Jan. 13, 1953 R. R. CUDY 2,625,055

AXLE HOUSING

Filed March 2, 1948 2 SHEETS—SHEET 1

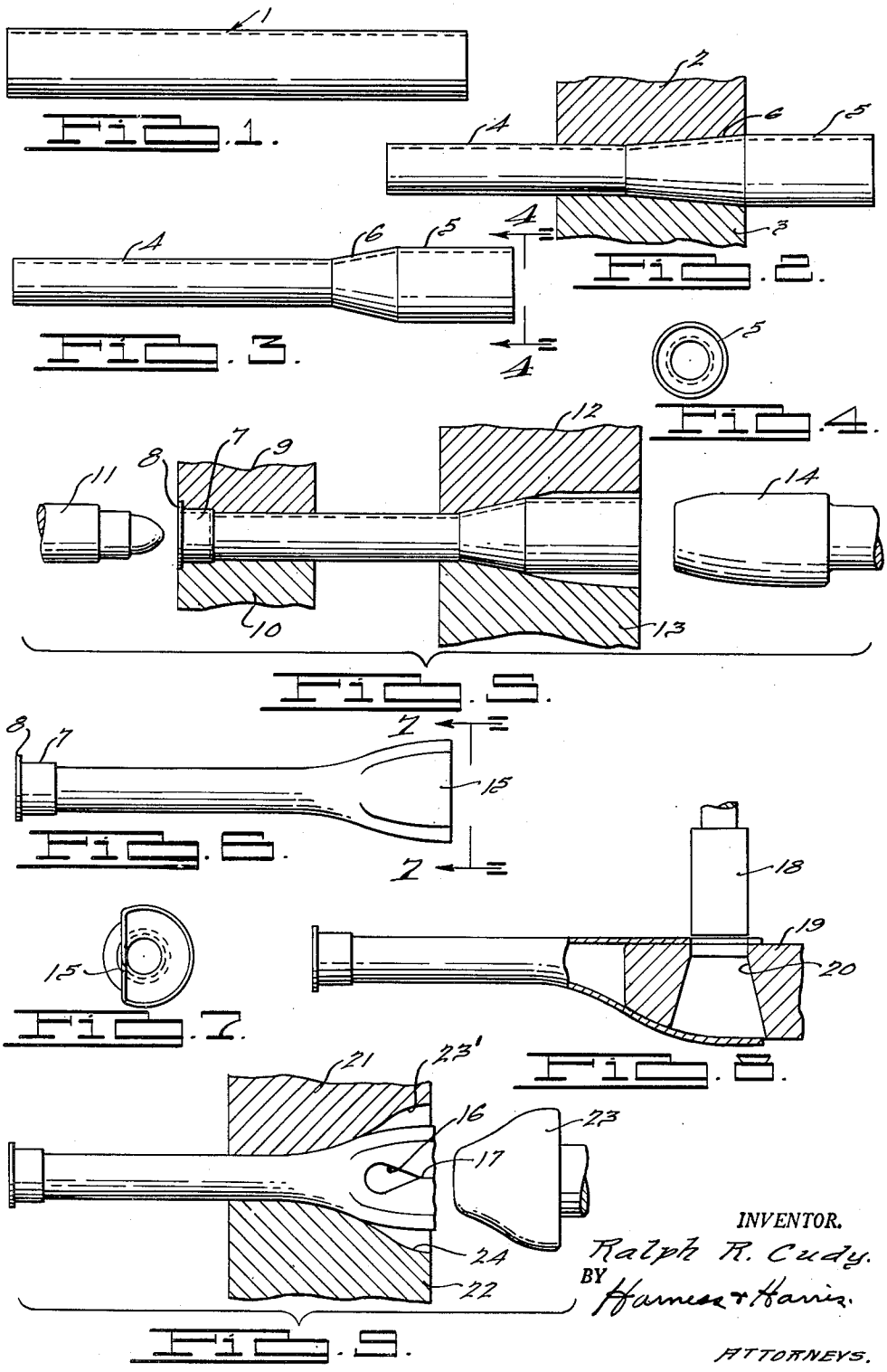


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

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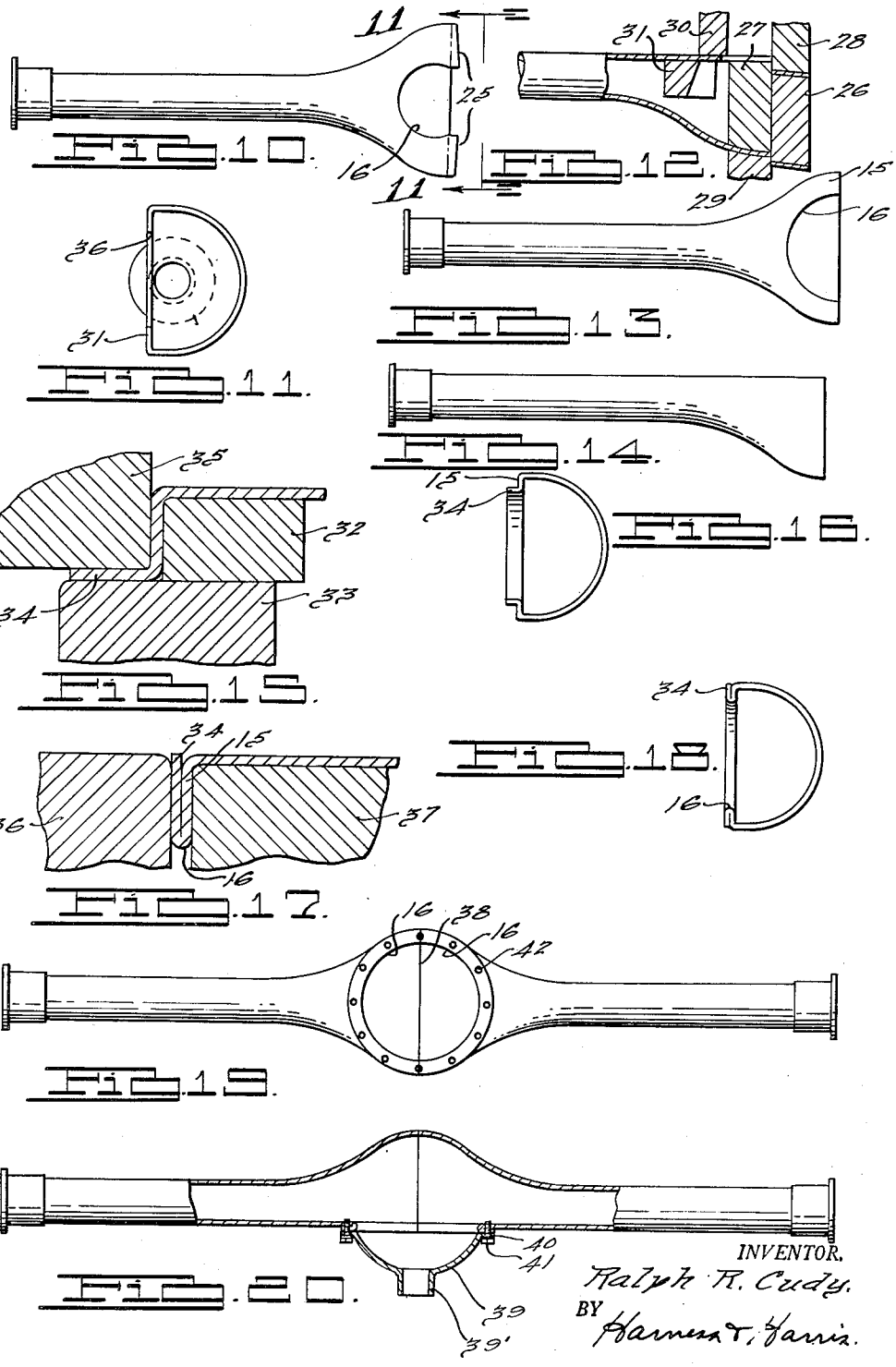


FIG. 10.

FIG. 12.

FIG. 13.

FIG. 11.

FIG. 14.

FIG. 16.

FIG. 15.

FIG. 18.

FIG. 17.

FIG. 19.

FIG. 20.

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AXLE HOUSING

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1 Claim. (Cl. 74—607)

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This invention relates to an improved axle housing.

More particularly, the invention pertains to an improved housing for the differential and driving axles of a motor vehicle.

One of the main objects of the invention is to provide an axle housing of this character which has a main body portion that consists of two integral sections having a single seam therebetween.

Another object of the invention is to provide a two-section axle housing body portion which has a seam located at substantially the largest transverse section thereof.

A further object of the invention is to provide an axle housing of this kind in which the wall thickness is reduced at those sections which are of largest peripheral dimensions.

Another object of the invention is to provide an improved axle housing body portion which comprises two abutting welded together sections having integral portions joined together and extending across the central part of the housing to take the place of one of the separate cap structures heretofore conventionally employed in axle housings of this kind.

An illustrative embodiment of the invention is shown in the accompanying drawings, in which:

Fig. 1 is a side elevational view of a piece of tubular stock from which one of a pair of identical complementary axle housing sections may be formed in accordance with my invention.

Fig. 2 is a sectional view of a forming die illustrating an initial forming operation upon a piece of tubular stock by which an end and intermediate portions of the stock are reduced in diameter.

Fig. 3 is a side elevational view showing the stock in a further stage of formation as it appears following the operations illustrated in Fig. 2.

Fig. 4 is an end view of the stock shown in Fig. 3 taken on the line 4—4.

Fig. 5 is a side elevational view, partly in section, of dies for forming the reduced end of the stock to substantially its final shape and for initially expanding the opposite end of the stock.

Fig. 6 is a side elevational view showing the piece of stock in the form to which it is shaped by the die forming operations shown in Fig. 5.

Fig. 7 is an end view of the piece of stock shown in Fig. 6 taken on the line 7—7.

Fig. 8 is a plan view, partly in section, of the partially formed half axle housing blank showing a punching operation which is performed on

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it following the die forming operations illustrated in Fig. 5.

Fig. 9 is the side elevational view, partly in section, of a pair of dies for expanding the punched end portion of the blank and showing a blank in position to receive this expanding die about to perform operation.

Fig. 10 is a side elevational view of an axle housing blank which is mainly completely formed and ready to be trimmed for length.

Fig. 11 is an end view of the blank shown in Fig. 10 taken on the line 11—11 of Fig. 10.

Fig. 12 is a sectional view of a set of trimming dies and showing a trimming operation being performed on the blank illustrated in Fig. 10.

Fig. 13 is a side elevational view similar to Fig. 10, but showing the half axle housing section trimmed for length.

Fig. 14 is a plan view of the structure shown in Fig. 13.

Fig. 15 is a fragmentary sectional view diagrammatically illustrating a forming operation and dies by which the marginal portions of the metal surrounding an opening in one side of the blank is initially formed toward a double thickness state.

Fig. 16 is an end view of the half axle housing construction shown in Fig. 14 showing the results of the operation illustrated in Fig. 15.

Fig. 17 is a fragmentary sectional view diagrammatically showing an operation and dies by which adjacent marginal portions surrounding the opening are brought into superimposed relation to form a flange of double thickness.

Fig. 18 is an end view similar to that shown in Fig. 15, but illustrating the metal around the opening of the bell shaped end shaped to its final form.

Fig. 19 is a side elevational view of two completed half axle housing sections welded together in abutting end to end relationship.

Fig. 20 is a plan view, partially in section, of the housing assembly shown in Fig. 19.

In Fig. 1 of the drawings is illustrated a piece of tubular stock, generally designated by the numeral 1, from which one of the two identical sections of the body portion of the improved axle housing is formed. The tubular stock which is first subjected to a die forming operation by the die members 2 and 3 by which one end portion 4 of the stock is reduced in diameter, the other end portion 5 being allowed to remain of its initial diameter. In this operation a frusto-conical intermediate portion 6 is formed between the small and large end portions 4 and 5, respec-

tively. The reduction of the end portion 4 and the formation of the conical intermediate section 6 may be affected in any conventional manner, such as by forcing the tubular stock endwise through die members having appropriate passages for forming the tube. This operation may be performed in a single step or in a series of step of which Fig. 2 represents only one. The final step of forming operation illustrated in Fig. 2 brings the tubular stock 1 to the contour and relative dimension illustrated in Fig. 3 in which it will be seen that the reduced end portion 4 extends throughout more than one half the length of the blank illustrated in Fig. 3. The relative length of the reduced and enlarged end sections 4 and 5, respectively, and the intermediate section 6 may vary depending upon the proportions of the respective parts of the final axle housing to be ultimately formed of the blank.

After the tubular stock 1 has been brought to the form shown in Figs. 3 and 4, it is then subjected to another forming operation which may comprise one or more steps by which the extremity of the reduced end portion is enlarged to provide a bearing receiving chamber 7. In this operation, there is also provided a radial flange on the free extremities of the reduced end section 4. The operation performed on the free extremities of the end section 4 of the blank shown on Fig. 3 may be produced by companion die members 9 and 10 and a punch type of die member 11 or in any other conventional manner.

After formation of the chamber 7 and radial flange 8 on the left end portion of the blank, as illustrated in Fig. 5, the tapered intermediate section 6 and large end portion 5 of the blank are formed to the contour illustrated in Figs. 6 and 7 by companion die members 12 and 13 and a male die member 14. Cavities of the companion die members 12 and 13 and the male die member 14 are so contoured as to provide a flat side 15 on the left side portion of the blank which extends from the right extremity of the blank completely throughout the large end portion 5 thereof and throughout its intermediate frusto-conical section 6. This flat side 15 lies in a plane substantially parallel to the longitudinal axis of the reduced section 4 of the blank and, as shown in Fig. 8, it is substantially axially aligned with the wall of the reduced end portion at the longitudinal central section of the blank. During the formation of the flat side wall 15, the remaining portions of the large end portion 5 and intermediate section 6 of the blank are held to curvilineal contour as illustrated in Fig. 7 although the curvature may vary somewhat from true circular curvature toward elliptical formation. The transformation of the right end portion of the blank from the contour shown in Figs. 3 and 4 to that illustrated in Figs. 6 and 7 may be affected by a single step or the operation may require a plurality of successive steps each producing gradually increasing departure from the contour shown in Figs. 3 and 4 to that shown in Figs. 6 and 7, depending upon the wall thickness of the blank and the characteristics of the metal of which it is formed.

The flat side 15 is punched in the manner illustrated in Fig. 8 to produce a teardrop shaped opening 16 therein. The tail portion of teardrop opening 16 merges with a split 17 which extends through the right extremity of the flat wall. The punching operation may be performed in any suitable manner such as by punch mechanism comprising a male punch member 18 and a mandrel 19, receivable in the right end portion of the blank and which is provided with a suitable opening 20 for accommodating the male punch member 18 and the section of metal of the flat wall 15 which is removed therefrom.

Following the punching operation illustrated in Fig. 8, the entire end portion of the blank is further expanded and this expansion is readily accommodated by the aperture and split 16 and 17 respectively which are provided by the aforementioned punching operation. In this expanding operation, the right end portion of the blank is engaged by suitable die members 21 and 22 as illustrated in Fig. 9 and the male die member 23 is inserted in the open right extremity of blank as illustrated in this figure. The cavities 23' and 24 of the companion die sections 21 and 22, respectively, and the male die member 23 are so shaped as to spread the split 17 and opening 16 and to bring the right end portion of the blank to the scoop-like contour illustrated in Figs. 10 and 11. The flat side of the enlarged end portion of the blank is preserved in flat condition and the remaining perimeter of this enlarged end portion is held to a curvilineal contour of desired shape and curvature.

As a result of the work performed on the right end portion of the blank, its right extremity becomes somewhat ragged and, in order to remove any irregularities present at this location, marginal portions 25, indicated by dotted lines in Fig. 10, are cut off by the cutting operation illustrated in Fig. 12. This may be accomplished in any suitable manner such as by providing two relatively shiftable mandrel sections 26 and 27 in the interior of the right end portion of the blank and a cooperating cutting blank member 28 which shifts the mandrel section 26 during a shearing operation, while the main body portion of the blank is suitably supported on an enveloping rest 29, thereby shearing off the marginal portions 25 to produce a regular and square extremity. Following the squaring of the right extremity of the blank, the aperture 16 thereof is enlarged by a punch 30 which operates in opposition to a suitable support 31 provided in the interior of the blank. This punching operation brings the aperture 16 to substantially semicircular shape, as illustrated in Fig. 13. Following the above-mentioned punching and shearing operations, the blank is in the shape and condition illustrated in Figs. 13 and 14.

The next operation performed upon the blank consists in bringing the marginal portions of the flat wall 15 surrounding the opening 16 therein into outwardly overlapping relationships with respect to the adjacent part of the flat wall. This is accomplished, as illustrated in Fig. 15, by inserting a pair of inner and outer die members 32 and 33 through the open right extremity of the blank in order to engage them adjacent the inner surface of the flat wall portion which surrounds the opening 16. The inner die member 33 is then shifted outwardly with respect to the opening, that is, leftwardly, as viewed in Fig. 15, to bend a flange 34 which comprises marginal portions of the flat wall surrounding the opening 15 outwardly to a substantially parallel relation to the axis of the opening 16. This is accomplished by providing a die member 35 adjacent the portions of the flat wall 15 which it is desired to retain in an undisturbed condition. The above described operation produces a flange 34 extending at substantially right angles to the

flat wall portion 15 of the blank, as illustrated in Fig. 16.

The flange 34 is thereafter rolled outwardly toward a parallel relation to the flat wall 15 by a conventional forming operation, and it is finally pressed into superimposed relation upon the flat wall 15 by die members 36 and 37, as illustrated in Fig. 17. This operation provides a rim, shown in Fig. 18, of double wall thickness surrounding the opening 16.

A pair of axle housing sections formed in the above described manner are brought together in axial alignment with each other, with the extremities of their enlarged ends preferably in abutting relationships, and these two axle housing sections are welded together at their abutting adjacent extremities, as illustrated at 38 in Fig. 19. The weld extends throughout the entire perimeter of the abutting extremities of the axle housing sections and it is, therefore, provided at the zone of maximum transverse cross section of the axle housing. The main body portion of the axle housing thus consists of two integral sections joined by a single welded seam which is located at a zone of the axle housing of maximum outer dimension, thus providing structural rigidity at the joined portions of the axle housing sections.

By uniting together two axle housing sections in the above manner, a comparatively flat wall is provided on one side of the structure at its intermediate portion in which is formed a circular opening surrounded by a marginal portion of double wall thickness. Opposite the circular opening, provided by the semi-circular openings 16 at the respective axle housing sections, is a lobe shaped wall which provides the banjo portion of the axle housing. A cap or cover 39 having a tubular sleeve 39' for receiving a propeller shaft (not shown) is provided on the flat wall portion of the axle housing over the circular opening therein. This cap has a radial flange 40 which seats upon the flanges 34 of the axle housing sections, and the cap is removably mounted on the main body portion of the axle housing by bolts 41 threaded in aperture 42 provided in the rim of the double wall thickness which surrounds the opening.

Since the main body portion of the axle housing comprises only two sections, each of which is entirely integral, and which are secured together by a single continuous welded seam, the possibility of leakage of the housing contained lubricant is greatly reduced and waste of metal is avoided. Any reduction of wall thickness in the structure resulting from expansion of localized portion of tubular stock from which it

is formed occurs at various sections of the housing which are sufficiently large to compensate for the strength decreasing effect of such wall thickness reduction.

Although but one embodiment of the invention is herein shown and described, it will be understood that various changes in the details of construction materials and sequence of operations and steps employed may be made without departing from the spirit of the invention.

I claim:

An axle housing including a bowl-like body portion having oppositely disposed tubular arm portions projecting outwardly from the body portion, said housing comprising two complementary, integrally connected, axially aligned, sections with each section being formed from a single piece of tubular stock and having tubular outer end portions and adjacent, enlarged, scoop-like, inner end portions, each enlarged inner scoop-like end portion having an open end extending in a plane substantially perpendicular to the longitudinal axis of said housing and a flat side that extends in a plane substantially perpendicular to the plane of said open end, the flat side of each scoop-like inner end portion having a semi-circular opening therein with the material of the section around the periphery of the opening reversely bent upon itself to provide a peripheral flange of double thickness and each of said enlarged inner end portions also including a side wall of substantially fragmentary spherical contour located opposite said flat side, and a single welded seam joining the adjacent open ends of the enlarged inner end portions of the two axle housing sections.

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