

Jan. 9, 1945.

S. T. JOHNSON

2,366,965

TUBULAR RIVET

Filed July 19, 1940

2 Sheets-Sheet 1

Fig. 1

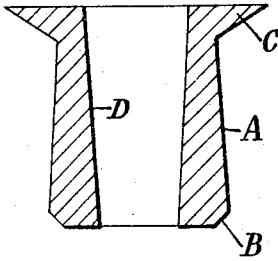


Fig. 2

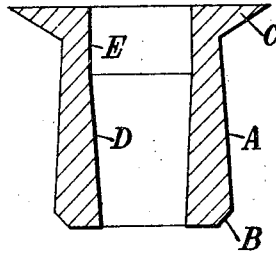


Fig. 3

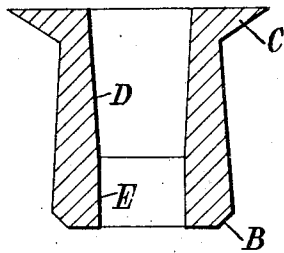


Fig. 4

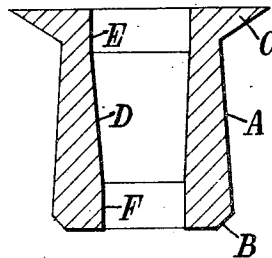


Fig. 5

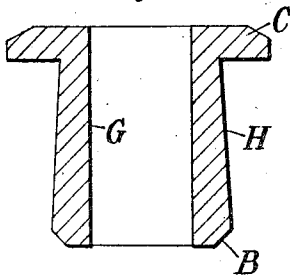


Fig. 6

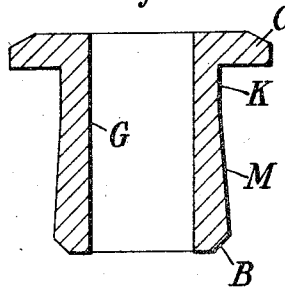


Fig. 7

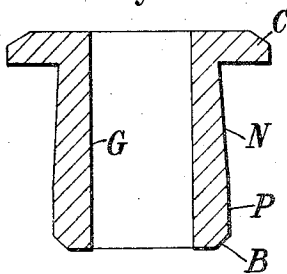
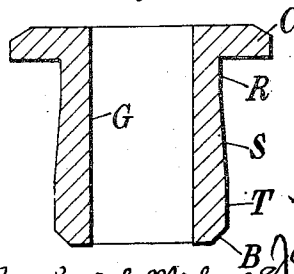


Fig. 8



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2 Sheets-Sheet 2

Fig. 9

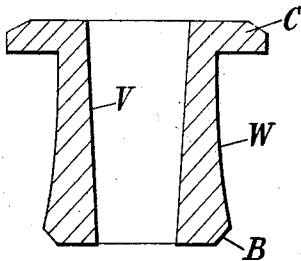


Fig. 10

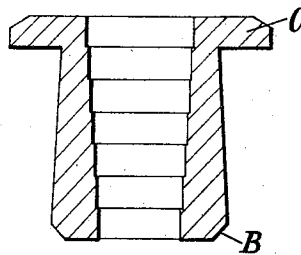


Fig. 11

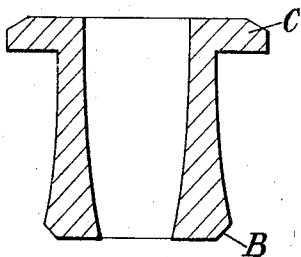


Fig. 12

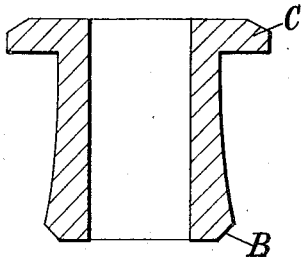


Fig. 13

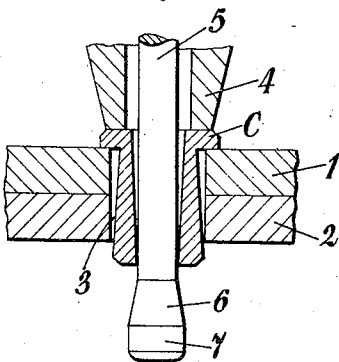
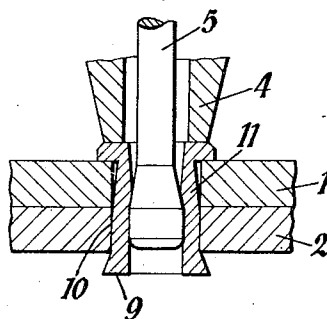


Fig. 14



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# UNITED STATES PATENT OFFICE

2,366,965

## TUBULAR RIVET

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Application July 19, 1940, Serial No. 346,424  
In Great Britain August 18, 1939

10 Claims. (Cl. 85—40)

This invention relates to tubular rivets constructed so as to be upset by exerting an outward pressure upon the internal bore of the rivet, but more particularly to tubular rivets intended to be threaded upon a mandrel and upset by drawing from one end of the rivet to the other an enlarged head of the mandrel while exerting an opposing thrust against the end of the rivet towards which the head of the mandrel is drawn.

According to the present invention there is provided a tubular rivet whose stem is uniformly tapered externally so that the wall is thickened at the tail end of the rivet. The rivet may be upset by drawing a mandrel having a rigid pear-shaped head through the bore of the rivet so that an outward radial pressure is exerted by the mandrel head on the stem of the rivet throughout the whole or the greater part of its length, causing the stem to be expanded to a tight fit in the rivet hole. After the rivet has been upset and the head of the mandrel reaches a position in line with the face of the workpiece remote from the rivet head, some of the metal of the rivet stem is drawn along by the mandrel head, so as to increase the radial pressure and ensure the filling of the rivet hole.

Typical forms of rivet according to the present invention and a method of upsetting the same are illustrated, by way of example, in the accompanying drawings, in which:

Figures 1 to 12 illustrate in longitudinal section twelve forms of rivet constructed in accordance with the present invention, and

Figures 13 and 14 illustrate sectional views indicating successive steps in the upsetting of a rivet in accordance with the present invention. Figure 13 illustrates the rivet in position and the shank of the upsetting mandrel extending through the rivet, while Figure 14 illustrates a later stage of the upsetting operation.

Referring to the drawings, it will be seen that the form of rivet illustrated in Figure 1 is one in which the stem of the rivet has a tapered external surface A which terminates in a chamfered portion B and is provided at one end with a countersunk head C. The bore D of the rivet is uniformly tapered throughout its length, the diameter of the bore being a minimum at the tail end of the rivet, thereby producing a rivet having a thickened wall at the tail end of the rivet.

Figure 2 illustrates a modified form of rivet to that illustrated in Figure 1 wherein the external configuration of the rivet is the same as that illustrated in Figure 1 but wherein the in-

ternal bore of the rivet comprises a cylindrical portion E adjacent to the head of the rivet and thereafter for the major portion of the length of the rivet a uniformly tapered portion D. The minimum diameter of the bore of the rivet is so arranged as to form a thickened wall at the tail end of the rivet.

Figure 3 illustrates a modified form of the rivet illustrated in Figure 1, wherein the external configuration of the rivet is the same as that illustrated in Figure 1 but wherein the internal bore of the rivet comprises a tapered portion D adjacent to the head of the rivet and thereafter a cylindrical portion E disposed adjacent to the tail of the rivet so as to form a thickened wall at the tail end of the rivet.

Figure 4 is a combination of the rivets illustrated in Figures 2 and 3 in which the external configuration of the rivet is the same as that illustrated in Figure 1, but wherein the internal bore comprises cylindrical portions E and F disposed respectively at the head and tail of the rivet and disposed between the two cylindrical portions E and F is a uniformly tapered portion D the minimum diameter of which is disposed adjacent to the cylindrical portion F adjacent to the tail end of the rivet. Further the tapered portion D extends over the greater part of the length of the internal bore and forms together with the cylindrical portion F a thickened wall at the tail of the rivet.

Figure 5 illustrates a rivet having an internal cylindrical bore G and a stem H, the external surface of which tapers externally over the whole of its length so as to produce a thickened wall at the tail end of the rivet.

Figure 6 illustrates a rivet having an internal cylindrical bore G and a stem, the external surface of which is cylindrical at that portion K thereof which is adjacent to the head of the rivet, whereafter the stem tapers at the portion M over the greater part of the length of the stem to form a thickened wall at the tail end of the rivet.

Figure 7 illustrates a rivet having an internal cylindrical bore G and a stem, the external surface of which tapers at N from the head towards the tail for the greater part of the length of the stem whereupon the surface is cylindrical as at P so that with the tapered portion above referred to a thickened wall is formed at the tail end of the rivet.

Figure 8 illustrates a rivet having an internal cylindrical bore G and a stem, the external surface of which is divided into three portions R,

S and T. The portion R of the stem adjacent to the head of the rivet is of cylindrical formation, the portion S of the stem tapers outwardly towards the tail of the rivet and the portion T of the stem is of cylindrical formation. The portions R and T of the stem are shaped so as to form a thickened wall at the tail of the rivet whilst the tapered portion S is made of such a length as to form the greater part of the length of the rivet.

Figure 9 illustrates a rivet wherein both the internal bore V and the external surface W of the stem of the rivet taper in opposite directions so as to produce a thickened wall at the tail end of the rivet, but the external surface of the stem of the rivet is curved outwardly but yet may be modified in the manner indicated in Figures 6, 7 or 8 and further the internal bore of the rivet may be modified in the manner indicated in Figures 2, 3 or 4 without in any way departing from the spirit of the invention which is to produce a tapering wall which thickens at the tail end of the rivet.

Figure 10 illustrates a rivet similar to that illustrated in Figure 1 wherein the tapered interior of the rivet is of a stepped formation and it is to be understood that any of the tapered surfaces referred to with reference to Figures 1 to 4 may be of stepped formation.

Figures 11 and 12 illustrate rivets in which the external surface tapers in the form of a curve similar to that illustrated in Figure 9 so as to produce a thickened wall at the tail end of the rivet, the internal bore of the rivets being respectively curved and cylindrical.

It will be appreciated that the heads of the rivets may be of any desired shape and that the tail end or the internal bore at the head of the rivet may be chamfered or not as desired without departing from the essence of the present invention.

A method of fixing the rivets according to the present invention is diagrammatically illustrated, by way of example, in Figures 13 and 14. A rivet for instance of the form illustrated in Figure 1 is inserted into two coaxial holes drilled in two members 1 and 2 to be secured together. The diameters of the holes are made slightly greater than that of the stem of the rivet thus leaving a clearance 3 between the work and the rivet.

The head C of the rivet is pressed against the outer surface of the member 1 by the nose 4 of a riveting machine of which only a part is illustrated. The shank 5 of a mandrel of the riveting machine is formed with an enlarged pear-shaped head 6, 7 and is drawn through the rivet from the tail towards the head thereof.

As the conical portion 8 of the head of the mandrel is drawn through the rivet it causes the tail end 9 of the rivet to be expanded and upset into the position 9 illustrated in Figure 14. Further movement of the mandrel in the same direction expands the body of the rivet outwardly into contact with the sides of the hole to fill the space 3 as indicated at 10 in Figure 14. During the passage of the mandrel through the bore of the rivet a ridge of metal 11 is formed in advance of the conical surface 8 of the mandrel head and this is expanded outwardly to ensure the tightness of the rivet, the material of the rivet being sufficiently ductile to allow this action.

To complete the fixing of the rivet the head of the mandrel is drawn completely through the rivet.

Owing to its simple form most of the rivets

which constitute the subject matter of the present invention may as an alternative to machining be formed by pressing or stamping from blanks or tubes. With certain materials it may be advantageous to subject the rivets so formed to heat treatment to increase or restore their ductility.

In the examples of rivets hereinbefore described and illustrated the external tapered surface of the rivet has been indicated as a plane surface or surfaces. It is to be understood that the external tapered surface of the rivet may if necessary be stepped in a similar manner to that indicated in the rivet illustrated in Figure 10 with regard to the internal tapered surface thereof.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, the length of said stem exceeding the maximum external diameter thereof, and said stem being tapered externally toward the tail end of the rivet so that the wall of the rivet is thickened at the tail end thereof where the stem has an external diameter exceeding the external diameter of the remainder of said stem.

2. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, the length of said stem exceeding the maximum external diameter thereof, and said stem being tapered externally toward the tail end of the rivet over at least the greater part of the length thereof, so that the wall of the rivet is thickened at the tail end thereof where the stem has an external diameter exceeding the external diameter of the remainder of the stem.

3. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, the length of said stem exceeding the maximum external diameter thereof, and the exterior of said stem being tapered outwardly toward the tail end of the rivet and having its bore uniformly tapered inwardly toward the tail end of the rivet over at least the greater part of the length thereof to form a thickened wall at the end of the rivet remote from the head, at which end the stem has an external diameter exceeding the external diameter of the remainder of the stem.

4. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, the length of said stem exceeding the maximum external diameter thereof, and said stem having an internal bore which is tapered inwardly toward the tail end of the rivet over the whole of the length thereof so that the portion of lesser diameter of the bore is located at the end of the rivet remote from the head, the external surface of said stem being tapered outwardly toward the tail end of the rivet, so that the wall of the rivet is thickened at the tail end thereof where the stem has an external diameter exceeding the external diameter of the remainder of the stem.

5. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, the length

of said stem exceeding the maximum external diameter thereof, and the exterior of said stem being tapered outwardly toward the tail end of the rivet, the bore of said stem being cylindrical for a part of the length thereof so that the wall of the rivet is thickened at the tail end of the rivet where the stem has an external diameter exceeding the external diameter of the remainder of the stem.

6. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, the length of said stem exceeding the maximum external diameter thereof, the exterior of said stem being tapered outwardly toward the tail end of the rivet over at least the greater part of the length thereof, the bore of the stem being cylindrical to form a thickened wall at the tail end of the rivet where the stem has an external diameter exceeding the external diameter of the remainder of the stem.

7. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, said rivet having an internal bore which is tapered over a portion of the length thereof and inwardly toward the tail end of the rivet and is cylindrical for the remainder thereof, the exterior surface of the stem being tapered outwardly toward the tail end of the rivet to form a thickened wall at said tail end where the stem has an external diameter exceeding the external diameter of the remainder of the stem.

8. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, the length of said stem exceeding the maximum external diameter thereof, and the bore of said stem being

substantially cylindrical, the exterior of said stem being tapered uniformly toward the tail end of the rivet over the greater part of its length to form a thickened wall at the tail end of the rivet where the stem has an external diameter exceeding the external diameter of the remainder of the stem.

9. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, the length of said stem exceeding the maximum external diameter thereof, the bore of said stem being tapered inwardly toward the tail end of the rivet, and the exterior of the stem being tapered uniformly outwardly toward the tail end of the rivet, both tapers extending over at least the greater part of the length of the stem to form a thickened wall at the tail end of the rivet where the stem has an external diameter exceeding the external diameter of the remainder of the stem.

10. A tubular rivet comprising an enlarged head and a stem, said stem being deformable when subjected to outward radial pressure to expand the stem to a tight fit within a rivet hole, the length of said stem exceeding the maximum external diameter thereof, said stem being tapered both internally and externally over the greater part of the length thereof, the internal portion of said stem being tapered inwardly toward the tail end of the rivet and the external portion of said stem being tapered outwardly toward the tail end of the rivet, the remainder of the internal portion of said stem being cylindrical and the arrangement being such as to form a thickened wall to the tail end of the stem where the stem has an external diameter exceeding the external diameter of the remainder of the stem.

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