July 24, 1934. E. C. MOGFORD ET AL 1,967,317

METHOD OF FORMING AND TREATING AXLES

Original Filed May 15, 1929 2 Sheets-Sheet 1

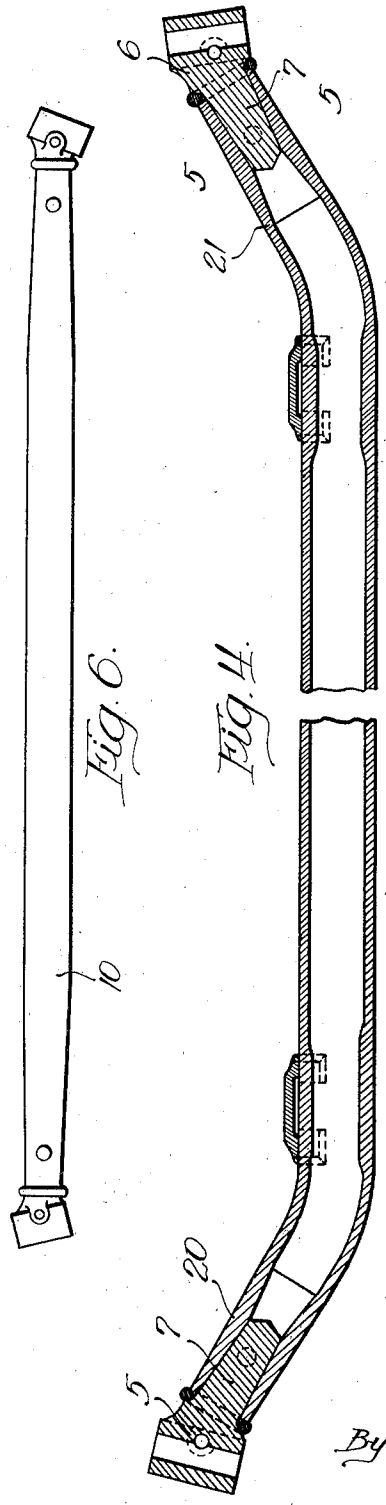


Fig. 6.

Fig. 4.

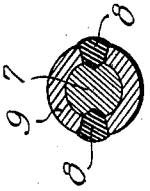


Fig. 5.

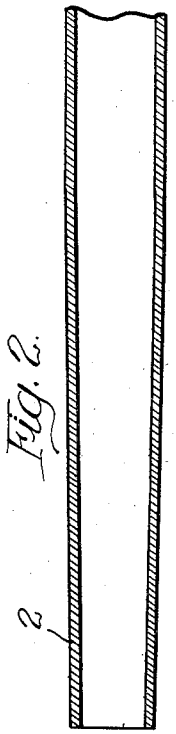


Fig. 2.

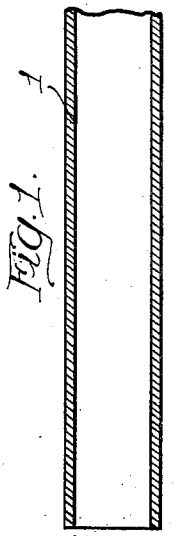


Fig. 1.

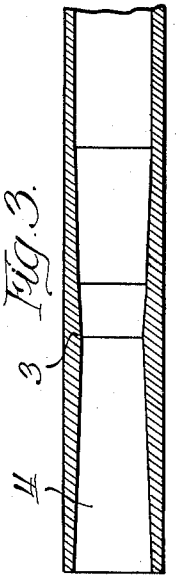


Fig. 3.

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Fig. 7.

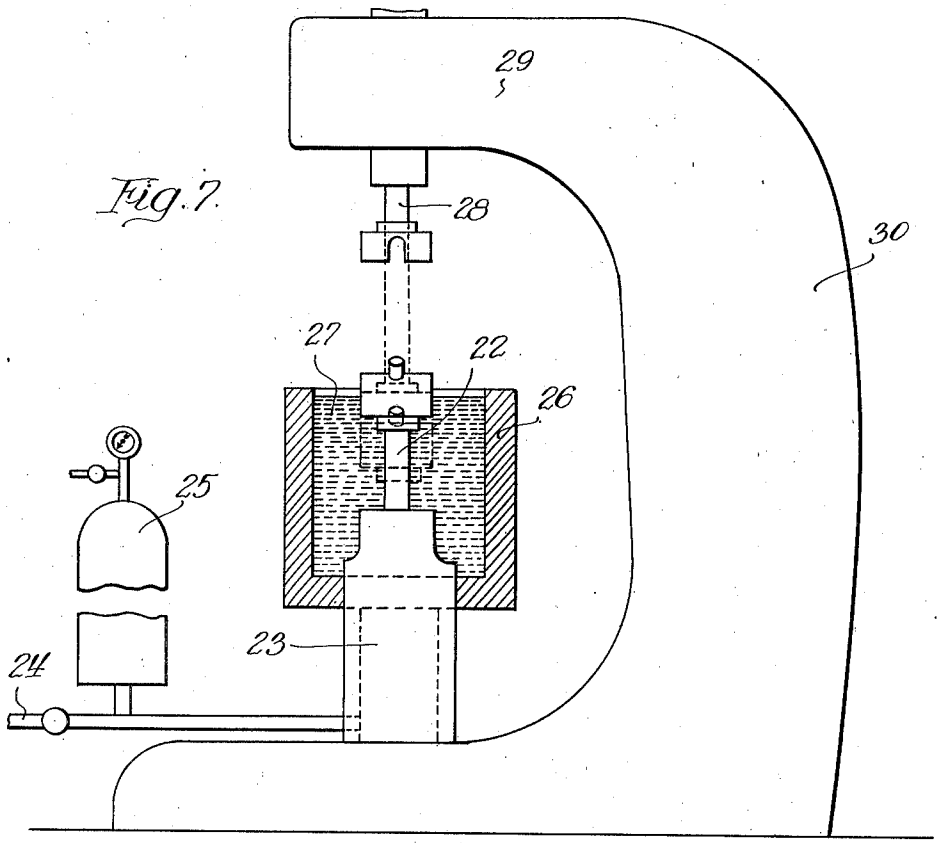
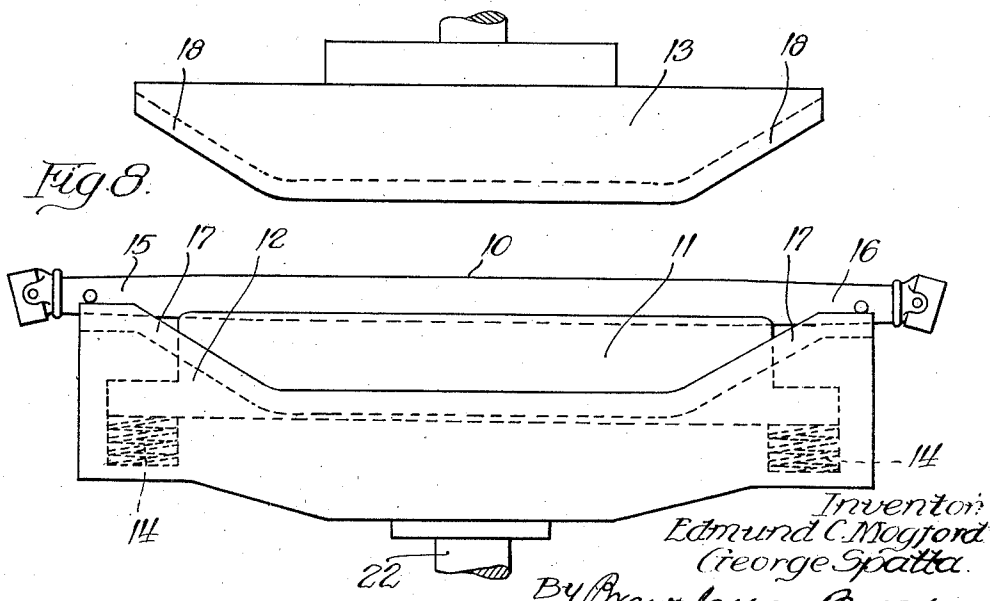


Fig. 8.



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METHOD OF FORMING AND TREATING AXLES

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Original application May 15, 1929, Serial No. 363,362. Divided and this application January 30, 1931, Serial No. 512,247

2 Claims. (Cl. 148—12)

Our invention relates to the method of and means for forming and heat treating axles for automobiles and the like.

In our co-pending application, which issued February 28, 1933, as Patent No. 1,899,347, and of which our present application is a division, we disclose an improved tubular front axle for automobiles and the like. This axle is formed from a piece of steel tubing which is first upset to thicken its walls and to form sockets in its ends, into which the knuckle pieces are fitted and attached by welding. The axle thus formed is shaped and heat treated in the final stage of formation by the method which forms the subject matter of the instant application.

In a commercial embodiment of our invention, this forming and quenching operation is performed by the use of a press such as is shown and described in detail in our co-pending application, Serial No. 409,096, this press being arranged with suitable dies to grip and tightly hold the work during the quenching operation, thereby insuring that the set of the metal will be made without warping or disforming of the pattern.

Our invention can be best understood by reference to the accompanying drawings in which:

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

Figure 2 is a similar view of the blank after it has been tapered;

Figure 3 is a cross-sectional view of the blank after it has been upset to form a socket for receiving the knuckle piece;

Figure 4 is a cross-sectional view of the completed axle showing the knuckle pieces in place in it;

Figure 5 is a cross-sectional view of Figure 4, taken along the line 5—5 looking in the direction of the arrows and showing the method of attaching the knuckle piece to the axle;

Figure 6 is an elevational view of the axle prior to the final forming operation;

Figure 7 is an elevational view partly in section of the press by which the final forming operation and quenching operation is performed; and

Figure 8 is an exploded view of the dies employed in this final forming operation.

The axles of the present invention are formed from tubular stock of proper diameter and wall thickness in the manner more fully explained in our first above mentioned co-pending application. Briefly, this process consists in cutting a length of tubular stock 1 to form a blank, shrinking the end of that blank to taper it in the manner shown at 2 in Figure 2, upsetting it by endwise forging in the manner shown in Figure 3 to form a thickened wall portion 3, and separating the end sockets 4 from the remainder of the axle. Of course, the sockets 4 are formed in each end of the tubular blank. The knuckle pieces 5 and 6 are forged with a tapered shank 7 adapted to register with the sockets 4 into which they are forced and held by means of welded plugs 8 built up in drill holes through the walls 9 of the sockets 4. These plugs 8 are bonded to the shank 7 of the knuckle piece and to the walls 9 of the axle so that the knuckle piece is thereby securely fastened in its socket against both rotation and endwise movement.

At the completion of these operations, the blank appears as in Figure 6, and it is at this stage of the fabrication of the axle that the method of the instant application begins.

The blank shown in Figure 6 is heated to the proper forging temperature, preferably heated uniformly throughout its entire length, and this blank 10 is then laid upon the lower die member 11 as shown in Figure 8. This die member 11 is spring pressed into a cooperating die member 12 under the action of the die member 13 carried by the plunger of the machine.

As this plunger descends, its mid portion grips the mid portion of the axle 10 pressing it firmly against the die in the member 11 and when sufficient pressure has been thus exerted to overcome the springs 14 by which this member 11 is held in place with respect to the member 12, the member 11 and the axle are depressed into the member 12. This brings the end sections 15 and 16 of the axle blank into registration with the tapered sections 17 of the die block 12, with the result that the upturned arms 20 and 21 of the axle are formed between the upturned portion 17 of the die block 12 and the corresponding portions 18 of the plunger die 13.

The lower die 12 is mounted upon a plunger 22 which communicates with a cylinder 23 maintained under constant fluid pressure to exert an upward pressure on the die block 12. This fluid pressure in the cylinder is maintained by a suitable pump connected to the pipe 24; this pump forms no part of the present invention and has been omitted from the drawings. An air dome 25 connected with the pipe 24 permits variation of pressure in the cylinder as will presently appear.

Surrounding the cylinder 23 and plunger 22 is a tank 26 containing the plunging liquid 27, the height of this liquid normally being below the

lower surface of the die 12. The plunger die 13 is carried upon a suitable plunger 28 carried by the upper end 29 of the press frame 30, this plunger 28 being operated in any preferred manner such as by fluid pressure to lower the die block 13 under pressure against the work in the lower die.

The cylinder 23 is maintained at any desired pressure which is sufficient, in cooperation with the pressure exerted by the upper die member, to form the body of the axle to the desired shape, and the cylinder, not shown, by which the plunger 28 is operated, is capable of exerting a greater pressure so that when the plunger 28 is lowered the die blocks 12 and 13 are forced downward against the pressure in cylinder 23 into the quenching liquid 27 where the work in the die quenched and the die blocks are cooled. The additional pressure in the cylinder 23 causes the liquid therein to back up into the air dome 25 in which the air is compressed to counteract this pressure.

When the pressure is released upon the plunger 28 the built up pressure in the air dome 25 forces the plunger 22 and the die members upward out of the quenching bath, and thus permits opening of the die by a retraction of the plunger 28 and die 13 carried thereby to permit removal of the work from the machine.

Since the dies 12 and 13 are immersed in the cooling liquid 27 with the work itself, they are cooled down to a low temperature so that when the hot work is brought into contact with them and forced between them to form it to the required shape they extract an appreciable quantity of heat from it and give it an initial set.

The added pressure placed on the plunger 28 to then submerge the two dies and the work in the quenching bath causes these dies to very tightly grip the work throughout its entire length so that the axle itself is very firmly held in the required shape during the complete quenching operation. This permits forming the axle accurately to the desired shape and holding it accurately in that shape while it is quenched and thereby set in its final form. The initial cooling of the axles by the die members themselves is carried on at a much lower rate of speed than is the quenching operation, so that the temperature of the axle is lowered to such a point that when it is quenched and quickly set it is not too hard to be sufficiently tough for the purpose for which it is intended.

The axle shown in the drawings is shown by way of example only, as it is obvious that by suitable change in the design of the die, axles having other specific shapes could be equally well formed within the manner of the teachings of our invention. We are not, therefore, to be limited by the specific disclosure but rather only by the scope of the appended claims.

What is claimed is:—

1. The method of forming and heat treating a tubular axle having solid knuckle pieces which close the ends of the axle which comprises, heating the axle to a temperature higher than the desired quenching temperature, closing complementary dies on the heated axle from knuckle piece to knuckle piece to form the axle to shape and to initially cool the same, maintaining said dies closed around the formed axle, and submerging the axle and dies in a bath of cooling fluid which quenches the axle by extracting the heat contained therein through the dies and knuckle pieces.

2. The method of forming and heat treating an axle which comprises heating it to a forging temperature, placing it on a die and bringing a second die down upon it to forge the axle between the dies, and continuing the downward movement of the upper die to force the lower die and the axle downward into a quenching bath while maintaining the grip of the dies along the entire worked portions of the axle to retard the transfer of heat from the worked portions of the axle.

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