Sept. 15, 1931. E. C. MOGFORD ET AL 1,823,158

AXLE AND METHOD OF MAKING THE SAME

Original Filed May 15, 1929

Fig. 1.

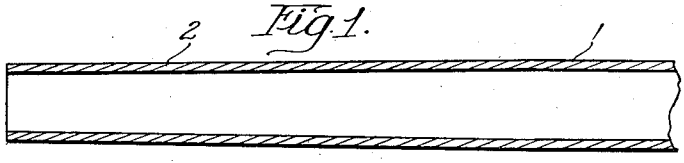


Fig. 2.

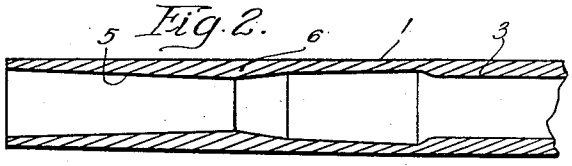


Fig. 4.

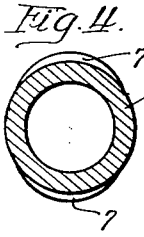


Fig. 3.

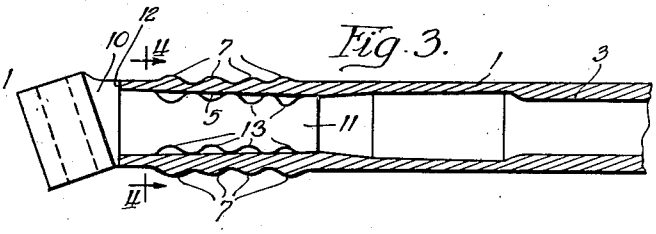


Fig. 6.

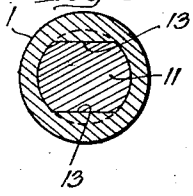


Fig. 5.

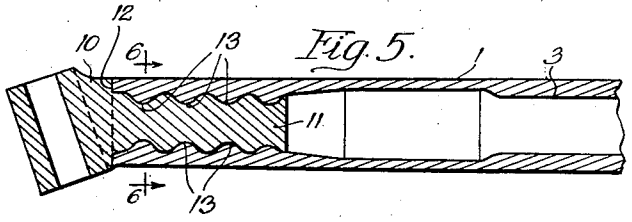
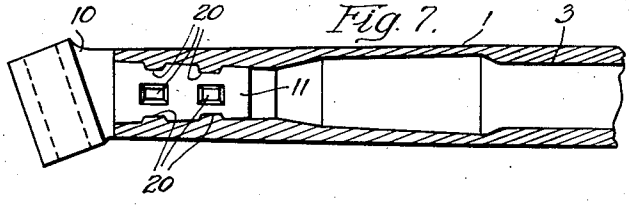


Fig. 7.



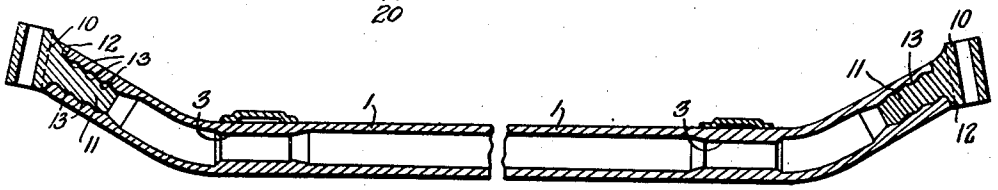


Fig. 8.

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UNITED STATES PATENT OFFICE

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AXLE AND METHOD OF MAKING THE SAME

Original application filed May 15, 1929, Serial No. 363,362. Divided and this application filed May 10, 1930. Serial No. 451,229.

Our invention relates to tubular front axles for automobiles and the like and to the method of making the same.

This application is a division of our co-pending application Serial No. 363,362, filed May 15, 1929, and discloses a tubular axle of the reverse Elliott type. However, the method of constructing axles disclosed in this invention is not limited to the construction of axles of this particular type.

Forged axles are known and have been accepted in automotive construction. Tubular axles of the Elliot type are also known. In such known tubular axles the end yoke and spring pad are forged from solid metal and the scrapping of considerable metal is entailed in the process of machining. This is avoided in our method of construction as the spring pads are of pressed steel and the knuckles in the end of the tubing can be forged very nearly to the size required with much less work or machining and less waste of metal.

Our method of constructing axles may also be employed in axles of the Elliott type and constitutes an improvement over devices of the prior art.

In such tubular axles of the prior art the tubing is of the same section from end to end whereas in the axle made in accordance with the teachings of our invention the arms are upset from a region under the spring pads to the outer ends thus strengthening and stiffening the axles where the maximum bending movement occurs.

As compared with an axle of the same strength, an axle made in accordance with the teachings of our invention is much lighter than an axle of either the solid forged type or prior known tubular axles, for example, the particular embodiment herein shown is at least twelve pounds lighter than a corresponding size of forged axle. This saving in unsprung weight is, of course, a great advantage as is well known to those skilled in the art.

In carrying out our invention, we upset the ends of a tubular blank by endwise forging to give the desired strength to the arm under the spring pads and the part of the arm extending outwardly towards the wheels. In forming this latter part of the arm, we also upset protuberances of metal on the outside surface of the blank on its top and bottom sides. Forged knuckle pieces having circular shanks containing transverse slots are inserted in the ends of the tube and held therein by forging the metal from these proturberances into the transverse slots, this operation keying the knuckle piece against movement longitudinally of the axle and also against movement about the axis of the axle.

The axle is then formed to shape and spring pads are welded in place on it. The spring pads are preferably made of sheet metal stampings although for certain purposes forgings may be used.

Now in order to acquaint those skilled in the art with the manner of constructing an axle in accordance with the teachings of our invention, we shall describe in conjunction with the accompanying drawings a specific embodiment of the invention.

In the drawings:

Figure 1 is a cross-sectional view of the blank from which the axle is made;

Figure 2 is a cross-sectional view of the blank after it has been upset by endwise forging;

Figure 3 is a similar view showing the protuberances upset into the walls of the blank and showing the knuckle piece inserted in it;

Figure 4 is a cross-sectional view taken along the line 4—4 of Figure 3 showing the position of the protuberances on the blank;

Figure 5 is a cross-sectional view similar to Figure 3 showing the blank after the protuberances have been forged into the slots in the knuckle piece;

Figure 6 is a cross-sectional view taken along the line 6—6 of Figure 5;

Figure 7 is a cross-sectional view through a similar axle showing a slightly different method of attaching the knuckle piece to the blank; and

Figure 8 is a cross sectional view through a completed axle.

Referring now to the drawings in more detail, the blank 1 from which the axle is made comprises a piece of seamless or welded steel tubing having an outside diameter and a wall thickness dependent upon the size of the particular axle being made. In one embodiment, the tube 1 has an outside diameter of 2¼ inches and a wall thickness of $\frac{3}{16}$ inch, the length of the tube being approximately 60 inches. The lengthwise dimension of the tube will of course vary with the particular type of axle being made.

In fabricating an axle from the blank 1 the end of the tube is first swaged down as by rolling to taper the outer end 2 as indicated in Figure 1. This results in a slight elongation of the blank and a slight thickening of the walls of the outer ends which later form the arms of the axle. This rolling down is preferably accomplished at each end either simultaneously or individually and is preferably done hot. The tube is then brought to a proper forging heat and is upset endwise to thicken the walls about the entire periphery of the part which is upset, at a point 3 within the space where a spring seat is later attached.

At the same time or by subsequent operation, the upsetting of the outer end to form a socket 5 is accomplished, the inside diameter of the socket being held to a definite shape by a mandrel and the maximum wall thickness of the tubular blank being produced just back of the socket as indicated at 6 in Figure 2.

Simultaneously with the forming of the socket 5 and thickening of the walls at the end of the tube, we form external protuberances 7 in the top and bottom surfaces of the blank, these protuberances being crescent shaped and formed from metal upset during the endwise forging and consequent shortening of the blank.

The socket 5 is then reamed out to an accurate diameter to receive the shank of the knuckle piece of the axle.

The knuckle piece 10, illustrated as a knuckle piece of a reverse Elliott type axle, contains a circular shank 11 which is provided with transversely disposed round bottom slots 13 machined or forged into its top and bottom surfaces. The external surface of the shank 11 is machined to accurately fit into the socket 5 in the end of the blank. A shoulder 12 formed at the junction of the shank 11 and the knuckle piece 10 serves as an abutment for the end of the axle 1 thereby insuring that the knuckle piece will be properly inserted into the socket 5.

The protuberances 7 are forged into the transverse slots 13 in the shank 11 of the knuckle piece, this operation restoring the circular contour of the outside of the axle and securely locking the shank 11 into the axle against both endwise and rotary movement. The disposal of the metal from the protuberances on the top and bottom sides of the axle places it in a position where it has maximum value for increasing the moment of inertia in bending.

The operation of forcing the metal inwardly may be performed in a suitable two-part die engaging the top and bottom of the outside of the socket.

Instead of grooves or slots 13 across the top and bottom, the shank 11 of the knuckle piece 10 may be provided with a series of frusto-conical or frusto-pyramidal recesses 20 disposed about the periphery of the shank, as shown in Figure 7. Protuberances similar to the protuberances 7 of Figure 3 are formed in the walls of the blank by an endwise upsetting operation, and these protuberances are subsequently forged into the recesses 20 to lock the shank in place in the axle.

The end of the axle blank 1 and the shoulder 12 of the knuckle piece 10 may be welded if desired but if properly forged this welding is not necessary. The welded joint has the advantage that the inside of the axle is completely closed off from the outside and moisture cannot get into it and corrode the axle.

The same operations as herein described are performed on the other end of the axle, which is then heated and formed to the desired shape in any preferred manner such as by the process fully outlined in our copending application Serial No. 409,096, filed November 22, 1929. Spring seats, preferably of the type fully disclosed in our copending application Serial No. 409,095, filed November 22, 1929, are then attached to the axle by welding at the point 3 where the wall thickness of the tube has been increased as hereinbefore described.

Although the knuckle piece 10 is shown as for the reverse Elliott type axle, obviously knuckle pieces for an Elliott type axle or any other desired type of axle may be attached to the tubular member by the process herein pointed out within the teachings of our invention.

Tests made upon this axle indicate its superiority in performance as against axles of the prior art. The tubular shape of the body of the axle is highly desirable because of the maximum strength against bending in any direction and also because of its high torsional strength.

What we claim is:

1. In a method of forming a tubular axle, the following steps, viz., tapering the end portions of the tubular blank, upsetting said end portions to increase the wall thickness thereof and to form a tapered socket, upsetting said socket to throw metal outwardly while maintaining the tapered form of the socket, forming a knuckle piece with a

tapered shank, forming recesses in said shank, inserting the shank into the socket with the recesses in alignment with the outwardly projected metal of the socket and then pressing the outwardly projected metal of the socket inwardly to fill said recesses in the shank.

2. In a method of forming a tubular axle, the following steps, viz., upsetting the end of a tubular blank to form a conical socket, projecting the metal of the socket outwardly to form protuberances, forming a knuckle piece with a conical tapered shank and forming recesses in said shank, inserting the shank into the socket with the recesses in alignment with the protuberances and pressing said protuberances inwardly to throw metal into the recesses in the shank.

3. The method of joining a plug and socket which comprises upsetting the socket to draw metal outwardly, forming recesses in the plug, inserting the plug in the socket and pressing the metal of the socket inwardly to cause the same to flow into the recesses.

4. In a method of forming a tubular axle, the following steps, viz., tapering the end portions of the tubular blank, upsetting said end portions to increase the wall thickness thereof and to form a tapered socket, upsetting said socket to throw metal outwardly while maintaining the tapered form of the socket, reaming the tapered socket, forming a knuckle piece with a tapered shank, forming recesses in the shank, inserting the shank into the socket with the recesses in alignment with the outwardly projected metal of the socket and then pressing the outwardly projected metal of the socket inwardly to fill said recesses in the shank.

5. In a method of forming a tubular axle, the following steps, viz., upsetting the walls of a tubular blank to thicken them in the region of a spring seat, upsetting the end of the blank to thicken them and to form a tapered socket, projecting the metal of the socket outwardly by endwise upsetting to form protuberances on the top and bottom sides of the blank, forming a knuckle piece with a tapered shank, forming recesses in the top and bottom sides of the shank, inserting the shank into the socket with the recesses in alignment with the protuberances, pressing said protuberances inwardly to throw metal into the recesses in the shank, clamping the blank intermediate its ends and repeating the steps on its other end.

6. In a method of forming a tubular axle, the following steps, viz., rolling a taper in end of the blank, upsetting the walls endwise of the blank to thicken them adjacent said taper and about their entire periphery, upsetting the tapered end of the blank to form a tapered socket projecting the metal of the socket outwardly by endwise upsetting to form protuberances on the top and bottom sides of the blank, forming a knuckle piece with a tapered shank, forming recesses in the top and bottom sides of the shank, inserting the shank into the socket with the recesses in alignment with the protuberances, pressing said protuberances inwardly to throw metal into the recesses in the shank, clamping the blank intermediate its ends and repeating the steps on its other end.

7. In a method of forming a tubular axle, the following steps, viz., tapering the end portions of the tubular blank, upsetting said end portions to increase the wall thickness thereof and to form a tapered socket, upsetting said socket to throw metal outwardly while maintaining the tapered form of the socket, reaming the tapered socket, forming a knuckle piece with a tapered shank, forming recesses in the shank, inserting the shank into the socket with the recesses in alignment with the outwardly projected metal of the socket and then pressing the outwardly projected metal of the socket inwardly to fill said recesses in the shank and welding the ends of the tubular blank to the knuckle piece.

8. A tubular axle comprising a thin walled cylindrical central portion, thickened walled spring seat portions on opposite ends thereof, arms extending beyond said seat portions, said arms containing sockets, knuckle pieces, shanks on said knuckle pieces fitting into said sockets, said shanks having slots disposed transversely of their axes and into which the walls of the sockets are forged to lock the knuckle pieces onto the axle.

9. A tubular axle comprising a thin walled cylindrical central portion, thickened walled spring seat portions on opposite ends thereof, arms extending beyond said seat portions, said arms containing sockets, knuckle pieces, shanks on said knuckle pieces, fitting into said sockets, said shanks having slots disposed transversely of their axes on their top and bottom sides and into which the walls of the sockets are forged to lock the knuckle pieces onto the axle.

10. A tubular axle comprising a thin walled cylindrical central portion, thickened walled spring seat portions on opposite ends thereof, arms extending beyond said seat portions, said arms containing sockets, knuckle pieces, shanks on said knuckle pieces fitting into said sockets, said shanks having slots disposed transversely of their axes and into which the walls of the sockets are forged to lock the knuckle pieces onto the axle, against rotation about said axes and movement longitudinally of them.

11. A tubular axle comprising a thin walled cylindrical central portion, thickened walled spring seat portions on opposite ends thereof, arms extending beyond said seat portions, said arms having thickened walls

and containing tapered sockets, knuckle pieces, shanks on said knuckle pieces fitting into said sockets, said shanks having slots disposed transversely of their axes and into which the walls of the sockets are forged to lock the knuckle pieces onto the axle.

12. A tubular axle comprising a thin walled cylindrical central portion, thickened walled spring seat portions on opposite ends thereof, arms extending beyond said seat portions, said arms containing sockets, knuckle pieces comprising cylindrical heads and frusto-conical shanks, said shanks fitting into said sockets and containing slots into which the walls of the sockets are forged to lock the knuckle pieces onto the axle.

13. A tubular axle comprising a thin walled cylindrical central portion, thickened walled spring seat portions on opposite ends therof, arms extending beyond said seat portions, said arms containing sockets, knuckle pieces comprising cylindrical heads and frusto-conical shanks projected with their axes intersecting at an angle of less than 90°, said shanks fitting into said sockets and containing slots into which the walls of the sockets are forged to lock the knuckle pieces onto the axle.

14. A tubular axle comprising a thin walled cylindrical central portion, thickened walled spring seat portions on opposite ends thereof, arms extending beyond said seat portions, said arms containing sockets, knuckle pices comprising cylindrical knuckles which are longer than the diameter of said cylindrical axle portion, frusto-conical shanks formed integral with said knuckles and disposed in said sockets, said shanks containing recesses into which the walls of the sockets are forged to lock the knuckle pieces onto the axle.

15. A tubular axle comprising a thin walled cylindrical central portion, thickened walled spring seat portions on opposite ends thereof, arms extending beyond said seat portions, said arms containing sockets, knuckle pieces comprising cylindrical knuckles, integral frusto-conical shanks, and shoulders at the junctions of the knuckles and shanks, said shanks fitting into said sockets and containing recesses into which the walls of the sockets are forged to lock the knuckle pieces on the axle, said walls abutting said shoulders and being welded thereto to seal interior of the axle.

In witness whereof, we hereunto subscribe our names this 6th day of May, 1930.

EDMUND C. MOGFORD.
GEORGE SPATTA.