Feb. 25, 1969 J. D. CALLAGHAN 3,429,033

METHOD OF SECURING A ROD TO A SUPPORTING STRUCTURE

Original Filed May 27, 1965 Sheet 1 of 4

Fig. 1.

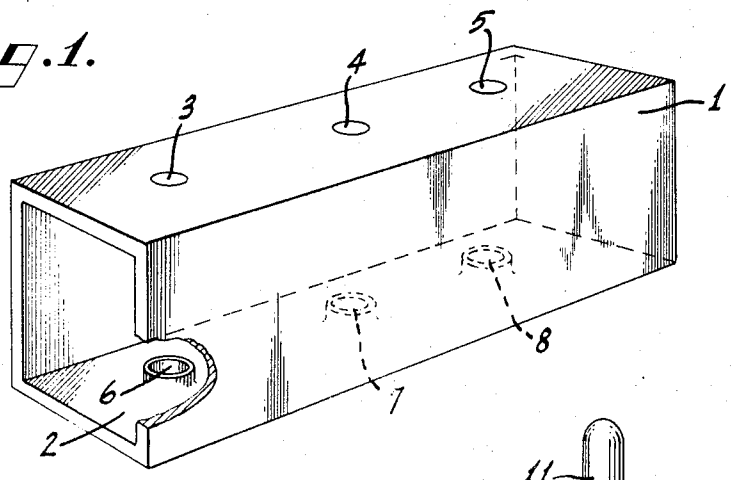


Fig. 2.

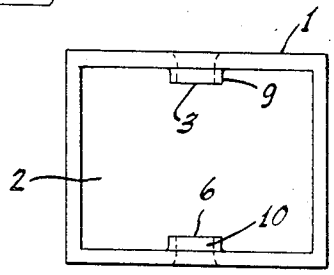


Fig. 3.

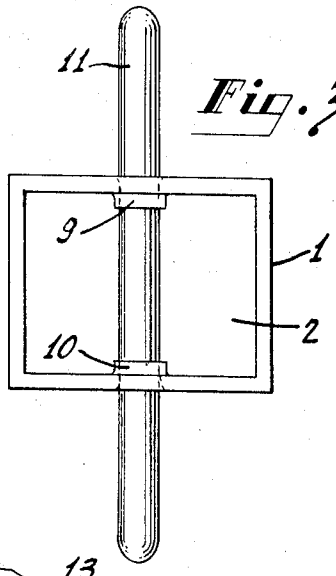
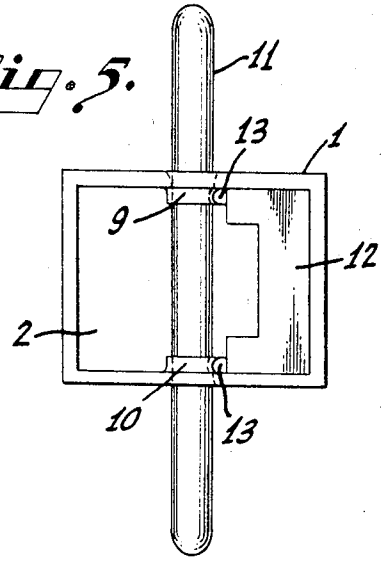


Fig. 5.



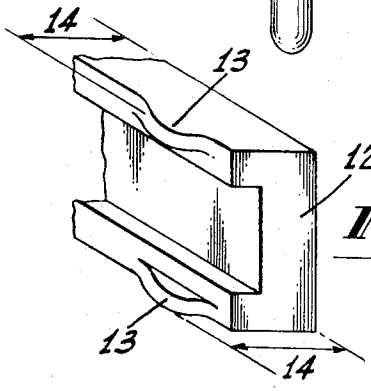


Fig. 4.

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Fig. 6.

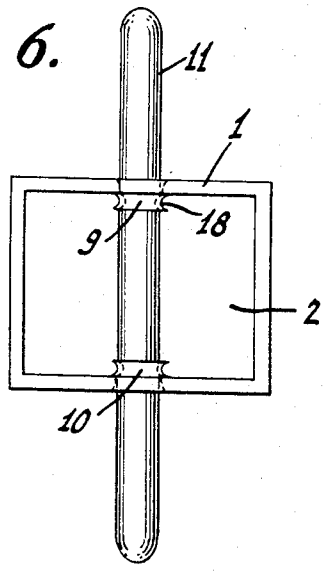


Fig. 8.

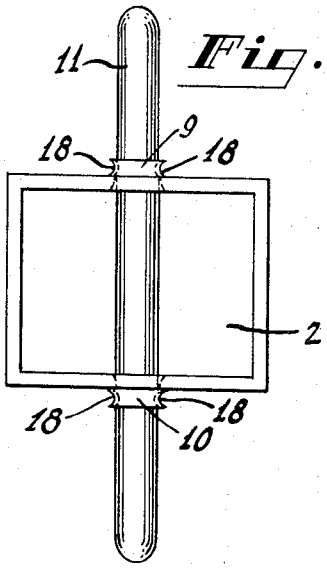
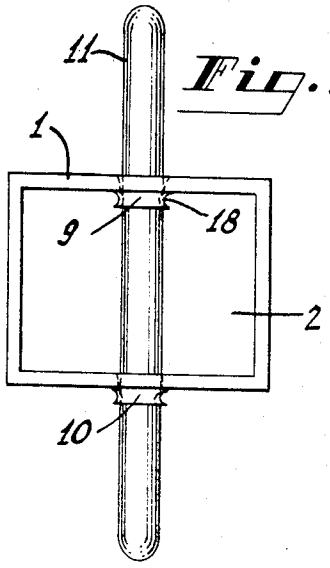


Fig. 9.



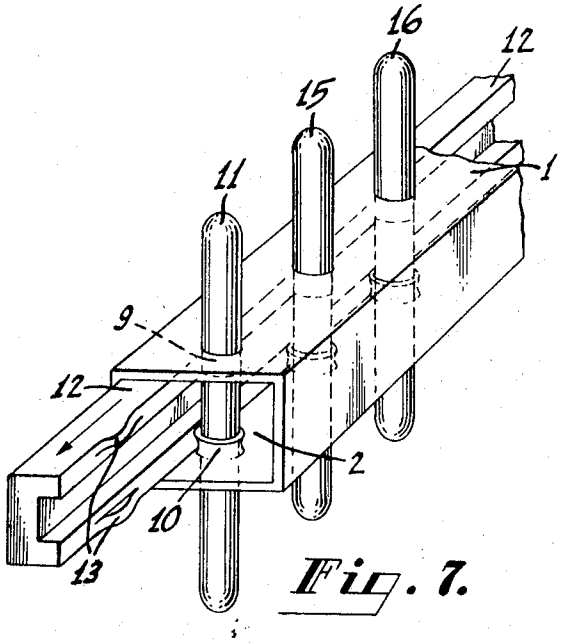


Fig. 7.

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Fig. 10.

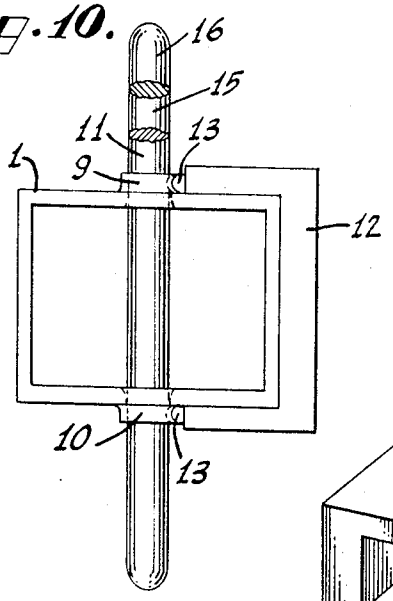


Fig. 11.

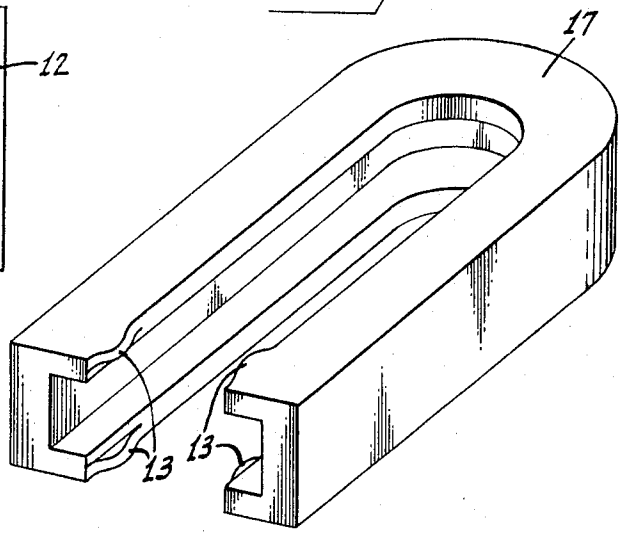
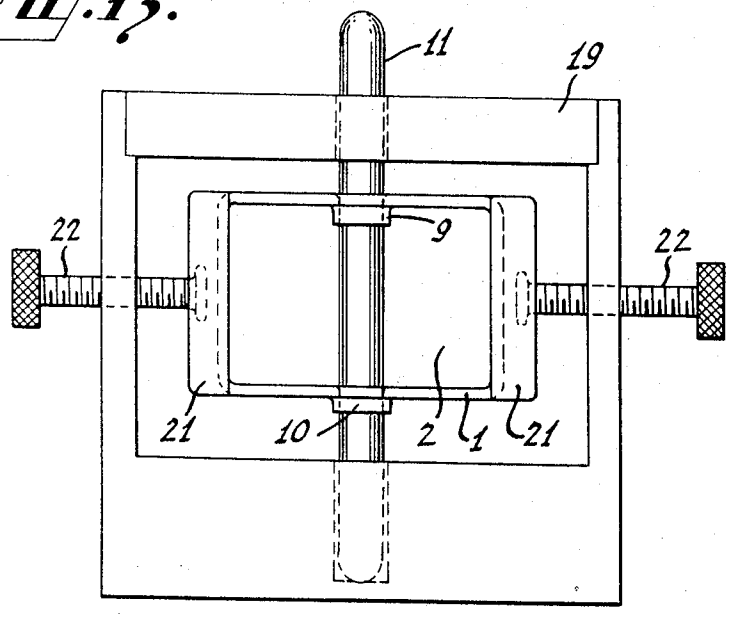


Fig. 13.



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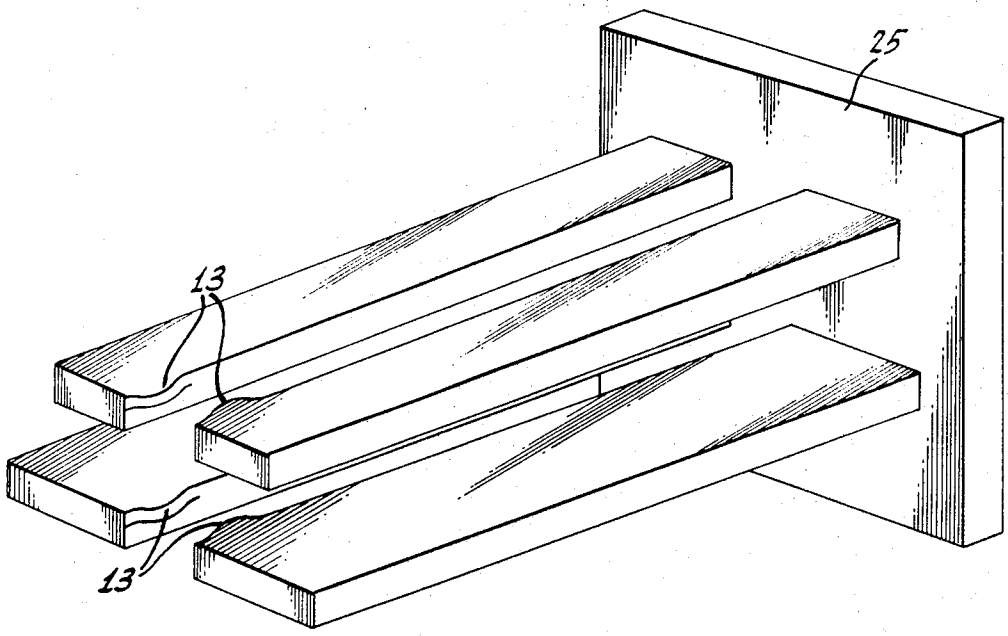

Fig. 12.

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3,429,033

METHOD OF SECURING A ROD TO A SUPPORTING STRUCTURE

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Original application May 27, 1965, Ser. No. 459,386. Divided and this application Feb. 19, 1968, Ser. No. 706,310

U.S. Cl. 29—600 5 Claims

Int. Cl. H01p 11/00; B21d 39/00; F16b 7/00

ABSTRACT OF THE DISCLOSURE

A method of securing a rod to a hollow support structure comprises the steps of forming matching holes through the hollow support structure with the structure material being flared within the structure in a direction transverse to the support structure at the internal edge of the holes, inserting a rod into the holes and passing a member having a die surface through the hollow structure so that the die surface indents a portion of the flared material and forces the material into the rod whereby the rod is locked to the supporting structure.

This is a division of pending application Ser. No. 459,386, filed May 27, 1965, now abandoned by John D. Callaghan.

This invention relates to an improved method of securing a rod or rods to a supporting structure and to apparratus constructed by said method.

The present art teaches the securing of a rod to a supporting structure by various means and for a variety of purposes. For example, in the fabrication of certain types of antennas, the need exists for placing antenna elements or rods perpendicular to the supporting structure or mast.

This is done by fabricating a hole in the element or rod and fabricating another hole in the mast or supporting structure. The rod can now be secured to the supporting structure or mast by conventional means, as a screw, bolt or rivet. The disadvantages of this technique are apparent. The strength of the rod is greatly impaired due to the resulting removal of material caused by the fabrication of the hole in the rod. Another disadvantage is the distortion of the rod if too much pressure is exerted by the screw, bolt or rivet. Still another disadvantage is that, if too little pressure is applied via the screw, bolt or rivet, the rod will have a tendency to rotate with respect to the supporting structure. In order to compensate for some of the above disadvantages, additional means are presently employed. Such means require additional parts, for example, various clamping arrangements, to secure the rod. While such clamping devices supply the necessary support, the additional parts, as in any manufacturing process, require fabrication and hence increase the cost of the final product. The additional parts also require additional steps thereby lengthening the manufacturing process.

Accordingly it is another object of this invention to provide an improved method of securing a rod to a supporting structure.

It is a further object to provide a method of the type described which does not substantially decrease the strength of the rod.

It is a still further object to provide a method of fastening a rod to a supporting structure by the use of a minimum number of parts, thereby reducing cost and decreasing manufacturing time.

It is a still further object to provide a method of the type described which eliminates the possibility of rotation of the rod with respect to the supporting structure.

One embodiment of the present invention entails a method of securing a rod to a supporting structure comprising the steps of forming a hole in said supporting structure so that the structure material is flared in a direction transverse to the supporting structure at the margin of the hole, inserting the rod into the hole and deforming the rod and said flared material by the application of a force transverse to said flared material and rod thereby locking the rod to the supporting structure.

The invention will be described in detail with reference to the accompanying drawing, in which:

FIGURE 1 is a perspective view of a typical supporting member with holes fabricated on two parallel surfaces;

FIGURE 2 is an end view of a typical supporting member showing the flared material forming a collar around the margin of the hole;

FIGURE 3 is an end view of a typical supporting member showing a rod inserted through the hole, surrounded by the collar;

FIGURE 4 shows a perspective view of a typical member having a die surface;

FIGURE 5 is an end view of the member having a die surface inserted in the supporting structure, with the die surface against the flared collar;

FIGURE 6 is an end view of the rod firmly locked to the supporting structure;

FIGURE 7 is a perspective view of a member having a die surface passing through a supporting structure containing a plurality of rods;

FIGURE 8 is an end view of a supporting structure with a rod locked therein by means of indentations on outer flared collars;

FIGURE 9 is an end view of a supporting structure with a rod locked therein by means of indentations on an outer flared collar and on an inner flared collar;

FIG. 10 is a perspective view of a member with a die surface passing by the top and bottom surfaces of a supporting structure;

FIG. 11 is a perspective view of a member having a fork-like structure with die surfaces;

FIG. 12 is a perspective view of a member having elongations with die surfaces; and

FIG. 13 is an end view of a rod and supporting structure inserted and held in a representative jig or fixture.

In the several figures like parts are indicated by similar reference characters.

Referring to FIGURE 1, a hollow, rectangular, elongated supporting structure **1** is shown. The structure **1** is formed with a longitudinal passage **2**, with holes **3**, **4** and **5** appearing on the top surface and holes **6**, **7** and **8** which are in line with holes **3**, **4** and **5**, respectively, appearing on the bottom surface. The structure **1** may be made of metal, for example, aluminum, or a desired non-metal material. In the specific embodiment illustrated in FIG. 1, the supporting structure **1** is about six inches long with a height and width of about ¾ inch. In other embodiments the length might be several feet, fifteen feet for example, and, assuming the support to be a hollow square, the height and width might be one foot. In general, the dimensions are such that there is restricted access to the interior of the supporting structure. In FIG. 2 the numerals **9** and **10** indicate collars surrounding the holes **3** and **6**. The collars **9** and **10** can be fabricated, from the supporting structure material **1**, during the hole forming process; by conventional techniques, such as shaping, flaring or extruding. A method of achieving this is to use a hybrid tool configuration where the lower por-

tion of the tool consists of a conventional drill bit and the upper portion consists of a cone-like section such that the diameter gradually increases in a direction towards the top of the tool. With said tool, after the hole is drilled by the drill-like portion; the cone-like portion of the tool is forced through the hole thereby forming a collar or flaring of the structure material. Other methods for producing the holes with collars or flaring are well known in the field and any such method is acceptable.

In FIG. 3 there is shown a rod **11** inserted into the holes **3** and **6**, the flared or extruded material forming the collars **9** and **10** surrounding the rod **11**. The rod **11** can be formed of rolled metal formed into a tube-like configuration or can be made of any other suitable material. A U-shaped elongated member **12** is shown in FIG. 4. Near the end of the member **12**, a bead or die surface **13** is provided at the two ends of the U. The dimension represented by reference **14**, designates the dimension from the outer most point on the die surface **13** to the back wall of the member **12**. This dimension **14** is made somewhat longer than the distance between the collar **9** (and the collar **10**) within the support structure **1** and the adjacent wall of said support structure. The die surface **13** of the U-shaped member **12** is made of a material harder than that of the support structure **1**, to prevent excessive wear during the herein described method.

A form of the method will be described in connection with FIG. 7. An additional rod **15** is shown inserted through the holes **4** and **7** on the structure; and a further rod **16** is shown inserted through the holes **5** and **8** on the structure **1**. The member **12** of FIG. 4 is inserted in the longitudinal cavity **2** of the support structure **1**. As the member **12** is forced through the cavity **2** in the direction indicated by the arrow the progress of the member **12** is hampered first by the engaging of the collars or flaring surrounding the rods **15** and **16** with the beads or die surfaces **13** of the U-shaped member **12** and then by the engaging of the beads **13** with the collars **9** and **10** which surround rod **11**. By forcing the U-shaped member **12** through the cavity **2** by suitable means, not shown, the die surfaces **13** are made to exert a force transverse to the collars. Hydraulic, air or other force exerting means can be employed. Referring to collars **9** and **10**, for example, the bead or die surfaces **13** force the engaged area of the collars **9** and **10** inwardly, creating a similar indentation upon the rod **11**. By this means the rod **11** is locked in its position with the supporting structure **1**. This step in the operation is shown in FIG. 5.

From this it can be easily visualized that the member **12** in conjunction with its die surfaces **13** performs the same operation upon each rod **15**, **16** and associated collars as it does on rod **11** and collars **9** and **10** as the member **12** is forced through the longitudinal cavity **2** of the support member **1**. When the U-shaped member **12** is forced past all the collars and rods, each rod will be locked in its position within the support structure **1**. The member **12** can be easily pulled out from either end as the indentation formed will allow clearance of the bead or die surface. It is also clear that the same U-shaped member **12** inverted, or another suitable member will perform the identical operation upon the opposite side of the collar by moving the member through the longitudinal cavity **2** with its outer wall against the opposite wall of the supporting structure **1**.

FIG. 11 illustrates a fork-like member **17** that will cause both sides of the collars around the respective holes **3** through **8** to be indented into the rods as the member **17** is forced past such collars and rods via the longitudinal cavity **2**. This member **17** can then be removed from the supporting structure **1**, in a direction opposite to the direction in which the force was exerted.

An end view of the final composite structure is shown in FIG. 6. Reference **18** indicates the typical indentations necessary to secure the rod in the supporting structure.

FIGS. 8 and 9 show configurations that will lock the rod in the supporting structure by slightly different variations of the same method. If reference is made to FIG. 10 there is shown a perspective view of a plurality of rods in a supporting structure **1** where the collars **9** and **10** are formed by a similar process, as hereinbefore described, but on the outside of the parallel surfaces of the supporting structure **1**. The support structure **1**, may be solid or hollow for this operation. Here the U-shaped member **12** having die surfaces **13** passes over the support structure and in doing so exerts a force upon each collar and rod, thereby indenting such combination exactly as in the former case, causing said rods to be locked in said supporting structure. The final composite structure produced by this variation in method is shown in FIG. 8. The identations referenced as **18**, firmly lock the rod in the support structure.

It should be noted that the previously described operations require a suitable jig or fixture to keep the assembly, consisting of the support structure and rods, secure and properly oriented during the application of force by the member having a die shaped surface. FIG. 13 shows a supporting structure **1**, and rod **11**, secured in position within a representative fixture or jig **19**. The fixture **19** can be firmly secured to a table or other body, not shown. The supporting structure **1** is held in position by the two clamp-like structures designated as **21**. These in turn can be positioned by means of the adjustable bolt arrangements **22**. The assembly consisting of elements **21** and **22** and the side wall of the fixture constitutes a vise-like configuration.

It can be seen that the jig or fixture **19**, although only a typical representation, can accommodate a member having die surfaces, such as the member shown in FIGS. 4, 7, 10, 11 or 12, and consequently may act upon the collars **9** and **10** whether they are as shown in FIGS. 9 and 13 or are as shown in FIGS. 2 and 8.

While the diagrams show rectangular supporting structures it is clear that the support structure may take any other desired shape, such as square, hexagonal, oval, round or even irregular as required. The member having a die shaped surface will preferably be given a corresponding shape as to enable it to exert the required force. It is also clear that a member could be so devised as to perform an operation resulting in a composite structure as represented in FIG. 9. This can be done with a member having characteristics of both the member shown in FIG. 7 and the member shown in FIG. 10. If reference is made of FIG. 12, the member **25** shown, will perform the operation resulting in the composite structure shown in FIG. 9. It is also clear that the holes fabricated in the support structure can take on any irregular shape corresponding to any type of rod to be inserted in such holes.

A feature of applicant's invention is that no parts other than the rod and support structure itself are required to firmly lock the rod on the support structure. No rivets, clamps, or other means are needed. The invention is particularly useful in applications where a large number of rods are to be supported. In the past, each rod had to be secured in turn so that each rod required a separate, individual operation involving a number of different steps. By the present invention, a plurality of rods can be substantially simultaneously locked to a support structure by a single action, namely, the movement of the die member. Further, since it is not necessary to drill holes in the rods, or otherwise remove surface portions of the rods, the rods are not structurally weakened.

I claim:

1. The method of securing a rod to a hollow support structure which comprises the steps of:

(a) forming a hole through said hollow support structure with said structure material being flared within said structure in a direction transverse to the support structure at the internal edge of the hole,

(b) inserting said rod into said hole, and

(c) passing a member having a die surface through said hollow structure in such a manner that said die surface indents a portion of said flared material forcing said material into said rod whereby said rod is locked to said supporting structure.

2. The method of securing a plurality of rods to a hollow support structure in rapid succession which comprises the steps of:

(a) forming holes in said structure at predetermined spaced intervals along said support structure,

(b) flaring said structure material in a direction transverse to the supporting structure at the edge of each of said holes,

(c) inserting said rods in said holes, and

(d) passing a member having a die surface through said hollow structure in such a manner that said die surface indents a portion of said flared material at each of said holes forcing said material into said respective rods whereby such rods are locked to said supporting structure.

3. The method of securing a plurality of rods to a hollow support structure along two surfaces of said support structure which comprises the steps of:

(a) forming holes through each of said surfaces at specified intervals along each surface with said structure material being flared in a direction transverse to the supporting structure at the edge of each hole,

(b) inserting said rods into said holes such that said rods pass through and extend from each of said surfaces of said supporting structure,

(c) inserting said combination of rods and supporting structure in a suitable jig or fixture to hold said combination rigid and properly oriented, and

(d) passing a member having a die usrface through said hollow structure in such a manner that said die surface indents a portion of said flared material forcing said flared material at each of said holes into said respective rods, whereby said rods are locked in said supporting structure.

4. The method of securing a plurality of rods to a hollow support structure along two parallel surfaces of said support structure which comprises the steps of:

(a) forming holes through each parallel surface of said support structure at specified lengths along each surface with said structure material being flared in a directon transverse to the support structure at the edge of each hole, such that such flared material forms a collar on the inside of said support structure around each hole on each of said parallel surfaces,

(b) inserting said rods in said holes such that said rods pass through and extend from each surface of said supporting structure,

(c) inserting said combination of rods and support structure in a suitable jig or fixture to hold said combination rigid and properly oriented, and

(d) passing a member having a die surface through said hollow support structure in such a manner that said die surface indents a portion of said flared material at each of said holes forcing said flared material into said respective rods, whereby said rods are locked in said supporting structure.

5. The method of securing a plurality of rods to a hollow support structure along two parallel surfaces of said support structure which comprises the steps of:

(a) forming holes through each parallel surface of said support structure at specified lengths along each surface with said structure material being flared in a direction transverse to the support structure at the edge of each hole, such that said flared material forms a collar on the outside of said support structure around each hole on each of said parallel surfaces,

(b) inserting said rods in said holes such that said rods pass through and extend from each surface of said supporting structure,

(c) inserting said combination of rods and support structure in a suitable jig or fixture to hold said combination rigid and properly oriented, and

(d) passing a member having a die surface over said support structure in such a manner that said die surface indents a portion of said flared material at each of said holes forcing said flared material into said respective rods, whereby said rods are locked in said supporting structure.

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U.S. Cl. X.R.

29—517; 287—54; 343—818, 912