May 20, 1958 W. S. PEARSON 2,835,513

MEANS FOR ANGULARLY JOINING RIGID METAL TUBING INCLUDING A FLAT KEY ELEMENT

Filed Dec. 13, 1954

Fig. 1

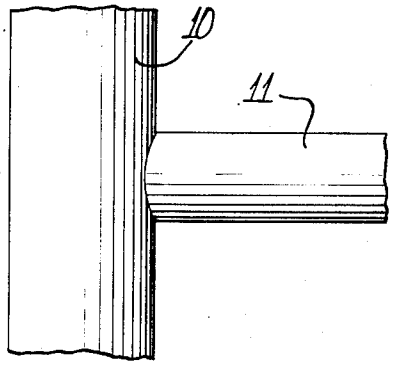


Fig. 4

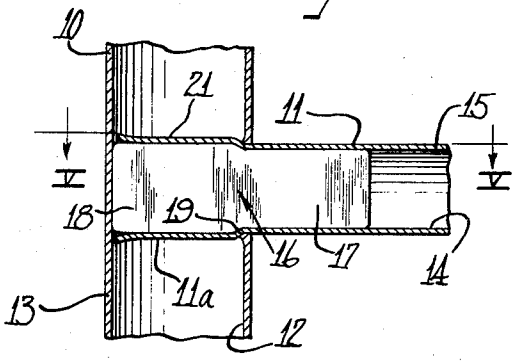


Fig. 3

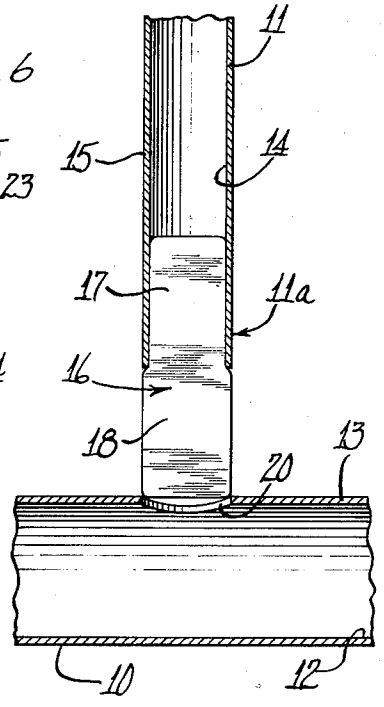


Fig. 2

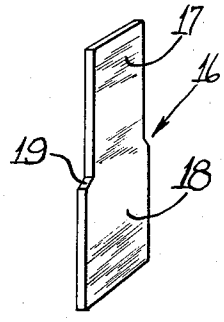


Fig. 6

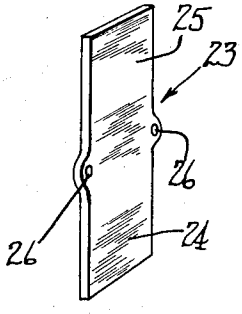
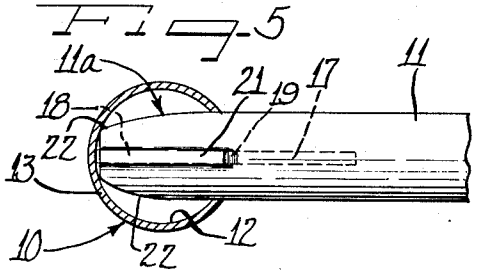


Fig. 5



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United States Patent Office 2,835,513
Patented May 20, 1958

2,835,513

MEANS FOR ANGULARLY JOINING RIGID METAL TUBING INCLUDING A FLAT KEY ELEMENT

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Application December 13, 1954, Serial No. 474,699

2 Claims. (Cl. 285—222)

The present invention relates to a new and improved means for angularly joining rigid, hollow metal tubing members wherein an end portion of one of the hollow tubes is deformed into tight locking engagement within the interior of another hollow tube.

In accordance with the general features of the instant invention, means are provided whereby the end portion of a first rigid hollow metal tube is disposed angularly within the axial bore of a second tube and the tubes locked together by expansively deforming the end portion of the first tube into tight locking engagement with the interior of the second.

A principal feature of this invention lies in the provision of means for expansively deforming the end portion of a tube disposed angularly within the axial bore of another, such means comprising a novel key carried by the end portion of the former tube and which responds to and reacts to axial pressure applied to the tube upon which the key is carried by expansively deforming the end portion of the tube into tight locking engagement with the interior of another tube.

It is, therefore, an object of this invention to provide a means for angularly joining rigid, hollow metal tubes.

Another object is the provision of a novel key which allows the end portion of one rigid, hollow metal tube to be expansively deformed into tight locking engagement with the interior of another tube.

A further object is the provision of a hollow, rigid metal tubing construction in which one tube is held in locked angular engagement with another tube by expansively deforming an end portion of the former into tight locking engagement with the interior of the latter.

Other objects, features and advantages of the present invention will be readily apparent from the following detailed description of a preferred embodiment thereof taken in conjunction with the accompanying sheet of drawings, in which:

Figure 1 is a fragmentary elevational view of a pair of hollow, rigid metal tubes angularly joined in accordance with the instant invention;

Figure 2 is a perspective view of one embodiment of the novel tube expanding key employed in the instant invention;

Figure 3 is a fragmentary, longitudinal sectional view with parts in elevation and parts in section illustrating the manner in which the key shown in Figure 2 is employed in joining tubes together;

Figure 4 is a fragmentary sectional view with parts in section and parts in elevation taken through the union of two metal tubes joined in accordance with the instant invention;

Figure 5 is a view taken substantially along the section line V—V of Figure 4; and

Figure 6 is a perspective view of another embodiment of a novel tube expanding key which may be employed in the instant invention.

By way of illustration, the instant invention is illustrated in the drawings in conjunction with the joining or

union of two, hollow, rigid, metal tubes **10** and **11**, respectively.

The tube **10**, which is illustrated as having a substantially larger diameter than the tube **11**, has an axial bore **12** defined by a cylindrical wall **13**. The smaller diametered tube **11**, likewise, has an axial bore **14** defined by a cylindrical wall **15**.

Tube expanding and deforming means are provided for tightly locking the end portion of the tube **11** within the interior of the tube **10**. Such means (Figure 2) include a generally paddle-shaped tube expanding key **16** adapted to be carried within the axial bore **14** of the tube **11** in an end portion thereof. To this end, the key **16** has a generally rectangular first part **17** which is dimensioned for snug slidable engagement within the bore **14**, and a generally rectangular, integral, larger second portion **18** merging with the first part **17** in tapered relation thereto at shoulders **19** on the sides of the key. The corners of the smaller first part **17** and the larger second part **18**, are rounded or chamfered. This aids in introducing the first part **17** into the axial bore of the tube **11** and the second larger part **18** into a suitable aperture formed in the wall of the tube **10**.

The smaller, first part **17** of the key **16** is preferably transversely dimensioned to have a width substantially equal to or just slightly smaller than the diameter of the axial bore **14** of the tube **11**. To aid in retaining the key **16** in the end portion of the tube **11** during joining thereof with the tube **10**, the width of the first part **17** is preferably such that the first part is slidably receivable snugly within the axial bore **14** of the tube **11**.

The width of the larger sectiond portion **18** is greater than the width of the first part **17**, and preferably is transversely dimensioned to have a width substantially the equivalent of the outer diameter of the tube **11**.

The length of the second part **18** of the key **16** may be substantially equal to or slightly smaller than the diameter of the axial bore **12** in the tube **10**. Preferably, however, the second part **18** is longitudinally dimensioned to have a length substantially equal to the diameter of the axial bore **12** minus the thickness of the wall **15** of the tube **11**. This insures a tight fit between the outer periphery of the tube **11** and the margin of an aperture **20** provided in the wall of the tube **10** in which the tube **11** is inserted when the end portion thereof is expanded into tight engagement with the interior of the tube **10**.

The key **16** may be formed from a suitable strip or sheet metal stock, such as by die punching or the like, and preferably having a sufficient hardness and resistance to bending and compressive deformation to allow expansive tube wall deformation or displacement thereabout without being deformed itself.

In joining the tubes **10** and **11** together in a tight angular relationship, the aperture **20** is first formed in the cylindrical wall **13** of the tube **10** (Figure 3). The aperture **20** preferably has a diameter substantially equal to the outer diameter of the tube **11** so that the tube **11** may be inserted therein and have a snug sliding fit with that part of the wall **13** defining the margin of the aperture **20**.

The key **16** is disposed to be carried by the end portion of the tube **11** by slidingly introducing the first, smaller width part **17** of the key **16** into the axial bore **14** of the tube **11**. When thus positioned, the key **16** rests on the marginal extremity of the tube **11** on the tapered shoulders **19** with the larger width second part **18** of the key projecting axially beyond the extremity of the tube **11**.

The end portion of the tube **11** carrying the key **16**, as at **11***a*, is then inserted angularly into the axial bore **12** of the tube **10** via the aperture **20**, with the plane of the key disposed axially of the tube **10**, so that the end edge of the second part **18** of the key **16** is bottomed

on or butted against the inner surface of the wall **13** in the tube **10** opposite the aperture **20**.

As seen best in Figure 4 relative assembly movement is then imparted to the tubes as by applying pressure axially to the tube **11** radially inwardly toward the tube **10** while solidly backing the wall of the latter exteriorly opposite the end of the key **16**. As the assembly pressure is applied the second part **18** of the key **16** in cooperation with the tapered shoulders **19** functions in a wedge-like manner, allowing the inwardly moving tube wall **15** to be expansively displaced or deformed over and about the side edges of the second part **18**. To this end, the shoulders **19** provide means for guiding the expansive deforming displacing movement of the end portion **11***a* of the tube wall over and about the larger key part **18**. As a result diametrically opposed locking means in the form of ribs **21** (Figs. 4 and 5) are formed on the end portion **11***a* within the tube **10**. These ribs **21** expand the inserted tube portion **11***a* to an over-all larger dimension than the aperture **20** and thus prevent withdrawal of the tube **11** from the assembled relation. In the region of the tapered shoulders **19** there is provided by the outer ends of the ribs **21** a tight gripping, interlocking engagement with the marginal portion of the aperture **20** to effectively prevent rotation of the tube **11**. Rotation is further prevented by the fact that as ribs are deformed or displaced outwardly as seen from the side in Figure 4, other parts of the end portion are deformed or displaced inwardly as shown from the top at **22** in Figure 5. This deformation produces an out-of-round configuration at the end of tube **11** which coacts with the inner bore **12** of tube **10** to lockingly prevent relative rotation of the tubes.

Additional locking of the tube **11** against rotation relative to the tube **10** attains as a result of drawing in of the extremity of the tube terminal portion **11***a*, as seen at **22** in Figure 5, toward the extremity of the key part **18**, thus generally flattening the tube terminal parallel to the axis of the tube **10**. Interengagement of the tips of the flattened sides **22** with the cylindrical bore **12** cooperates with the shoulder interlock to resist relative turning as well as relative canting.

In Figure 6 is shown another embodiment of a tube displacing key which may be employed in the instant method. As seen therein this key **23** includes a first part **24** adapted to be received within the axial bore of the tube **11** in the same fashion as the first part **17** of the key **16**. The key **23** also includes a second integral portion **25** adapted to project axially from the end portion of a tube in which the key **23** is carried. The second portion **25** merges with the first part **24** at a pair of laterally opposite lug portions **26** formed on the side of the key **23**.

The width of the key **23** in the region of the lugs **26** is preferably substantially equal to the outer diameter of the tube **11**; the lugs **26** acting in substantially the same wedge-like manner in guiding and effecting tube displacement as the shoulders **19** on the key **16**.

The key **23** may be cut from suitable strip metal stock and the lugs **26** formed thereon by upsetting the edge portions of the key by suitable punch or die means.

It will be appreciated that the instant invention provides an economical, efficient method whereby a pair of hollow substantially rigid metal tubes can be joined angularly in an improved manner. No external fastening means are exposed to the exterior of the tube union and, accordingly, the aesthetic qualities of the instant tube joint are superior to those obtainable by the use of rivets, brazing, welding or the like.

In addition, by expansively deforming the end portion of one tube into tight locking engagement with the interior portion of another, large tube areas are contacted in locking relation making for a tighter and stronger union than is possible with rivets or similar external fastening devices. Further it is not necessary to provide slots or holes through the tubes, such as is required in employing rivets or the like. This absence of apertures other than the aperture **20** formed in the tube **10** to receive the tube **11**, minimizes the possibility of ingress of water within the tube construction and provides a more weather resistant joint.

Although the instant invention is applicable for angularly joining substantially all forms of rigid metal tubing, it is especially suitable for producing ladders, play ground equipment, fences and scaffolds, besides many other uses.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. In a rigid hollow tubing construction including a first tube having an aperture formed in the wall thereof for receiving a second tube the improvement comprising, a key including a first part adapted to be carried by the axial bore of the second tube in an end portion thereof, and an integral larger substantially flat second part, said second part having a length slightly less than the inside diameter of the second tube, and an end remote from said first part defining a line transverse to the axis of said tube end portion, said second part adapted to project axially therefrom for joint disposition with said end portion via said aperture within the axial bore in the first tube with the end of said second part engaging the interior of said second tube along an axial line, said key parts being smoothly joined by a shoulder portion providing a camming surface adapted to react therein to axial pressure applied relative to said end portion radially inwardly toward the first tube to effect and guide an out-of-round expansive tube deformation of said end portion by said surface as said second tube is forced over said surface during movement of the said second tube past said surface to lock the tubes tightly against disengagement and relative rotation.

2. In a rigid hollow tubing construction, the combination of: a first tube having an aperture in the wall thereof; a second tube having an out-of-round end portion extending inwardly of said aperture; and a key including a first part thereof carried by the axial bore of said second tube adjacent to said out-of-round end portion, and an integral substantially flat second part disposed within said end portion; said second part having a length slightly less than the inside diameter of said first tube and a width slightly less than the diameter of said aperture, and an end remote from said first part engaging the interior of said first tube along an axial line, said key parts being smoothly joined by a shoulder portion disposed slightly inward of said aperture; said out-of-round end portion having a transverse dimension slightly greater than said aperture and snugly disposed intermediate said shoulder portion and said aperture, whereby said tubes are positively locked against disengagement and relative rotation.

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