PATENT SPECIFICATION (11) 1603440

1603440

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(54) EXTERNAL MEMBER FOR UNIVERSAL JOINT

(71) We, TOYOTA JIDOSHA KOGYO KABUSHIKI KAISHA, a Japanese Corporation, of 1, Toyotacho, Toyota, Aichi, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to non-extensible universal tripod joints and more particularly to external members for such universal joints.

Referring to Figure 1, shown therein is a known design of a non-extensible tripod-type homokinetic universal joint for large angles. As shown in Figure 1, the universal joint includes an external member 1. The external member 1 includes a cup shaped spider holding portion 2 and a stem portion 3 integrally connected to the bottom of the spider holding portion 2. The stem portion 3 is formed with splines for transmitting power.

In the spider holding portion 2, a spider 6 is integrally formed with trunnions 5 projecting in three directions. The trunnions 5 engage with projections 7 formed on the inner surface of the spider holding portion 2 and thereby support the spider 6. The trunnions 5 are each axially slidably and rotatably coupled to roller 8. The rollers 8 roll in rolling grooves 10 of tulip shaft 9. The rollers 8 are coupled to the tulip shaft 9 such that rotating force can be transmitted even if the tulip shaft 9 and the external member 1 make an angle that is less than a predetermined value. A tripod spring 11 supports the tulip shaft 9 on the spider 6 and a poppet 12 is coupled to the end face of the spider 6 opposite to the tripod spring 11 and is urged by a compression spring 13 in a direction opposite to the tripod spring 11.

In conventional external members 1, the spider holding portion 2 and the stem portion 3 are arc welded together to form the external member 1. In the case of arc welding, as shown in Figure 2 for example, a flange 3A of the stem portion 3 is inserted into and welded to a large hole provided in the bottom 2B of the cup shaped spider holding portion 2.

However, in the case of arc welding, there have been such disadvantages that weld beads B, weld spatters and other deposits result on the inside of the spider holding portion 2 and their removal thereof is troublesome. Also, a large variation in bead shape results and the quality of the product is not uniform. Therefore welded external members 1 must be inspected periodically by cutting the product into sections and frequently it is not always possible to set the tripod spring 11 stably on the weld beads B having a large variation in shape when the tulip shaft 9 is assembled.

In an attempt to overcome these disadvantages, another form of external member 1 as shown in Figure 3 has been developed.

In Figure 3, the flange 3A formed on a stem portion 3 is friction welded to the end face of a cylindrical member 2A thereby forming the bottom of an external member 1. In the case of friction welding described above, as indicated by the reference 14 in the drawing, internal weld flash is formed inside of the external member 1. The weld flash 14 is firmly secured to the cylindrical member 2A and the flange 3A. Moreover, there are many small pieces of burrs 14A and 14B which are caught at the tips of the flash or small pieces of burrs 14C caught in the center dent of the flash formed on two sides of the flange 3A and the cylindrical member 2A in such a manner that the small caught pieces of burrs may easily fall off.

Since the amount of welding is usually set at a small value in order to prevent heat distortion and changes in the structure caused by heat treatment due to friction welding, the internal weld flash 14 radiates

heat easily through heat conduction and upon completion of the welding undergoes a sharp decrease in temperature and hardens very fast. It is therefore extremely difficult to machine these hardened weld flash 14 and considerable labor and a very high cost is required to anneal them by an electric arc or flame from the inside. Even after the machining, the inside of the spider holding portion 2 must be cleansed. The cleansing treatment, including dehydrating and drying of the holding portion 2, is condiderably troublesome and expensive.

Since it is so difficult to machine only the small pieces of burrs with a turning lathe or the like leaving the hardened internal weld flash 14 intact, other methods such as wire brushing, shot blasting, high speed water streams or the like have been utilized to remove the small pieces of burrs and by such methods it is almost impossible to completely remove the small pieces of burrs on the internal weld flash in a short period of time. Accordingly, such universal joints usually have small pieces of burrs remaining thereon which have not come off even after the removal work and include small pieces of broken wire brush or crushed small pieces of shock balls, etc. which result from the attempted removal process. These small pieces of material have created a disadvantage in that these small pieces frequently break off and fall between the rollers and roll grooves of the tulip shaft and cause problems.

Accordingly, it is the general object of the present invention to provide an external member for a universal joint of the above-mentioned type wherein no weld flash is created on the inside surface of the cup shaped spider holding portion.

According to one aspect of the present invention there is provided an external member for a non-extensible universal tripod joint for a large angle comprising a cup shaped spider holding portion having a thin wall thickness and an imperforate bottom; and central portion of said bottom being raised outwardly in stepped manner leaving an annular shoulder portion surrounding the central portion; and a stem portion having an annular ridge formed on one end, said annular ridge being friction welded to the said annular shoulder portion of the spider holding portion.

According to a further aspect of the present invention there is provided an external member for a non-extensible universal tripod joint for a large angle comprising a cup shaped spider holding portion having a thin wall thickness and an imperforate bottom; and welded thereto a stem portion, one end of which has an annular ridge formed thereon, the annular ridge having, prior to welding, a small port at a position close to the end face thereof, the annular ridge having been friction welded to the bottom of the spider holding portion in such a manner that when the welding is completed the port is substantially blocked by heat deformation of the material of the welded portions.

The present invention will be illustrated further, by way of example only, with reference to the accompanying drawings wherein like reference numerals denote like elements and in which:

Figure 1 is a partially broken away front view showing an external member in an assembled state with a tulip shaft;

Figure 2 is a partially broken away front view illustrating an external member of the prior art which is arc welded;

Figure 3 is a partially broken away front view illustrating an external member of the prior art produced by friction welding;

Figure 4 is a sectional view illustrating a spider holding portion in accordance with the teachings of the present invention;

Figure 5 is a partially broken away front view illustrating a stem portion before welding for an external member in accordance with the teachings of the present invention;

Figure 6 is a partially broken away front view illustrating an alternative stem portion in accordance with the teachings of the present invention;

Figure 7 is a partially broken away front view illustrating an external member after welding the stem portion of Figure 6;

Figure 8 is a partially broken away front view illustrating the embodiment of Figure 7 before assembly with the spider.

Referring to Figures 1, 4 and 5, there is shown one embodiment of the parts of an external member 1 in accordance with the teachings of the present invention, said embodiment comprising a stem portion 3 having an axial annular ridge 15 projectingly formed on the end face of the welding side of the flange 3A of the stem portion 3, and a thin-walled cup-shaped spider holding portion 2 with an imperforate bottom 2B. The bottom 2B has a central portion 20 which is raised outwardly in stepped manner leaving a annular shoulder portion surrounding the central portion. To assemble the stem portion and the spider holding portion together, the annular ridge 15 of the stem portion 3 is friction welded to the annular shoulder portion of the bottom 2B of the spider holding portion 2.

The heat generated during friction welding of the two parts of the said external member causes the air in the space 16 formed between the two members to expand and this leads to difficulties in controlling the conditions of the frictional welding.

In an alternative arrangement this problem is overcome by forming a communicating port 18 in the annular ridge 15 of the

stem portion 3 as shown in Figure 6 so that the space 16 between the two parts is placed in communication with the outside. In this arrangement the bottom 2B of the spider holding portion 2 need not be stepped as shown in Figure 4. To prevent moisture and foreign material from passing through the port 18 and collecting inside the sealed spaced 16 and having some disadvantageous effects upon the external member 1, port 18 should be closed. To provide a simple and inexpensive means of closing the port 18, the port 18 is desirably closed by the deformation of the annular ring 15 during the friction welding operation. To achieve this end, the port 18 is formed at a position adjacent to the connecting end face of the annular ring 15 at a point near enough to the connecting face that during friction welding the port 18 is closed by the deformation of the annula ridge 15.

As can best be seen in Figure 7, as a result of the friction welding, internal weld flash 14 is produced in the sealed space 16 created by the annular ridge 15, the bottom 2B and the flange 3A. An external weld flash 17 is also created as a result of the friction welding.

Since the internal weld flash 14 is contained in the sealed space 16, there is no need to machine such internal weld flash 14 and internal small pieces of burrs 14A, 14B and 14C. Therefore, only the external weld flash 17 and the external small pieces of burrs 17A, 17B and 17C need be machined off. In this case, although the external weld flash 17 is usually hardened, it is easy to machine it away since the flash 17 may be easily annealed by an electric arc or flame from the outside. After the machining of the external weld flash 17, a completed and finished external member 1 is created as shown in Figure 8.

It should be apparent that since during the manufacturing of an external member by friction welding there are cases where one or both of the spider holding portion 2 and the stem portion 3 are in a state of roughly processed material, half finished product or finished product, the present invention could be applied at any point of the assembly.

From the above description it should be apparent that there are several advantages for the present invention over the prior art. Such advantages include:

1. The machining of internal weld flash and internal small pieces of burrs is not required;
2. Production costs can be reduced;
3. The internal shape of the spider holding portion can be arranged so as to stably maintain the tripod spring when the tulip shaft is assembled;
4. The power required for friction welding is decreased;
5. The quantity of heat generated by the friction welding is reduced; and
6. The amount of deformation of the shape of the spider holding portion is minimized.

WHAT WE CLAIM IS:—

1. An external member for a non-extensible universal tripod joint for a large angle comprising a cup shaped spider holding portion having a thin wall thickness and an imperforate bottom; a central portion of said bottom being raised outwardly in stepped manner leaving an annular shoulder portion surrounding the central portion; and a stem portion having an annular ridge formed on one end, said annular ridge being friction welded to the said annular shoulder portion of the spider holding portion.

2. An external member for a non-extensible universal tripod joint for a large angle comprising a cup shaped spider holding portion having a thin wall thickness and an imperforate bottom; and welded thereto a stem portion, one end of which has an annular ridge formed thereon, the annular ridge having, prior to welding, a small portion at a position close to the end face thereof, the annular ridge having been friction welded to the bottom of the spider holding portion in such a manner that when the welding is completed the port is substantially blocked by heat deformation of the material of the welded portions.

3. An external member according to Claim 2, wherein the bottom of the spider holding portion has a central portion which is raised outwardly in stepped manner leaving an annular shoulder portion surrounding the central portion, the annular ridge of the stem portion having been friction welded to said annular shoulder portion.

4. An external member for a universal joint substantially as hereinbefore described with reference to any one of Figures 1, and 4 to 8 of the accompanying drawings.

5. A universal joint including an external member as claimed in any one of the preceding claims.

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1603440 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

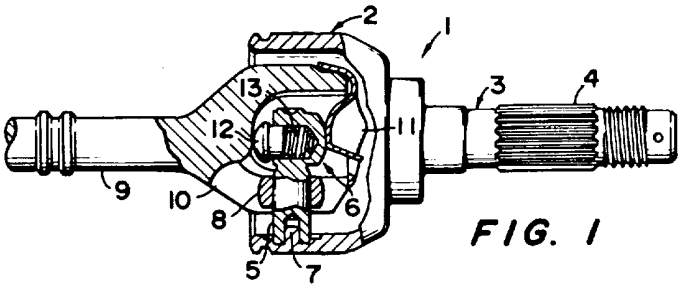

FIG. 1

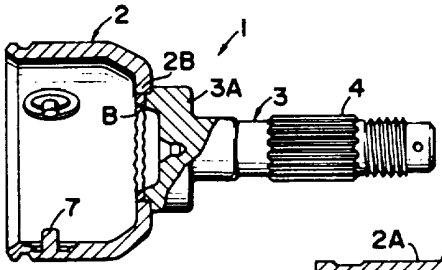

FIG. 2

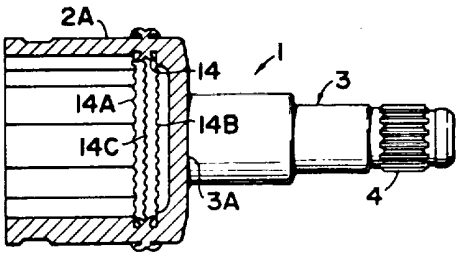

FIG. 3

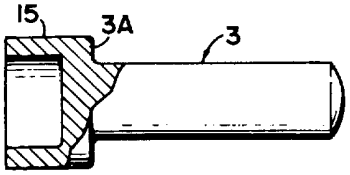

FIG. 5

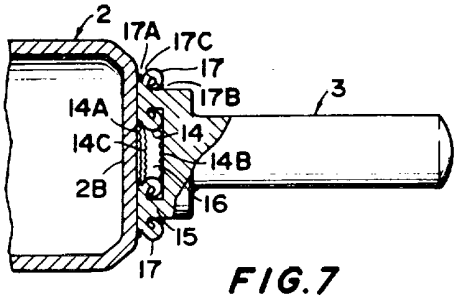

FIG. 7

1603440 COMPLETE SPECIFICATION
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Sheet 2

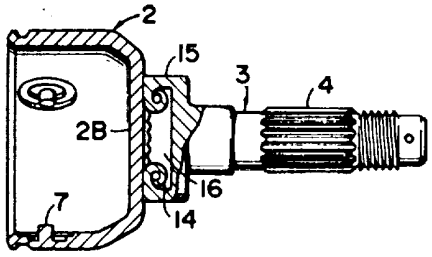

FIG. 8

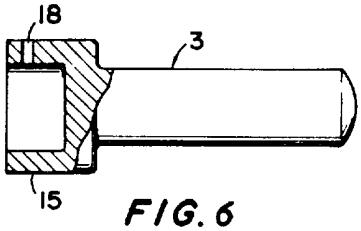

FIG. 6

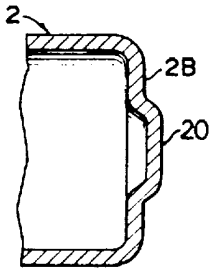

FIG. 4