This invention relates to methods of riveting employing tubular rivets placed upon a mandrel and upset by withdrawing an enlarged head of the mandrel through the rivet while exerting an opposing thrust against the rivet head. Various types of tubular rivet and methods of placing them have already been employed. In one method the enlarged head of the mandrel is deformed after it has upset the end of the rivet and is decreased in size on being drawn through the supported part of the rivet stem. A disadvantage of this method is that the head of the mandrel must be renewed for each rivet. In another method a mandrel having a rigid, generally pear-shaped, head is drawn through the bore of a rivet, which is provided with an internal annular bead. As the mandrel is drawn through the bore, the internal bead is expanded by the mandrel head to upset the rivet. The manufacture of this internally beaded type of rivet is expensive and difficult and the rivets do not lend themselves readily to the riveting of varying thicknesses of sheet, since if the rivet is too short a part of the internal bead is within the thickness of the work, thereby overstraining the mandrel and frequently breaking it. On the other hand, if the rivet is too long the expanded portion of the rivet stands clear of the work and the sheets are not held firmly together. Again, apart from its internal bead, the bore of the rivet, originally cylindrical, remains so and if the rivet hole is large enough for the rivet to be easily inserted the rivet may not be a tight fit, since after expanding the end of the rivet the head of the mandrel exerts little, if any, outward pressure upon the parallel sides of the stem.

According to the present invention a tubular rivet is employed having a head or flange at one end and a stem or shank which is internally tapered towards the free end away from the head. This provides a greater thickness of metal at the end which is entered by the enlarged head of the mandrel to upset the rivet. On drawing the enlarged head of the mandrel into the rivet the thickened end of the stem or shank is immediately upset and, due to the greater thickness of the shank, some of the metal is drawn in advance of the mandrel head and expands the shank of the rivet radially into a tight fit with the rivet hole which is initially of slightly greater diameter than the external diameter of the rivet shank. Further objects and advantages of the tubular rivets according to the present invention will be apparent from the following description of three forms of rivet and a method of upsetting them shown in the accompanying drawing in which:

Figs. 1 to 3 are longitudinal sectional views of two forms of rivet; and

Figs. 4 and 5 are sectional views showing successive steps in the upsetting of a rivet. Fig. 4 shows the rivet in position and the shank of the upsetting mandrel passed through the rivet, while Fig. 5 shows a later stage of the upsetting operation.

Referring to the drawing:

The form of rivet shown in Fig. 1 has a cylindrical external surface A and is provided at one end with a head B, the outside edge of which is chamfered as indicated at C. The bore D of the rivet is uniformly tapered throughout its length, the diameter being least at the tail end of the rivet. The rivet is chamfered as indicated at E to facilitate insertion of the rivet.

Fig. 2 shows a further form of rivet having a cylindrical external surface A and a head B which is tapered as shown at F. In other respects this rivet is similar to that shown in Fig. 1.

Fig. 3 shows a further form of rivet having a cylindrical external surface A and a head B tapered at F. The sharp edge of the tapered surface F is removed as indicated at G. The bore of the rivet is generally parallel over the part H at the head end of the rivet and is continued to the tail end of the rivet by a uniformly tapered section J. The diameter of the tapered section J is least at the tail end of the rivet. A chamfered surface E is formed to facilitate insertion of the rivet.

A method of fixing the rivets according to this invention is shown, by way of example, in Figs. 4 and 5. A rivet for instance of the form illustrated in Fig. 1 is inserted into holes drilled in two members K, L to be secured together and which form the workpiece, the diameter of the holes being slightly greater than that of the rivet thus leaving an annular space M surrounding the rivet.

The head B of the rivet is pressed against the outer surface of the member L by the nose N of a riveting machine of which only a part is shown. The shank O of a mandrel of the riveting machine has an enlarged pear-shaped head P, Q and is then passed through the rivet from its tail end and is enganged in the riveting machine as shown in Fig. 4.

As the conical part F of the head of the mandrel is drawn through the rivet it causes the tail end R of the rivet to be expanded and upset into...
the position S shown in Fig. 5. Further movement of the mandrel in the same direction expands the body of the rivet outward into contact with the sides of the hole to fill the space M as indicated at T (see Fig. 5). During the passage of the mandrel through the bore of the rivet a ridge of metal U is formed in advance of the conical surface P of the mandrel head and this is expanded outwards 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 the simple form of the rivets of the present invention they 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.

What I claim is:

1. The method of riveting comprising inserting through a hole in the parts to be riveted a hollow rivet having an outside diameter less than the hole, said rivet having a flange at one end and a wall increasing in thickness from the flanged end to the tail end, holding the rivet with the flange against one of the parts to be riveted and with the tail projecting beyond another part, and drawing through the rivet from the tail towards the flange a tool having a tapered head larger than the internal diameter of the tail of the rivet whereby to initially upset the tail of the rivet and expand the wall of the rivet into tight engagement with the walls of said hole.

2. The method of riveting comprising inserting through a hole in the parts to be riveted a tubular rivet having a flange head and a hollow shank wherein the external diameter is less than the hole and the internal diameter decreases away from the flange head over at least the greater part of its length so as to increase the thickness of the shank wall towards the tail end of the rivet, drawing through said shank from the tail end thereof an expanding tool having a head of larger diameter than the internal diameter of the tail end of the rivet whereby to upset said tail end and thereafter expand the shank of the rivet into tight engagement with the walls of the hole.

3. The method of riveting comprising inserting through a hole in the parts to be riveted a mandrel having a shank portion and an enlarged head, said shank portion carrying a hollow rivet having a flange at one end and an internally tapered wall increasing in thickness from the flanged end towards the tail end of the rivet and towards the enlarged head of the mandrel, holding the rivet with the flange against one of the parts to be riveted and with the tail projecting beyond another part and drawing the head of the mandrel through the rivet from the tail toward the flanged end whereby to upset said tail end and thereafter expand the wall of the rivet into tight engagement with the walls of the hole.

EGERTON MITFORD BETTINGTON.