

Dec. 27, 1932.

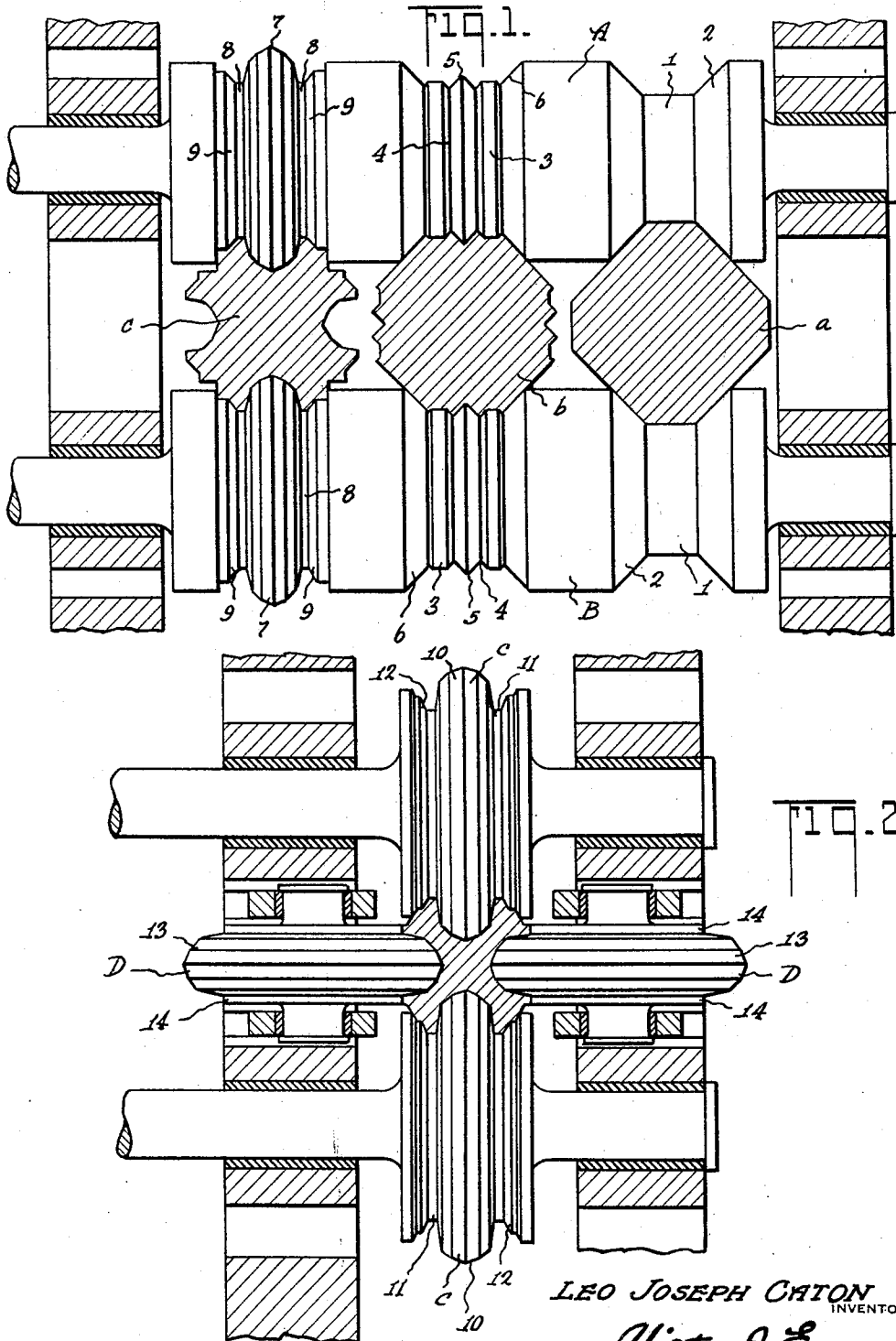
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1,892,608

METHOD OF ROLLING STEEL COLUMNS

Filed June 12, 1930

2 Sheets-Sheet 1



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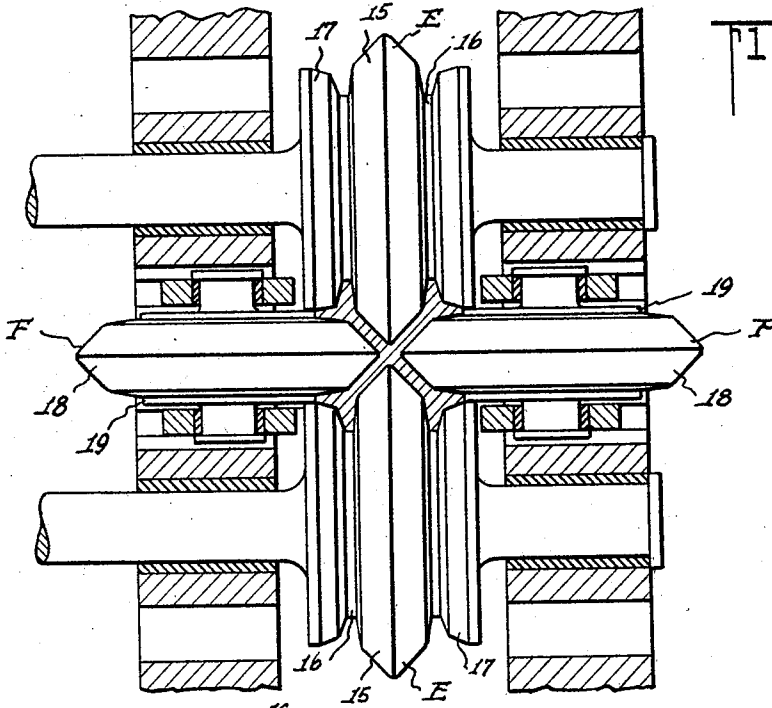


FIG. 3.

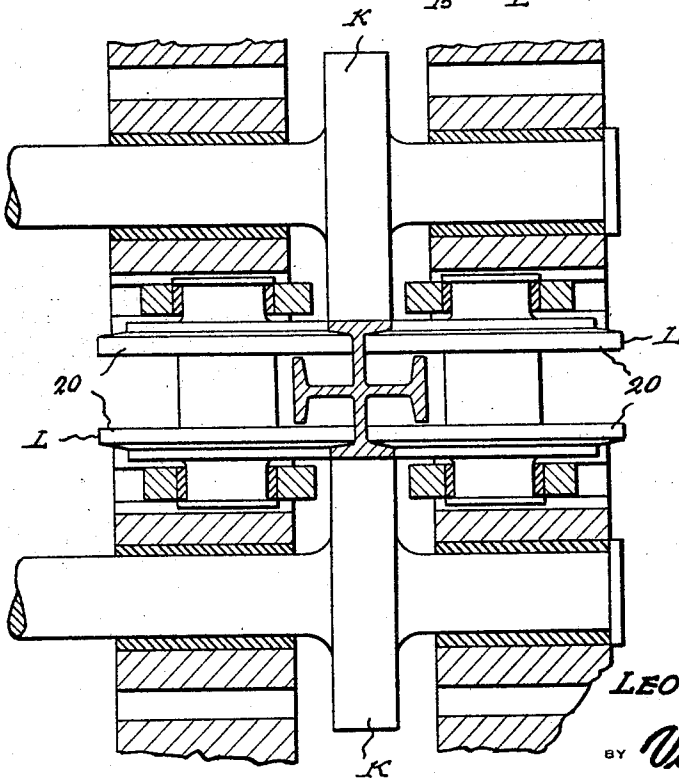


FIG. 4.

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METHOD OF ROLLING STEEL COLUMNS

Application filed June 12, 1930. Serial No. 460,612.

This invention has reference to improvements in the art of rolling structural steel columns.

The broad objects of the present invention are: First, to provide a new and improved steel column of a general cruciform flanged shape in section and rolled from a single ingot, and second, to provide an improved process for rolling such a column by passing the ingot through successive stages of rolls each stage forming a portion of the cruciform shape desired.

Other objects and advantages of the invention will be hereinafter specifically pointed out, or will become apparent, as the specification proceeds.

With the above indicated objects in view, the invention resides in certain novel constructions and combinations and arrangements of parts, clearly described in the following specification and fully illustrated in the accompanying drawings, which latter show embodiments of the invention as at present preferred.

In said drawings:

Fig. 1 is a diagrammatic view illustrating the arrangement of the rolls for forming the ingot partially to the shape desired.

Fig. 2 is a diagrammatic view of an arrangement of rolls for performing the second forming operation in the partially formed piece produced by the arrangement shown in Fig. 1.

Fig. 3 is a diagrammatic view of an arrangement of rolls for performing the third forming operation in the partially formed piece produced by the arrangement shown in Fig. 2.

Fig. 4 is a diagrammatic view of an arrangement of rolls for performing the final step in shaping the column.

It is customary in the erection of steel frame buildings, particularly those of great height, to carry the steel floor girders by means of structural steel columns of a fabricated nature where the loadings exceed certain limits. Such columns are usually fabricated at the steel mills from standard angles, Z-bars, I-beams, H-beams, and channels, such shapes being assembled in various ways and

riveted together either entirely or partially ready for erection in the field. Such a method of manufacture, involving as it does the placing of hundreds of rivets in each column section, is a costly one and produces a considerably weaker column than would be the case if the column were rolled in one integral piece of the desired section with its saving in metal which results from the absence of rivets.

The desirability of rolling a structural steel column of a cruciform shape in section and having four flanges will be readily appreciated by those skilled in the art and the advantage of such a shape and process of rolling will be readily perceived.

Figs. 1, 2, 3 and 4 it should be understood, represent vertical sections, partially in elevation; that is, these views assume the column being passed through the rolls while advancing horizontally.

A one-piece steel column of the new shape is rolled by means of the arrangements of rolls illustrated in Figs. 1 to 4 inclusive, which show the progressive steps necessary to produce the finished product. The ingot from which the column is to be produced is of a square section say as shown between upper and lower rolls A and B in pass *a*, of Fig. 1. These rolls after passage a suitable number of times in passes *a*, *b*, *c*, produce the section illustrated in pass *c* of Fig. 1.

The design of housing and rollers throughout (Figs. 1, 2, 3 and 4) are preferably such that any set of housings and rollers give a housing setup for rolling all sizes of beams in a given series.

Reverting to Fig. 1, rolls A and B are so designed with grooves and ridges to successively form the square ingot to a shape shown in pass *c* in Fig. 1.

It is contemplated there will be a number of operations in each of passes *a*, *b*, *c*, to reduce the square ingot to the shape required for the next rolling operation which is indicated in Fig. 2.

Now again reverting to Fig. 1 as the ingot passes through on edge those sections of the rolls defined by cylindrical surfaces 1 and sloping surfaces 2, are active and the cylin-

drical surfaces 1 flatten the corners of the ingot thereby forming the ingot into a hexagon shape while sloping surfaces 2 prevent the ingot from spreading.

5 Again reverting to Fig. 1, the partially rolled column is passed through that section of rolls indicated by ridges and grooves 3, 4, 5 and 6 which partially form the ingot to the shape required for the next rolling operation in Fig. 2. Again reverting to Fig. 10 1 at alternating passes from that section of rolls indicated by ridges and grooves 3, 4, 5, 6 the partially rolled column is passed through that section of rolls indicated by 15 grooves 8 and circular projection 7 and sloping surfaces 9. Circular projections 7 partially form the webs of the column while grooves 8 are working on the edges of the partially rolled flanges, the sloping surface 9 20 tending to hold in shape the column of the previous pass. Before referring to Fig. 2 let it be known here that after every pass in Fig. 1 the partially rolled column is turned 90° so that all sides are worked uniformly.

25 While the ingot is passed through one part of rolls it is contemplated no metal will be passed through other parts of rolls.

In Fig. 2 is shown a pair of horizontal rolls C and a pair of vertical rolls D arranged in 30 housings J all together defining a pass. The vertical rolls D are idle rolls, and not driven by power and, therefore very little if any reducing will be done by these rolls their main work being to hold the partially rolled column from spreading at every pass. Horizontal 35 rolls C which are power driven do all the work of elongating the column more to a cruciform shape. As all the work is done by the horizontal rolls C the partially rolled 40 column must be turned 90° after every pass thereby working all sides of the shape uniformly.

Again reverting to Fig. 2 circular projection 10 further forms the webs of the column 45 while groove 11 and sloping surface 12 further form the partially rolled flanges. Circular projection 13 and cylindrical surfaces 14 of the vertical rolls D hold in shape the two vertical sides of the column while the 50 work of reducing and elongating is being done by the horizontal rolls C.

The partially rolled column as shown in solid black in Fig. 2 is then passed on to another set of rolls shown in Fig. 3.

55 Fig. 3 shows a pair of horizontal rolls E and a pair of vertical rolls F arranged in housings G all converging gradually together at each pass. The vertical rolls F are idle rolls and not driven by power and, therefore 60 very little if any reducing will be done by these rolls, their main work being to hold the partially rolled column from spreading and to the required shape at each pass. Horizontal rolls E which are power driven do all the 65 work of elongating and reducing the column

to a cruciform shape with split flanges, and, therefore, the column must be turned 90° after every pass thereby working all sides of the shape uniformly.

Again reverting to Fig. 3 conical projection 15 of rolls E finally forms the webs of the column to the required shape while 70 grooves 16 and sloping surfaces 17 finally split and form the flanges to the required shape necessary. Conical projection 18 and 75 cylindrical surfaces 19 of vertical rolls F hold in shape the two vertical sides of the column while the work of reducing and elongation is being done by the horizontal rolls E.

The semi-finished column is then passed on 80 to the final shaping and straightening as shown in Fig. 4.

Fig. 4 shows a pair of horizontal cylindrical rolls K and a pair of vertical rolls L arranged in housings M converging gradually 85 at each pass.

Again reverting to Fig. 4, the final step in rolling, cylindrical rolls K flatten and spread the flanges to the shape required for the 90 finished product while that portion of vertical rolls 20 support the webs from buckling and forms a base for the flanges at the final pass. Since diametrically opposite flanges 95 only are operated upon at one time during this step, the column must be turned 90° for the rolling operation to be correspondingly performed upon the remaining flanges.

The operation of adjusting the rolls towards and away from each other is well 100 known and need not be described here.

The improved structural shape thus produced possesses certain decided advantages over the present fabricated columns. Its principal advantage is that it may be manufactured cheaply owing to the fact that building up of the column has been eliminated completely. The elimination of the riveting makes it possible to use a column section 105 which is smaller in area than is usually the case with riveted columns, since the presence of rivets always introduces a certain amount of weakness in a column which must be compensated for by increasing the cross-section to provide more metal in 110 order to secure the desired rigidity and resistance to compressive stresses. This means that in addition to the labor cost the cost of production is further reduced by a reduction in the cost of metal necessary. Another advantage is that by convenient adjustment in the rolls any size of column desired may be rolled within the limits of size 120 of the maximum weight of ingot which may be handled. A column such as is produced will have equal radius of gyration about both 125 axes, thus giving a more economical distribution of metal and providing greater resistance to bending.

Aside from the valuable physical properties of such a novel one-piece column, and the 130

reduced cost of manufacture, there are certain structural advantages in using a column of the shape produced by the process just described. Erection is simplified enabling all connections for floor beams to be riveted to the column in the fabricating shop and, eliminating the necessity of shipping the top angle of a beam connection loose on the web of present H-columns. Tall buildings are wind braced as a rule both ways, making it necessary to drive two to sixteen rivets in the top wind brace clip of a beam connection through the web of the present H-column in the field. Where the unitary four-flanged columns of the present invention are used, these rivets can be driven in the shop, thereby reducing to a certain extent the cost of erection. A further advantage in erecting is that the cross girders or floor beams may be swung into place sideways, between the columns, without the necessity of tilting such girders and slipping them into place between the flanges of the present type columns of H section.

While the steps of Figs. 1, 2, 3 and 4 have been described as though the step of Fig. 2 immediately succeeded the step of Fig. 1 and as though the step of Fig. 3 immediately succeeded the step of Fig. 2, etc., it will be understood that there may be a plurality of intervening steps, or passes in carrying out the invention.

It has been hereinabove pointed out that the same housing set-up may be maintained for rolling all sizes of the beams of a given series. In this same connection, it is now further pointed out that there is no necessity for changing rolls, except for repair or replacement.

While cover plates will ordinarily not be needed as riveted additions to the new beam or column of the present invention, yet, where insisted upon, they can easily be applied, by bottom drive "pinch-bug" rivet applicators or drivers, well known in the art, the use of which drivers is feasible and indeed very convenient by virtue of the openings between the side edges of the flanges.

The scope of protection contemplated is to be taken from the following claims, interpreted as broadly as is consistent with the prior art, inasmuch as it has become clear that the specification foregoing incorporates disclosures of the various important features of the invention which are merely illustrative, and intended solely to disclose an at present favored mode of working the invention as briefly and clearly as possible.

I claim:

1. The method of rolling a steel column from a single piece of steel, which involves rolling said piece toward and to a condition where the same is of cruciform section because including intersecting webs, and then rolling the opposite end portions of both

webs toward and to a substantially T flange shape.

2. The method of rolling a steel column from a single piece of steel, which involves rolling said piece toward and to a condition where the same is of cruciform section because including intersecting webs, and then rolling the end portions of both webs toward and to a substantially Y flange shape and then toward and to a substantially T flange shape.

In testimony whereof I hereby affix my signature.

LEO JOSEPH CATON.

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