Feb. 2, 1937. E. RIEMENSCHNEIDER ET AL 2,069,480

BLANK FOR AND METHOD OF MAKING AXLE HOUSINGS

Filed June 7, 1932 2 Sheets-Sheet 1

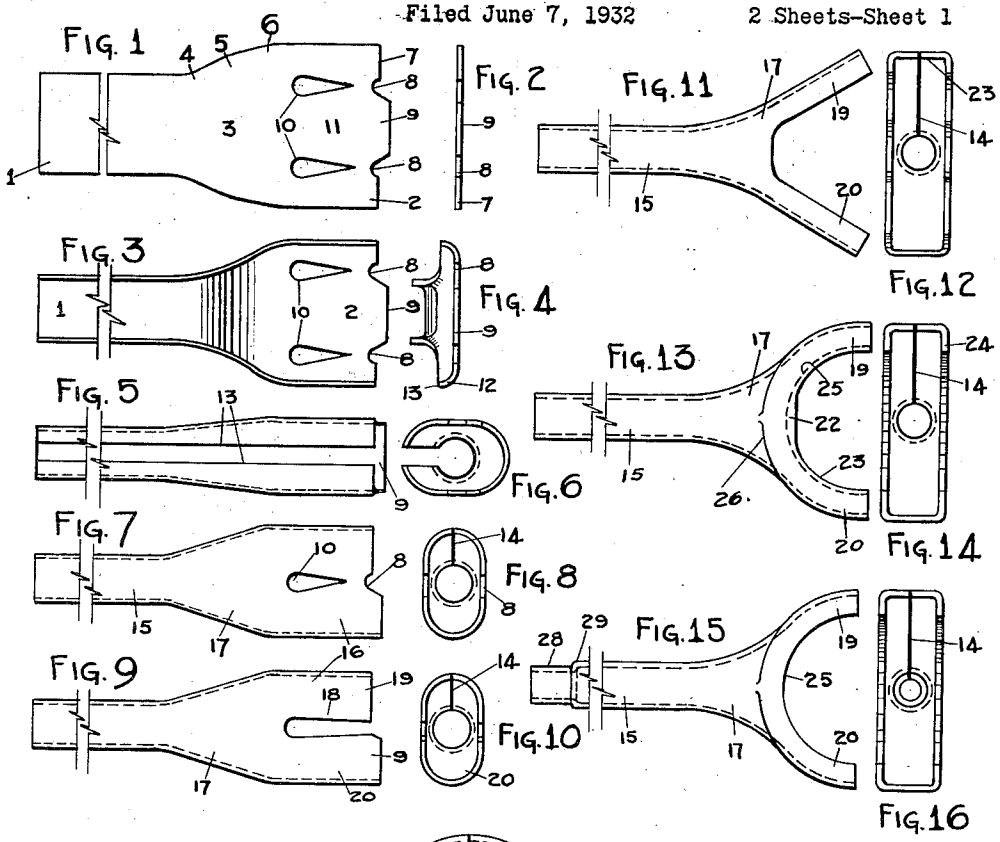

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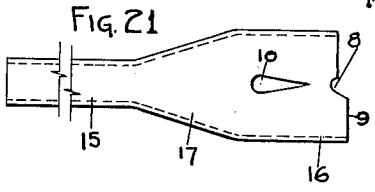
Fig. 21



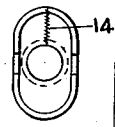
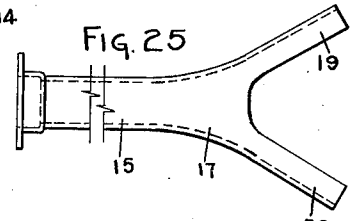


Fig. 22

Fig. 25



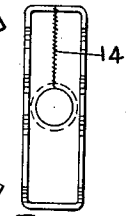
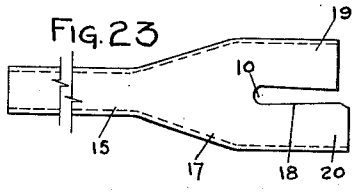


Fig. 26

Fig. 23



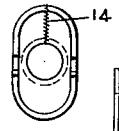
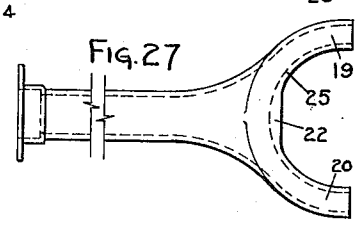


Fig. 24

Fig. 27



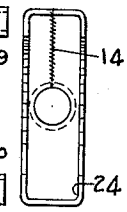
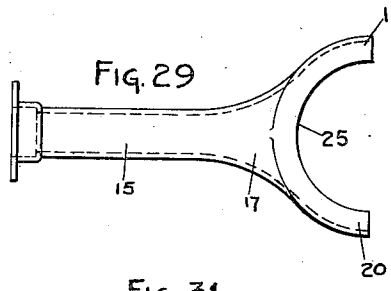


Fig. 28

Fig. 29



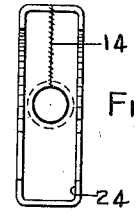


Fig. 30

Fig. 31

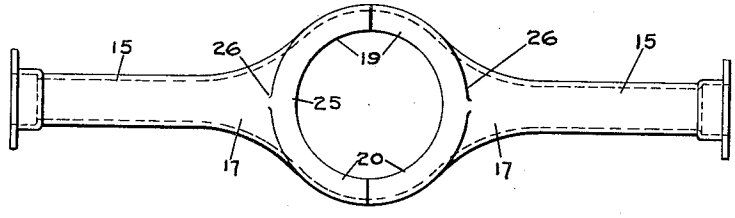
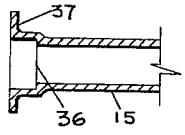


Fig. 32



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Patented Feb. 2, 1937 2,069,480

UNITED STATES PATENT OFFICE

2,069,480

BLANK FOR AND METHOD OF MAKING AXLE HOUSINGS

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Application June 7, 1932, Serial No. 615,848

19 Claims. (Cl. 29—153.1)

This invention relates to new and useful improvements in tubular articles, more particularly to the axle housing type and relates to the blank and method of forming the same into sections for the formation of complete axle housings.

An important object of the invention is to provide a method of manufacturing axle housings from a minimum amount of material from either flat or tubular stock and is made possible by operating upon the stock from one end rather than its mid-section, whereby said end can be spread or expanded with the simplest equipment to become appropriate size and shape for the gear housing portion and at the same time provide an opening without scrap losses for the admission of the differential gearing.

Another important object of the invention is to provide a tubular section tapering into an enlarged end, oval in cross section, and providing said enlarged end with slots arranged relative thereto and the tapered portion of the section so that in subsequent forming, the slots will define the approximate edges of the arms and control their symmetrical disposition while they are being bent toward their final arcuate shape.

A further object of the invention is to provide a blank which can be formed into a tube of circular section at one end and an enlarged developed end of oval section at the other with a connecting tapered portion which cooperates in controlling subsequent bending without receiving adverse conditions and characteristics so as to retain its requisite cross section, substantial shape and wall thickness to provide the necessary strength.

Another important object of the invention is to provide a welded tubular section with provision for the lack of displacement or flow of metal in the welded portion during subsequent forming operations.

Another object of the invention is to provide a unit including backing plate and bearing ring flanges for attachment to the reduced ends of the housing, the shoulders of both elements cooperating in the de-marking points of attachment and lending themselves to rapid welding together of the parts to be united.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the accompanying drawings forming a part of the description and wherein like numerals are employed to designate like parts throughout the several views,

Fig. 1 is a plan of a flat blank from which one-half of the rear axle housing is formed,

Fig. 2 is an end elevation of the same,

Fig. 3 is a plan of the same blank with its longitudinal edges flanged from the first forming operation,

Fig. 4 is an end elevation of the same,

Fig. 5 is a plan of the same blank formed into tubular sections,

Fig. 6 is an end elevation of the same,

Fig. 7 is a plan of the formed tube after being welded showing the diametrical disposition of the openings in the enlarged oval end thereof,

Fig. 8 is an end view of the same,

Fig. 9 is a view similar to Fig. 7 showing the tubular section divided up to the slot or opening,

Fig. 10 is an end elevation of the same,

Fig. 11 is an elevation of the tube after the enlarged oval end has been spread into Y-shape,

Fig. 12 is an end elevation of the same,

Fig. 13 is an elevation of the section after the forked arms have been bent into arcuate shape,

Fig. 14 is an end elevation of the same,

Fig. 15 is a view showing the axle housing section after the trimming operation,

Fig. 16 is an end elevation of the same,

Fig. 17 is a plan view showing two of the axle housing sections united in longitudinal alignment to form a substantially integral housing,

Fig. 18 is a similar view illustrating the bearing ring retainer and brake apron flange secured to each end thereof,

Fig. 19 is a longitudinal section of the combined bearing ring retainer and brake apron flange unit.

Fig. 20 is a similar view illustrating the same attached to one end of the axle housing,

Fig. 20*a* is a top plan of the housing section shown in Fig. 15,

Figs. 21 to 31 inclusive correspond to Figs. 7 to 18 inclusive but illustrating a bearing ring retainer and brake apron flange formed integral from the metal at opposite ends of the housing.

Fig. 32 is a longitudinal section of one end of the housing showing the one piece formation of the ring retainer and brake apron flange.

The manufacture of rear axle housings for motor vehicles has been a continual problem to manufacturers from the standpoint of economizing in both material and equipment. This has resulted in the practice of two different methods of forming the housings, one of which proceeds from flat blanking and the other from tubular stock. In the latter class, which effects a saving in scrap loss from blanking operations, special

equipment is necessary for operating upon the tubular section to form it into a complete housing. The type of housing including a plurality of tubular sections with an independent gear housing portion, has not met with favor due to the multiplicity of joints required, lack of strength and being generally crude in appearance. The other specie of this tubular type patented by Mogan and others required expanding operations on the mid-section of the tube, necessitating elaborate and expensive expanding tools and resulting in an objectionable thinning of the walls of the gear housing portion incident to the expanding operation.

The flat blank type of housing has always been objectionable by reason of the excessive scrap loss of material in the blanking operation. This type generally includes the use of a blank having two pairs of triangular wings adjacent its mid-section so common in the Murray patents. The loss by scrap was attempted to be obviated in many different ways, as for example by welding the triangular projections on the edges of the flat blanks or by welding a plurality of blanks together from which might be formed the tubular axle housing. While effecting a saving in the amount of material employed, it necessitated additional welding and more joints in the axle housing than was satisfactory.

The present invention proceeds from an economical blank because of its ability to be closely nested in the blanking operation which in turn is made possible by the fact that the housing is constructed from a pair of similar blanks giving rise to the possibility of forming the gear housing portion at one end of the blank instead of upon its mid-section as exemplified in the older practice. By performing the spreading or expanding operation on one end of the section, scrap losses are reduced, less expensive equipment is required for the spreading operation, and reduction of wall thickness of the gear housing portion is obviated.

Referring now more particularly in detail to the drawings, the invention, although not necessarily, proceeds from a flat blank or blanks, there being two similar blanks employed for each axle housing and as both are identical in construction and formation, only one will be described in detail. Reference has been made to the fact that the invention preferably proceeds from flat blank stock and as will appear hereinafter, it is within the realm of this invention to begin with tubular stock.

The flat blank shown in Figs. 1 and 2 of the drawings is of sufficient length to form one-half of the axle housing and is of a width sufficient to form up into a tubular section. This blank includes a pair of substantially rectangular ends 1 and 2, the latter being considerably wider than the former, with an intermediate generally tapered portion 3. The longitudinal edges of this intermediate portion each possess three portions which taper in varying degrees as indicated by the portions 4, 5 and 6 to provide the finished half section with a gradually tapering portion connecting the tubular end of the axle housing section with the enlarged forked gear housing portion for the addition of strength. The longitudinal edges of the two substantially rectangular ends of the blanks are substantially parallel as illustrated and meet the longitudinal edges of the tapered portion 3 as illustrated in Fig. 1.

The transverse edge 7 of the wider end of the blank is developed to properly meet conditions and characteristics of the stock and equipment employed in its formation, and in the present instance is provided with a pair of spaced notches 8 which define between them in a direction longitudinally of the blank, a portion which subsequently forms up into substantially one-half of the tubular section. Between these two notches, the enlarged end is developed into a longitudinally projecting extension 9 for the purpose of equalizing the length of the arms constituting the forked gear housing portion during its subsequent formation. This developed extension 9 is desirable when certain types of welded stock are employed, but obviously may be eliminated or reduced in dimensions when other types of stock are used. Its general purpose may therefore be said to compensate for the greater displacement or flow of metal which occurs in the unwelded portions of the housing. In the body of the enlarged end of the blank, in longitudinal alignment with the notches 8 are a pair of openings 10 which have their inner ends located approximately in a plane at the juncture of the tapered portion with the enlarged end 2. Preferably, these openings are sector or pear-shaped, each with its longitudinal edges converging in a longitudinal direction toward its respective notch 8. The larger ends of the openings are preferably arcuate in contour for the purpose of preventing checking or cracking of the metal when the arms of the gear housing portion are spread apart as will be subsequently described. While these openings are illustrated as terminating short of their respective notches 8, it is obvious that they may extend all the way to meet the notches either in the form of a slot or a mere slit but it is preferable that they terminate short of the notches in the flat blanks whereby the bending of the blank into tubular form will be better controlled. In fact, it is not necessary that these openings 10 be punched while the blank is in the flat as provisions for them may be made after the blank has been formed into tubular section. By reason of the blanks having one end enlarged, rather than the mid-section as has been the practice heretofore, it is possible that these blanks may be closely nested in the blanking operation from sheet or plate, thereby resulting in a saving of material.

In order to bring the flat blanks into a tubular section, the longitudinal margins 12 thereof, are flanged longitudinally to impart to the blank substantially channel formation, as shown in Figs. 3 and 4. This channel shaped blank is then further formed along longitudinal lines into substantially tubular section with the longitudinal edges 13 of the blanks in parallel substantially contiguous relationship as shown in Figs. 5 and 6 so that upon slight further formation of the section, the longitudinal edges are brought into abutment or a substantial abutment to be welded along a longitudinal line 14, which is disposed normal to the plane of the openings 10 which are now disposed at diametrically opposite points in the tubular section. Due to the configuration of the blanks and the forming operations, the smaller end 1 of the blank is brought to circular cross-section whereas the enlarged end 16 is developed into an enlarged end 16 substantially oval or elliptical in cross section. The intermediate portion 17 obviously assumes tubular formation flaring outwardly from the portion 15 into the enlarged oval end 16. According to this process, it may be begun from the flat blank shown in Fig. 1 or the process may start with

the tubular section shown in Fig. 7, either perforated as at 10 or not.

With the product in the tubular form as shown at Fig. 7, the enlarged end 16 is slit or slotted at diametrically opposite points along a line or lines extending from the notches 8 into the openings 10. When slit, these slits extend from the apex of the openings 10 to the medial portions of the notches 8 but it is preferable to actually slot the enlarged end as shown in Fig. 9 with the longitudinal edges of the slot either parallel or preferably slightly converging toward the enlarged free end of the tubular section whereby the arms 19 and 20 formed from the enlarged end by the slitting or slotting thereof are slightly wider at their outer free ends than at the portions adjacent the inner ends of the slots. This provides the free ends of the arms with sufficient material to cause the flanges thereof to be of substantially uniform width throughout after the arms are spread apart and bent into arcuate formation. In Fig. 9 it will be noted that the arm 20 of the bifurcated enlarged end is longer than its complementary arm 19 and is arranged in the portion of the tube opposite the welded seam 14. This elongation is of course due to the provision of the extension 9 in the blank. Its purpose is to provide for equalization in the arm length during the time the arms 19 and 20 are spread apart and bent into arcuate shape, this equalization being due to the fact that the usual non-ductile form of welded seam does not permit as ready a flow or displacement of the metal as occurs in the portions which are not welded, namely the arm 20 during the spreading and forming operations. As a result, during these operations, the metal of the arm 20 is displaced inwardly toward the tapered portion to impart additional strength thereto as the arms are being separated and bent into arcuate formation shown in Fig. 13.

The next step in the method consists of subjecting the tubular section shown in Fig. 9 to the action of dies as explained in the Riemenschneider co-pending application Serial No. 595,532, filed February 27th, 1932, to spread the two arms 19 and 20 apart and to give them preliminary channel-shaped cross section as indicated by the numeral 21 of Fig. 12. It will be particularly noted that the arms are separated to an extent causing them to assume substantially the same inclination as the tapered portions 17 and thereby form the product into substantially Y-shape. This is done for the purpose of preventing any material displacement of metal in the two arms to obviate thinning of wall thickness thereof when the arms are undergoing the final bending and shaping operation to bring them to the form shown in Fig. 13, and is due to the fact that the male die employed in the Riemenschneider copending application for bringing the product to the shape shown in Fig. 13, does not begin to engage the arms 19 and 20 until it practically bottoms. This action rather defers the final arcuate shaping of the arms and minimizes any possibility of serious displacement of the metal as practically all of the arcuate formation is imparted to the arms in the final stages of movement of the male die. A slight stretching of the metal in the web portion 22 may occur during the spreading and bending operation but this does not affect the final product inasmuch as the arcuate edges 23 of the flanges 24 are subsequently trimmed off along the dotted line 25. Likewise, the ends of the two arms 19 and 20 are trimmed to remove any inequalities of length and to prepare the same for a butt-welding operation which unites the arms of one section to the arms of a similar section in longitudinal alignment as shown in Fig. 17. The forming operations may or may not be used in simultaneously making the arcuate arms of the gear housing portion slightly wider than the intermediate tapered portion 17, and in the event of the widening of the arms being adopted, this provision will cause the wider arms to taper and merge as at 26 into the intermediate portions to reinforce the same. The merging of the tubular intermediate portion 17 into the more or less flat arms creates slight arched portions 27 on the top and bottom of the housing to gradually merge into the arms for further reinforcement thereof.

In order to provide the axle housing sections with means for locating the attachment of brake apron flange and bearing ring retainer units, the smaller tubular end 15 of each axle housing section at any desired stage of the method, may have its tubular end 15 reduced in diameter as at 28 and provides the tubular end 15 with internal and external shoulders, the latter being indicated by the numeral 29, to which brake apron flange to be presently described, is united.

After the formation of two sections such as shown in Fig. 15, they are placed in longitudinal alignment shown in Fig. 17 with the sheared ends of arms 19 and 20 of complementary sections arranged in edge to edge abutment and welded across the arms and flanges as indicated by the numeral 29. This union is preferably made by butt-welding the edges together although other forms of attachment may be employed.

Upon union of the two axle housing sections, the unitary structure is placed in a jig for the simultaneous location and tacking of a pair of units shown in Fig. 19 to the shouldered ends of the housing. These units are combined brake apron flanges and bearing ring retainers comprising a collar 30 having an annular outwardly extending flange 31, to the inner curve of which is fastened as at 32, preferably by welding a ring 33, the outer flange 34 of which constitutes the bearing ring retainer. The joint between the ring and collar forms an internal shoulder which is adapted to be secured to the external shoulder 29 of the reduced end of a housing. After the housing has been placed in a rotatable jig with the two units 30, tacked or spot-welded on the ends of the housing at the shoulders 29, two circumferential welds are made simultaneously, one between the shoulder 32 and the shoulder 29 at one end of the housing, and the other between the end of the collar 30 and the housing at point 35 at the other end of the housing. The housing is then turned end for end and welded in the above manner so that both units 30 are welded inside and outside to the ends of the housing. Instead of welding the collar units on the housing, they of course may be riveted if desired or secured in their place with any other suitable means.

In the modification of invention shown in Figs. 21 to 32 inclusive, the rear axle housing is formed, with the exception of the bearing ring retainer and brake apron flange, in exactly the same manner as described hereinbefore and corresponding numerals have been employed to designate corresponding parts in the two modifications. Instead of forming the brake apron flange as a separate unit, it may be formed integrally on each end of the housing at any stage in the method but preferably after the blank has been

formed into tubular section as shown in Fig. 7. This combined brake apron flange and bearing ring retainer is preferably formed by first upsetting the tubular end 15 of each axle section to increase its wall thickness, after which it is enlarged in diameter to form a bearing ring retaining shoulder 36 after which the outer end is turned into an outwardly extending annular flange 37 of considerable wall thickness.

From an inspection of Fig. 7 of the drawings, it will be apparent that the enlarged end 16 of the tubular section is approximately twice the diameter in one direction of that of the smaller tubular end 15 and therefore possesses sufficient metal to be formed into the largest possible size gear housing portion without danger of the wall thickness of this portion being reduced in subsequent forming operations. It is preferred to unite the two tubular sections together to form a complete axle housing with the welded seam of each disposed to meet one another in longitudinal alignment, but if desired for any reason, it is possible that the sections may be reversed relative to each other so as to dispose the welded seam of one on top of the housing and the welded seam of the other section at the bottom of the housing. It is also possible that it may be desired to expand the enlarged end to a larger diameter than provided by the blank and this is permissible due to the fact that the section can be operated upon from one end.

It is to be understood that various changes in the sequence of steps of this method may be varied to meet different conditions or to form other articles, some steps of the method may be entirely eliminated or the construction of the blank may be altered without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. The method of forming axle housings consisting of providing a flat blank, forming the same into a tubular section having one end larger than the other and of substantially oval cross section, bifurcating said larger end along its minor diameter to divide it into a pair of channel-shaped arms, spreading said arms apart and bending them to arcuate shape, and uniting a pair of such similar sections in longitudinal alignment.

2. The method of forming axle housings consisting of providing a flat blank, forming the same into a tubular section having one end larger than the other and of substantially oval cross section, bifurcating said larger end to divide it into a pair of channel-shaped arms, spreading said arms apart to form a substantially Y-shaped member with substantially straight diverging arms, exerting bending pressure on said arms adjacent their inner ends to form them into arcuate shape, and uniting a pair of such similar sections in longitudinal alignment.

3. The method of forming axle housings consisting of providing a flat blank having one end wider than the other and a tapered intermediate portion, forming said blank into a tubular section having its larger end substantially oval in section and its smaller end substantially circular in section, welding together the longitudinal edges of the blank, slotting said enlarged end from its free end to divide the enlarged end into a pair of substantially channel arms, spreading and bending said arms into arcuate contour and uniting a pair of such similar sections in longitudinal alignment.

4. The method of making axle housings consisting of providing a flat blank having one end wider than the other and a tapered intermediate portion, said wider end having a pair of openings disposed upon opposite sides of its longitudinal center, forming said blank into a tubular section having its larger end substantially oval in section and its smaller end substantially circular in section, welding together the longitudinal edges of the blank, slotting said enlarged end from its free end into said openings to divide the enlarged end into a pair of channel arms, spreading and bending said arms into arcuate contour, and uniting a pair of similar sections in longitudinal alignment.

5. The method of making axle housings consisting of providing a flat blank having one end wider than the other and a tapered intermediate portion, said wider end having a pair of openings disposed upon opposite sides of its longitudinal center, forming said blank into a tubular section having its larger end substantially oval in section and its smaller end substantially circular in section, welding together the longitudinal edges of the blanks, slotting said enlarged end from its free end into said opening to divide said end into a pair of substantially channel-shaped arms, spreading said arms to substantially Y-formation, forming said arms into arcuate shape to conjointly form a semi-circular enlarged forked end, and uniting the ends of the arms of a pair of similar sections in longitudinal alignment.

6. The method of making axle housings, the steps which consist in forming a blank with substantially rectangular ends, connected by a tapered intermediate portion, one of said ends being substantially wider than the other, forming said blank into tubular form with the wider end formed into substantially oval section, slotting said wider end at diametrically opposite points to divide the same into a pair of arms, and spreading said arms apart and bending them into arcuate shape.

7. In a method of making axle housings, the steps which consist in forming a blank with substantially rectangular ends of different relative size connected by a tapered intermediate portion, simultaneously providing said blank with a pair of spaced openings in the larger end, forming said blank into tubular form with the wider end formed into substantially oval section with the openings diametrically disposed, slitting said larger end from the openings out to the free end of the tube to divide the same into a pair of channel arms, and spreading said arms apart and bending them into arcuate shape.

8. The method of making axle housings consisting of blanking out a flat blank having one end wider than the other and an intermediate tapered portion, said wider end having a pair of spaced openings and the transverse edge of said wider end having an extension, forming said blank into tubular form with the longitudinal edges of the blank substantially contiguous, welding said edges together, one-half of the larger end opposite the weld projecting beyond the other half, dividing said larger end in half to form a pair of arms, one of which is longer than the other, spreading said arms apart and bending them into arcuate shape whereby the arms approximate each other in length, trimming the ends of said arms, and uniting the arms of one section to the

arms of a similar section arranged in longitudinal alignment therewith.

9. A method of making axle housings consisting of providing a tubular section having a longitudinal welded seam and one end larger than the other, one half of the larger end being longer than the half possessing the welded seam, dividing said larger end in half to form a pair of arms one of which is longer than the other, spreading said arms apart and bending them into arcuate shape whereby the arms approximate each other in length, and uniting the arms of two similar sections arranged in longitudinal alignment.

10. The method of forming axle housings consisting of providing a tubular section having one end larger than the other and of substantially oval cross section, bifurcating the larger end to divide it into a pair of substantially channel-shaped arms, spreading said arms apart and bending them into arcuate shape, and uniting the ends of the arms of one section to the ends of the arms of a similar section in longitudinal alignment by butt-welding.

11. The method of forming axle housings consisting of providing a tubular section having one end larger than the other, with an intermediate tapered portion, said larger end being of substantially oval cross section, bifurcating the larger end from its free end to a point adjacent the juncture of the tapered portion and larger end to divide it into a pair of substantially channel-shaped arms, the inner end of said bifurcation being arcuate to control the movement of the metal, spreading said arms apart and bending them to arcuate shape, and uniting the ends of the arms of one section to the ends of the arms of a similar section in longitudinal alignment.

12. The method of forming axle housings consisting of providing a tubular section having one end larger than the other, longitudinally slotting said larger end to divide it into a pair of substantially channel-shaped arms, the longitudinal edges of the slots converging toward the free end of the tube whereby the channel-shaped arms gradually increase in depth toward their free ends, spreading the arms apart and bending them into arcuate shape thereby rendering the arms of substantially uniform depth throughout their length and uniting the ends of the arms of one section to the ends of the arms of a similar section in longitudinal alignment.

13. A blank for the formation of an axle housing section comprising a flat body having one end of greater width than the remainder of the blank, said wider end having a pair of spaced openings adjacent the longitudinal edges thereof, and a longitudinally projecting extension from its transverse edge, and said blank being adapted to be formed along longitudinal lines into tubular shape to have its longitudinal edges welded together.

14. A blank for the formation of an axle housing section comprising a flat body and having one end of greater width than the remainder of the blank, the intermediate portion of the body having its longitudinal edges converging into the end of lesser width, said wider end having the middle of its transverse edge provided with a longitudinally projecting extension and said blank being adapted to be formed along longitudinal lines into tubular shape to have its longitudinal edges welded together.

15. A blank for the formation of axle housing sections comprising a flat body having one end of greater width than the remainder of the blank, said wider end having a pair of openings extending longitudinally of the blank toward the transverse edge of the wider end of the blank, and said transverse edge having a longitudinally projecting extension, said blank being adapted to be formed along longitudinal lines into tubular shape to have its longitudinal edges welded together.

16. The method of forming a metallic article consisting of providing a flat blank, forming the same to tubular section having one end substantially oval section and larger than the other substantially circular end, bifurcating said larger end across its minor axis to divide it into a pair of channel-shaped arms, and spreading said arms apart.

17. A blank for the formation of an axle housing section comprising a flat blank having one end of greater width than the remainder of the blank, said wider end having a pair of spaced openings arranged to be diametrically aligned by the blank being bent along longitudinal lines to form the blank into tubular form for its longitudinal edges to be welded together to provide a tubular structure.

18. A blank for the formation of an axle housing section comprising a flat blank having one end of greater width than the remainder of the blank, said wider end having a pair of spaced openings arranged to be diametrically aligned by the blank being bent along longitudinal lines to form the blank into tubular form for its longitudinal edges to be welded together to provide a tubular structure, having its smaller end of substantially circular section and its larger end of substantially oval section.

19. An axle housing section formed from a flat blank having one end of greater width than the remainder of the blank, said wider end having a pair of spaced perforations spaced from the wider transverse edge of the blank and arranged to be diametricaly aligned by the blank being bent along longitudinal lines to form it into tubular form for its longitudinal edges to be welded together to thereby provide the larger end of the tubular form with demarcations for continuing the perforations to the wider transverse edge of the tubular form whereby that wider end is provided with a pair of spaced substantially channel-shaped arms.

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WILLIAM BURT SMITH.