inclusive, and capable of safely carrying on any span whose length in feet is equal or exceeds the height of the beam in inches, for a given unit of material, a greater load than has heretofore been carried. In other words, this invention has in view the production of a solid rolled metal I-beam having a height within the above-mentioned range, which shall, by reason of an advantageous distribution of material in its web and flanges, be able to safely carry, on all spans included within the above-mentioned limitation, a larger load to the unit of weight in said beam than has heretofore been carried by any heretofore produced solid rolled I-beam of the same height.

The object of this invention, more specifically stated, is to produce solid rolled I-beams having a height of at least twelve and under sixteen inches and capable of safely carrying, on spans of one or about one foot for every inch in height of the beam, an evenly distributed safe load equal in amount to that carried by heretofore made solid rolled I-beams of the same height, with ten per cent. less weight of material.

Another object is not only the production of a solid rolled I-beam having a height within the range hereinbefore indicated, which shall, by reason of an advantageous distribution of material in its web and

flanges, be able to safely carry, on all spans included within the above-mentioned limitation, a larger load to the unit of weight in the said beam than capable of being carried by any heretofore produced solid rolled I-beams of the same height, but which has a web of considerably less thickness than the thickness of the webs of heretofore made solid rolled I-beams of the same height and about or approximately one-half the mean thickness of the flanges of the beam, and has a width which, measured straight across the outer sides of adjacent oppositely projecting flanges of the beam, is about or approximately twelve times the mean thickness of the flanges of the beam.

With these objects in view, this invention consists more especially in the production of solid rolled I-beams ranging in height from twelve inches to fifteen inches inclusive, which have such dimensions cross-sectionally and have the mean thickness of each flange and the thickness of the web bearing such proportion to each other that the coefficient of strength in any beam having a height within the said range, per unit of weight of one pound for a fiber stress of sixteen thousand (16,000) pounds per square inch, exceeds ten hundred and thirty pounds (1030 lbs.) for every inch of height of the beam.

In the accompanying drawings, Figures 1 and 2 are cross-sectional views of solid rolled I-beams embodying my invention and having a height of fifteen inches and twelve inches respectively. Fig. 3 is a cross-sectional view of a rough beam or blank suitable for use in the manufacture of my improved solid rolled "twelve inch" I-beam illustrated in Fig. 2, and portions are broken away in Fig. 3 to reduce the size of the drawing.

Referring to the drawings, *w* represents the web, and *f*, the flanges of the beams.

G designates the solid rolled I-beam illustrated in Fig. 1. The beam *G* has a height of fifteen inches, as already indicated,—that is, measures fifteen inches (15") between the outer sides of the flanges formed at one and the same side of the web of the beam. The beam *G* has a width of six inches and

seven tenths of an inch (6.7"),—that is, measures six inches and seven tenths of an inch (6.7") between the longitudinal edges of adjacent oppositely projecting flanges *f* of the beam. The thickness of each flange *f* of the beam *G* is seventy-five hundredths of an inch (.75") at the root of the flange and thirty-five hundredths of an inch (.35") at the longitudinal edge of the flange, so that the mean thickness of the said flange is fifty-five hundredths of an inch (.55") and approximately twice the thickness of the web of the beam, which last-mentioned thickness is twenty-eight hundredths of an inch (.28"). The taper of the inner sides of the flanges of the beam *G* is, therefore, twelve and one-half (12.5) per cent. It will be observed, also, that the width of the beam *G* is somewhat over or about twelve times the mean thickness of the flanges. The weight of the beam *G*, per running foot, is thirty-eight pounds (38 lbs.). The coefficient of strength in the beam *G*, for a fiber stress of sixteen thousand pounds (16,000 lbs.), per square inch, is six hundred and thirty-five thousand (635,000) pounds, and the coefficient of strength for a unit of one pound, in the said beam, is, therefore, sixteen thousand seven hundred and ten pounds (16,710 lbs.), the quotient obtained by dividing 635,000 lbs. by the number of pounds (38) per running foot in the beam. The quotient obtained by dividing the coefficient of strength for the unit of one pound (16,710 lbs.), by the number of inches that the beam is high (15) is eleven hundred and fourteen pounds (1114 lbs.) which is the coefficient of strength, in the beam *G*, per unit of one pound, for every inch of the height of the beam, and a load which the beam *G* can safely carry, per pound, on a span within the hereinbefore mentioned limitation, instead of nine hundred and ninety-eight pounds (998 lbs.) which is the greatest load which any heretofore made solid rolled beam of the same height can safely carry, per pound of material, on a corresponding span.

H, in Fig. 2, represents a solid rolled I-beam which has a height of twelve inches, as already indicated,—that is, measures twelve inches (12") between the outer sides of the flanges formed at one and the same side of the web of the beam. The beam *H* has a width of six inches (6"),—that is, measures six inches (6") between the longitudinal edges of adjacent oppositely projecting flanges *f* of the beam. The thickness of each flange *f* of the beam *H* is sixty-five hundredths of an inch (.65") at the root of the flange and thirty hundredths of an inch (.30") at the longitudinal edge of the flange, and hence the mean thickness of the said flange is four hundred and seventy-five thousandths of an inch (.475") and

about or approximately twice the thickness of the web *w* of the beam, which last-mentioned thickness is twenty-four hundredths of an inch (.24"). The taper of the inner side of the flange of the beam *H* is obviously twelve and one half (12.5) per cent. It will be observed, also, that the width of the beam *H* is somewhat over or about twelve times the mean thickness of the flanges. The weight of the beam *H*, per running foot, is twenty-eight and three tenths of a pound (28.3 lbs.). The coefficient of strength in the beam *H*, for a fiber stress of sixteen thousand pounds (16,000 lbs.), per square inch, is three hundred and eighty-three thousand five hundred and fifty pounds (383,550 lbs.), and the coefficient of strength, for the unit of one pound, in the said beam, is therefore, thirteen thousand five hundred and fifty-three pounds (13,553 lbs.), the quotient obtained by dividing 383,550 lbs. by the number of pounds (28.3) per running foot in the beam, and the quotient, obtained by dividing the coefficient of strength for the unit of one pound (13,553 lbs.), by the number of inches that the beam is high (12), is eleven hundred and twenty-nine pounds (1129 lbs) which is the coefficient of strength, in the beam *H*, per unit of one pound, for every inch of the height of the beam, and a load which the beam *H* can safely carry, per pound, on a span within the limitation hereinbefore mentioned, instead of ten hundred and fifteen pounds (1015 lbs.) which is the greatest load which any heretofore made solid rolled I-beam of the same height can safely carry, per pound of material, on a corresponding span.

The improved solid rolled I-beam hereinbefore described and illustrated in Figs. 1 and 2 of the accompanying drawings can be successfully produced by providing a suitably heated rough beam or blank I-shaped in cross-section and having such dimensions cross-sectionally that the mean thickness of each flange of the blank is about or approximately twice the thickness of the web of the blank, with the thickness of the said web and the mean thickness of the said flange corresponding or approximately corresponding, in their proportion to each other, with the proportion which the mean thickness of the said flange and thickness of the said web shall bear to each other in the beam to which the blank is to be reduced, and then rolling the flanges and web simultaneously and thereby reducing the mean thickness of each flange and the thickness of the web substantially in the proportion which the mean thickness of the said flange and the thickness of the web bear to each other in the blank. This method of reducing the said blank is invaluable to avoid imperfections, latent as well as visible, in any por-

tion of the resulting product. As an example h , in Fig. 3, represents a cross-sectionally I-shaped blank especially suitable for use in the production of the improved solid rolled "twelve-inch" I-beam illustrated in Fig. 2. The blank h measures, in height twenty inches and fifty-five hundredths of an inch (20.55"),—that is, measures twenty inches and fifty-five hundredths of an inch (20.55") between the outer sides of the flanges at one and the same side of the web of the blank. The blank h has a width of six and one-half inches (6.5"),—that is, measures six and one-half inches (6.5") straight across the outer sides of adjacent oppositely projecting flanges of the blank. The mean thickness of each flange of the blank h is four and three-fourths inches (4.75") and the thickness of the web of the blank is two inches and four-tenths of an inch (2.4") and hence the mean thickness of the said flange is about or approximately twice the thickness of the web of the blank. It will be observed, therefore, that the mean thickness of each flange of the blank h bears, to the thickness of the web of the blank, the same or approximately the same ratio which the mean thickness of the said flange, when finished and as it is to exist in the beam H , Fig. 2, to which the said blank is to be reduced, bears to the thickness of the web of the said beam.

I would remark that my invention, which constitutes the subject-matter of this application, is the result of an exhaustive study of the ways and means best adapted to meet economically and advantageously distribute the material used in the manufacture of solid rolled I-beams ranging in height from twelve to fifteen inches, and that my improved beams have no more material in their web than actually needed but obviously considerably less material than solid rolled I-beams of the same height heretofore made. Solid rolled I-beams made prior to my invention have too much material in close proximity to the neutral axis. The moment of inertia of an I-beam, when the latter is to be used as a joist or girder, is calculated by the well known formula, viz:

$$I = \frac{1}{12} \text{ of } \left[b d^3 - \frac{1}{4} (h^4 - l^4) \right]$$

In the said formula, I stands for the moment of inertia, with the neutral axis perpendicular to the web at the center; b , for the width of the beam; d , for the height of the beam; h , for the distance between the flanges at one and the same side of the web at the longitudinal edges of the said flanges; l , for the distance between the roots

of the flanges at one and the same side of the web;

$$r = \frac{h-l}{b-t}$$

65

and t stands for the thickness of the web. From the said moment of inertia a coefficient for any given fiber stress is calculated for determining the evenly distributed load that the beam will safely carry. The said formula shows the coefficient equal to

$$\frac{8 \times \text{fiber strain} \times I}{\text{span in inches} \times n}$$

75

and n stands for the distance of center of gravity of section, from top to bottom, in inches, and twelve inches (12") is used for the span; thus the coefficient obtained is for one foot and this, in general parlance, is called the coefficient. If the safe load, uniformly distributed, is required for any definite span, the coefficient is divided by the number of feet in that span, and the quotient obtained is the safe load for that given span.

What I claim is:—

1. As a new article of manufacture, a solid rolled I-beam the height of which is over twelve inches but under sixteen inches, the ratio of the width of the flanges to the thickness of the web being not less than twenty two.

2. As a new article of manufacture, a solid rolled I-beam, the height of which is substantially twelve inches, and the width of the flanges of which is substantially six inches, and the thickness of the web of which is substantially .24 of an inch.

3. As a new article of manufacture, a solid rolled steel I-beam, the height of which is not less than twelve inches, the width of the flanges of which is substantially six inches, the mean thickness of the flanges of which is substantially .475 of an inch, and the thickness of the web is substantially .24 of an inch.

4. As a new article of manufacture, a solid rolled I-beam the height of which is substantially fifteen (15) inches, the width of the flanges thereof is six and seven-tenths (6-7/10) inches, and the mean thickness of said flanges being substantially one twelfth (1/12) of their width.

In testimony whereof, I sign the foregoing specification, in the presence of two witnesses.

HENRY GREY.

Witnesses:

C. H. DORER,
G. M. HAYES.