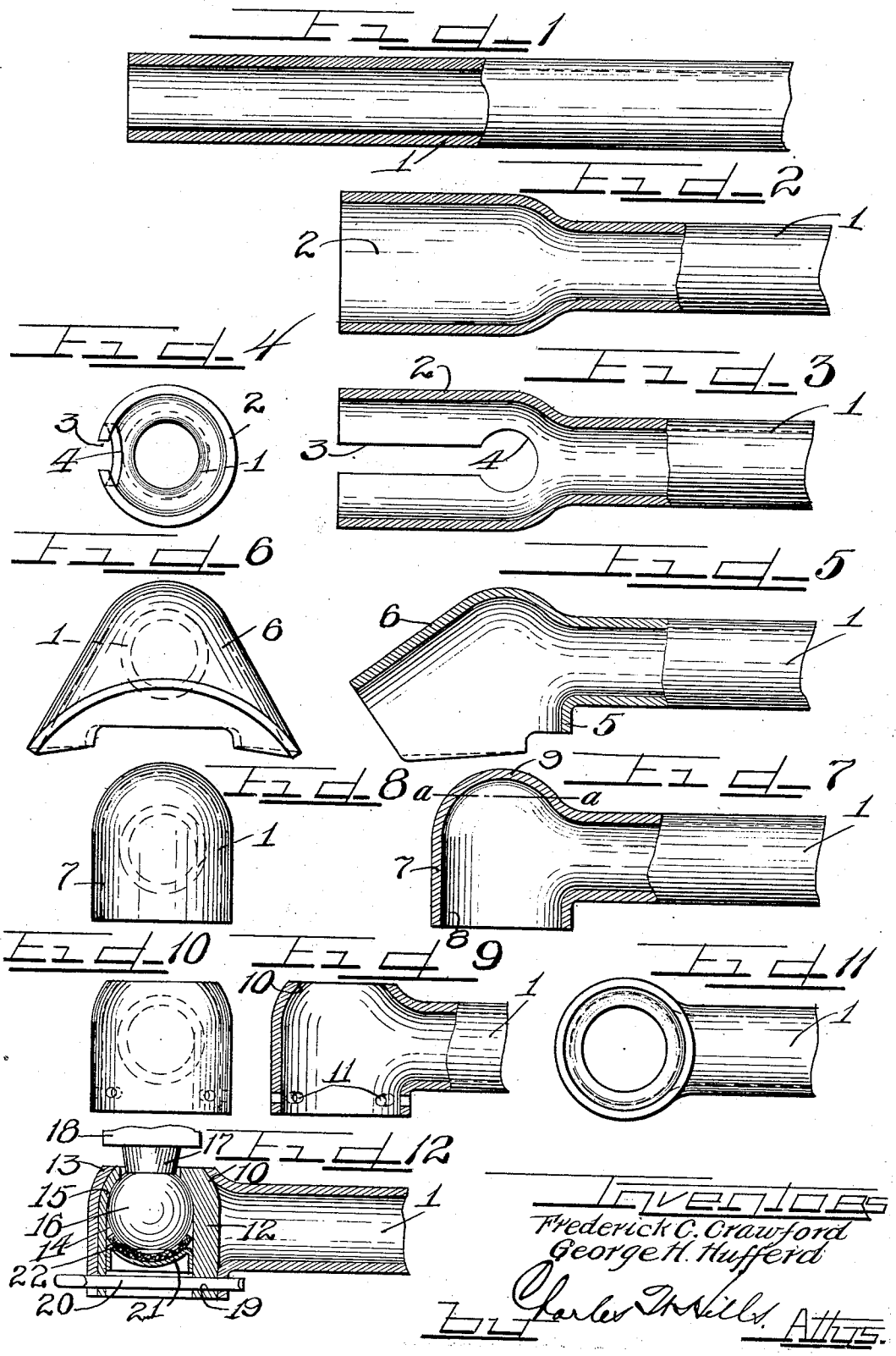
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PROCESS FOR MAKING TIE ROD ENDS

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PROCESS FOR MAKING TIE-ROD ENDS

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This invention relates to a process of making a ball and socket joint for use on connecting rods, such as tie rods and drag links for automobiles, and is a division of our co-pending application, Serial No. 90,899 filed February 26, 1926.

For proper steering of an automobile it is necessary to give the front wheels what is known as a "toe-in", i. e., the front wheels must be arranged in planes, not vertical and parallel, but in planes slightly converging toward the front. As the tie rod is rigidly connected to the opposite steering knuckles and as the front stub axles are also rigid therewith, it is apparent that in order to give the front wheels the proper "toe-in" under all conditions, some means of adjustment of the tie rod or joint connections is necessary. In the usual construction, in order to provide this adjustment, the tie rod is made of two end members and an intermediate member, which are relatively adjustable.

It is an object of this invention to produce a tie rod, rigid from end to end and without joints, and an associated ball joint, so constructed that the required adjustment can be made in the joint itself, by a novel process of treating a seamless metal tube.

This and other objects of our invention will be apparent from the following specification and drawing forming a part thereof, and from the annexed claims.

Our invention (in a preferred form) is illustrated in the following specification and accompanying drawing.

On the drawing:

Figure 1 is a view of a seamless metal tube, partly in section, from which the connecting rod is made;

Figure 2 illustrates the tube after the end has been expanded and upset to proper diameter;

Figure 3 illustrates the next step which consists of slotting one wall of the expanded end;

Figure 4 is an end view thereof;

Figure 5 shows the next step, by which the slotted expanded end illustrated in Figure 3 is spread open and flanged back, into a shape similar to a scoop;

Figure 6 is an end view of Figure 5;

Figure 7 illustrates the next step by which the scoop, shown in Figure 5, is drawn into the form of a cylinder having its axis at right angles to the axis of the tube;

Figure 8 is an end view thereof;

Figure 9 illustrates the next step which consists in cutting off the closed end of the cylinder illustrated in Figure 7, along the dotted line *a*—*a*;

Figure 10 is an end view thereof;

Figure 11 is a bottom plan view of the part shown in Figure 9;

Figure 12 is a view, in section, of the connecting rod and cooperating ball joint assembled therewith.

Referring to the drawing in detail in which the same reference character is used throughout to indicate the same part, and particularly to Figs. 1 to 12, the process is begun with a light, seamless, metal tube 1, the end of which is enlarged and expanded, as illustrated at 2, the extent of the enlargement depending upon the size of the ball joint housing or similar part which it is desired to form upon the end of the tube. In the process of enlargement it is obvious that the same metal which forms the wall of the tube must also constitute the wall of the enlargement, from which it follows that, if the end of the tube is subjected to the process of expansion alone, the resulting wall will be much thinner than the untreated wall of the tube. If it is desired to retain, in the enlargement, the original thickness of the tube wall, it is necessary to subject the treated part of the tube to the process of upsetting or thickening, which is a well known operation, and which may take place simultaneously with the operation of expansion in a manner known to the art. After the end of the tube has been expanded to the desired extent, a slot 3 is formed in the enlarged portion, preferably terminating at its inner end in a circular aperture 4.

After the slot has been formed, the end is shaped into the scoop-like form indicated in Figs. 5 and 6 by spreading the slotted end and flanging the metal about a portion of the circular aperture 4, the flange 5 forming a portion of a cylinder which is completed in

the succeeding step. Hereinafter the end of the tube, at this point of the process, will be referred to as the "scoop", designated as a whole by reference numeral 6. The step of forming the scoop 6 may be done by known shaping operations; the scoop 6 is then drawn into the form of a cylinder, as indicated at 7, having an open end 8 and a closed end 9 which is preferably spherically curved as indicated in the drawing, but may be of any other form so long as the elements of the interior surface are circular to permit rotation thereon of a cooperating ball seat. After the scoop is drawn into the cylinder 7, the metal at the open end 8 will not be of regular formation, such as indicated in Figs. 7 and 8, but will be of irregular formation, requiring a trimming operation to bring it to a circular edge lying in a plane parallel with the axis of the tube, as indicated in Figs. 7 and 8. Instead of trimming the edge after the drawing operation, the metal at the end of the scoop 6 may be trimmed away to a shape which will give the desired finish to the end 8 when the drawing operation has been completed; or the edges may be trimmed before the operation sufficient to effectively perform the drawing operation and again trimmed after the cylinder has been formed. The time when the trimming step is to be performed is a matter of choice.

After the formation of the cylinder 7 the closed end 9 thereof is cut away on the line *a*—*a*, as indicated on Figs. 7 and 8, by which a portion of the end 9 remains to form a drawn-in or contracted end having an interior bearing surface 10 (Fig. 9), the remainder of the cylinder 7 being of the same diameter throughout. In the use as a tie rod or drag link, specifically contemplated for the completed article, the bearing surface 10 will be uppermost. At the lower end 8 a series of apertures 11 is provided for the purpose hereinafter explained.

The cylindrical end of the rod as thus completed, forms a ball-joint housing whose axis is at right angles to the axis of the rod. This housing is adapted to receive a cylindrical ball seat 12 (Fig. 12), having an outer surface 13 at its upper end adapted to cooperate with the bearing surface 10 of the housing, and an eccentrically arranged bore 14 extending therethrough spherically curved at its upper end, as indicated at 15, upon which bears the ball 16 of a ball stud, the shank 17 of which extends upwardly and forms a bearing surface for a connected part 18.

A series of apertures 19 are formed in the ball seat 12, adapted to register with the apertures 11 in the ball joint housing, and, when registered, to receive a cotter pin 20, or the like. The lower end of the ball seat is preferably closed by a curved plate 21 between which and the ball 16, is a soft felt washer 22. In order to adjust the position of the shank 17 with respect to the body of the rod the cotter pin 20 is removed, the ball seat 12 is rotated in the housing by any suitable means, the pin is passed through a set of registering apertures 11, 19, and the pin again is secured from accidental withdrawal.

It will be apparent that we have formed a rod and ball housing adapted to receive a ball stud member of such form that the adjustment for toe-in can be made in the joint itself, by a simple and inexpensive process.

While we have described a preferred form of our invention, it is apparent that many changes may be made in the carrying out of the operations, and we therefore do not wish to limit ourselves otherwise than necessitated by the prior art and the scope of the claims.

We claim as our invention:

1. The process of making a one piece tubular connecting rod which comprises spreading the slotted expanded end of a metal tube into scoop form, drawing the so formed end into a cylinder closed at one end and whose axis is at right angles to the axis of the tube, and then cutting off the closed end of the cylinder.

2. The process set forth in claim 1 in which the part cut off from the end of the cylinder is of segmental spherical shape, thereby providing a cylinder open at both ends with one end slightly drawn in or contracted to form a segmental spherical ball-seat retaining-shoulder.

3. The process of making a one-piece tubular connecting rod which comprises spreading the slotted expanded end of a metal tube into scoop form and forming a segmental circular flange at the junction of the body of the tube and expanded end, drawing the so-formed end into a cylinder closed at one end and whose axis is at right angles to the axis of the tube, and then cutting off the closed end of the tube.

4. The process of making a one-piece tubular connecting rod which comprises expanding the end of a metal tube, slotting a wall of the expanded portion, spreading the slotted end into scoop form, drawing the so-formed end into a cylinder closed at one end and whose axis is at right angles to the axis of the tube, and then cutting off the closed end of the cylinder.

5. The process of making a tie rod end, which comprises expanding the end of a tube, slitting said end, spreading the end into scoop form and drawing the so formed end into a cylinder whose axis is at right angles to the axis of the tube.

6. The process of making a tie rod end, which comprises spreading the slotted expanded end of a metal tube into scoop form and drawing the end into a cylinder whose axis is at right angles to the axis of the tube.

7. The process of making a one-piece con-

necting rod which comprises slotting and expanding the end of a metal tube, forming the expanded end into a cylinder whose axis is at right angles to the axis of the tube and finishing the expanded end to adapt it to receive and retain a ball joint.

8. The process of making a one-piece tubular connecting rod which comprises slotting the end of a metal tube, forming the slotted end into a cylinder whose axis is at right angles to the axis of the tube and finishing the cylinder to adapt it to receive and retain a ball joint.

In testimony whereof I have hereunto subscribed my name at Detroit, Wayne County, Michigan.

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