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(54) **Spigot and socket connection for rail fencing**

(57) Vertical tubular rails 7 are joined at each end to a spigot 12 by deforming a part of the tube into a portion 15 of reduced diameter on the spigot. The upper spigot is formed on a decorative spear, the upper horizontal rail being located between the upper end of the rail 7 and the spear. The lower end of the rail 7 is secured to a spigot 12 on a boss 1, the boss having a further spigot 25 which extends through the lower horizontal rail and has an end cap 11 secured thereto. A list of posts is disclosed, Fig. 5 (not shown). The rail 7 is deformed by a tool 16 having a screw 20 with a pointed end 21.

Fig.8.

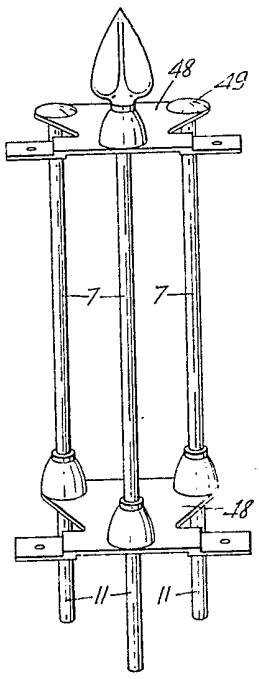
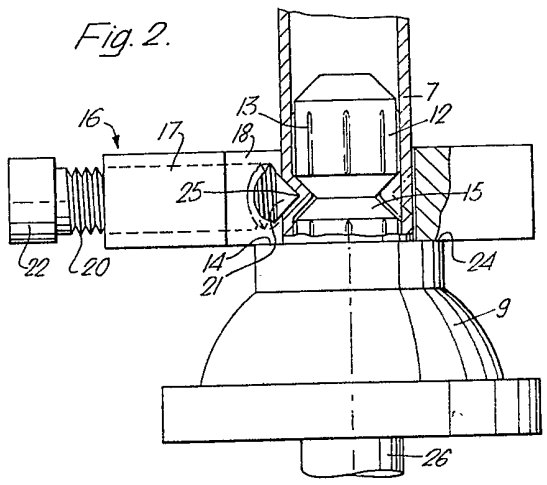


Fig. 2.



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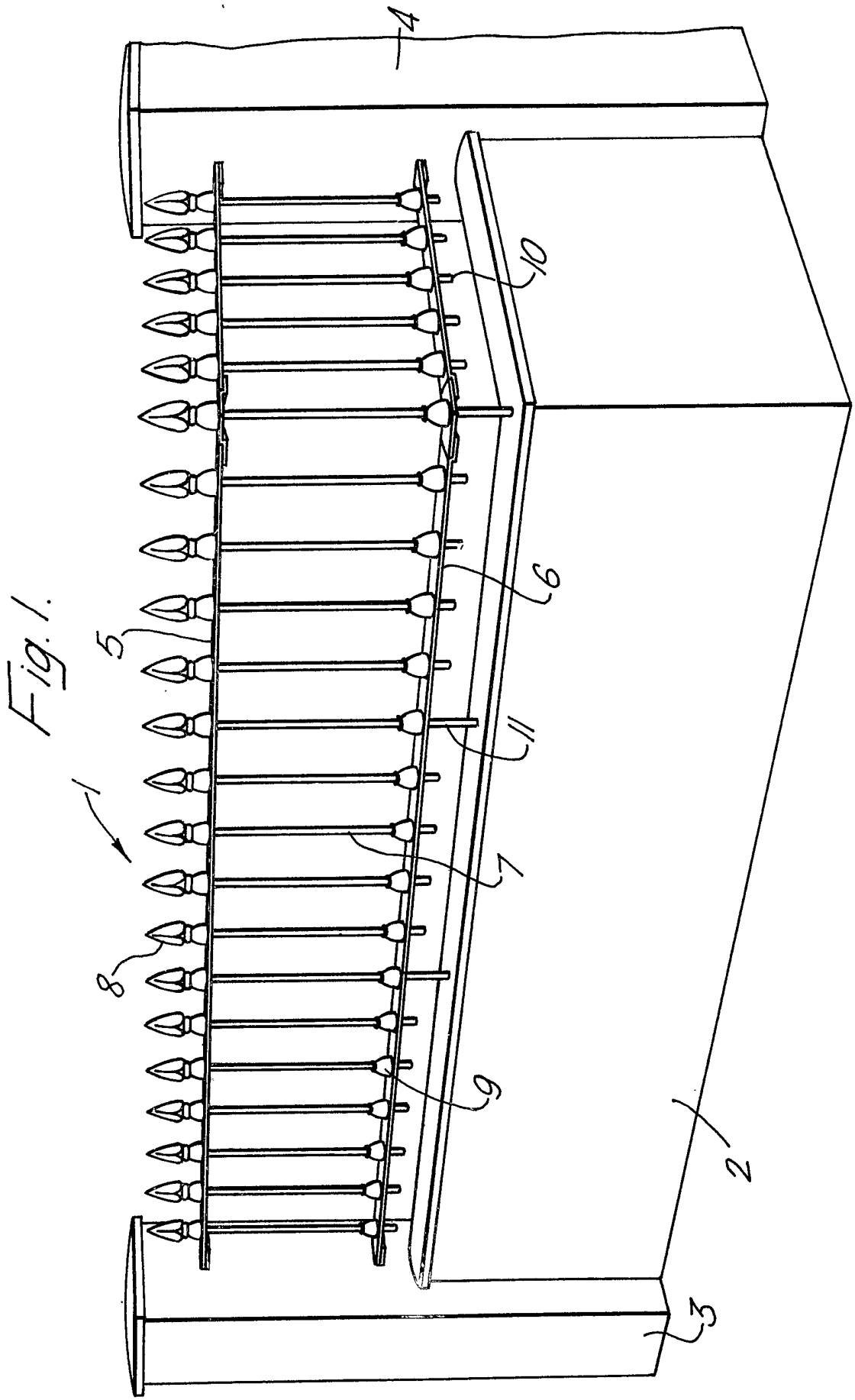


Fig. 1.

Fig. 2.

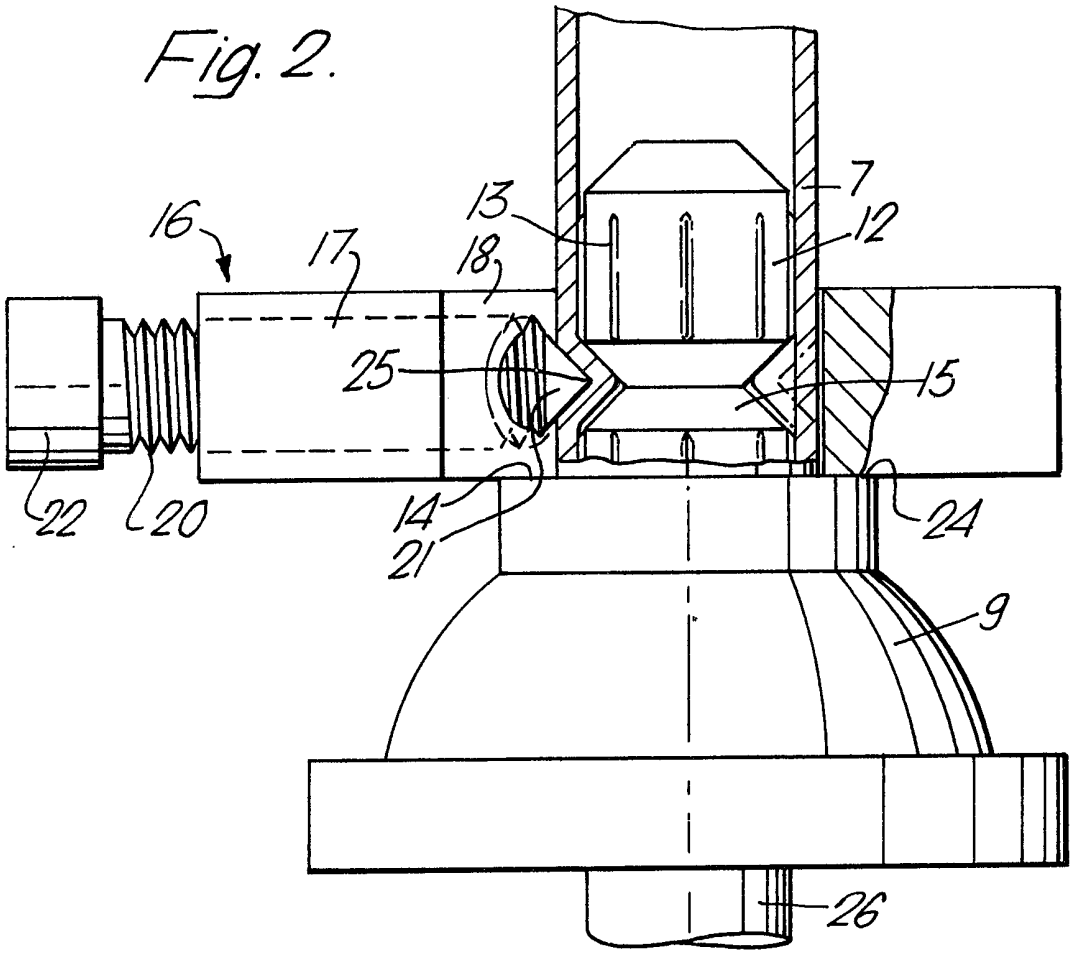
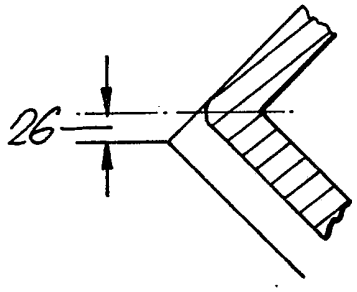


Fig. 2A.

Fig. 2B.



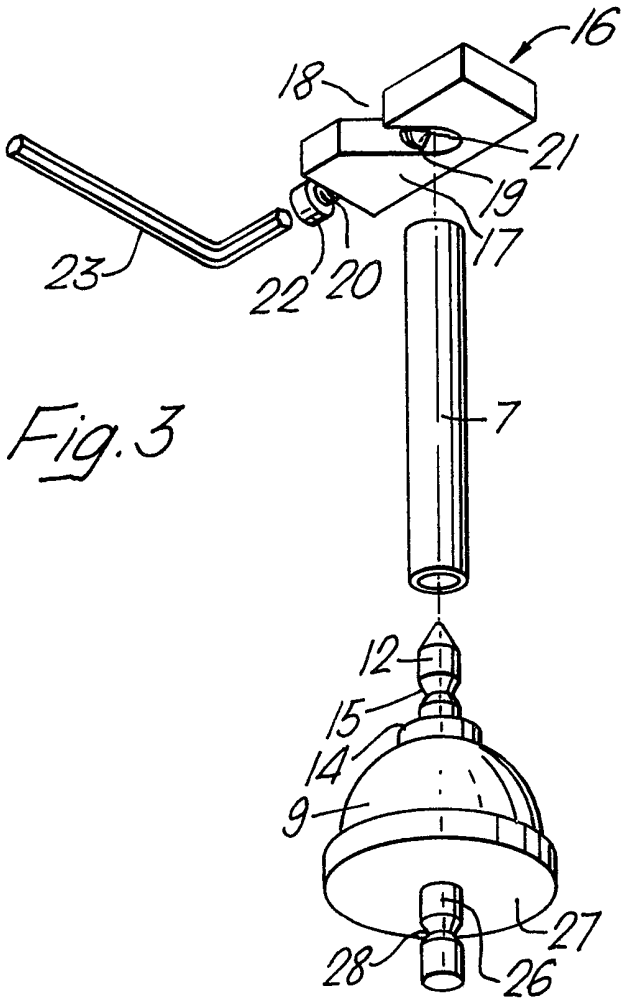


Fig. 3

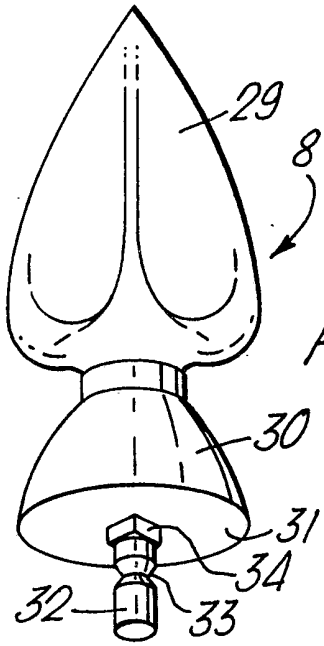
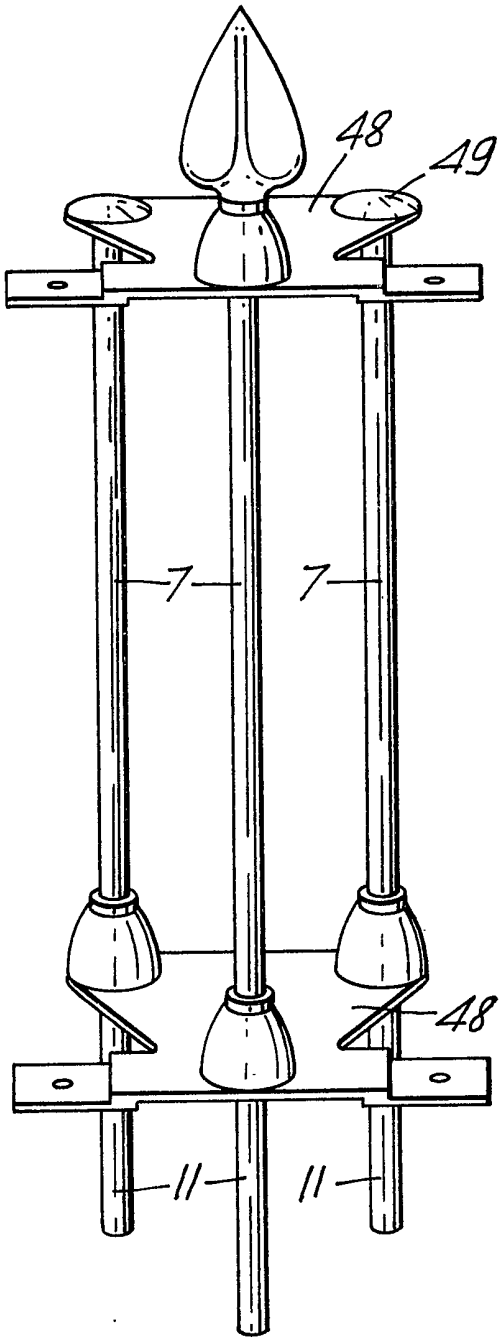


Fig. 4.

Fig. 8.



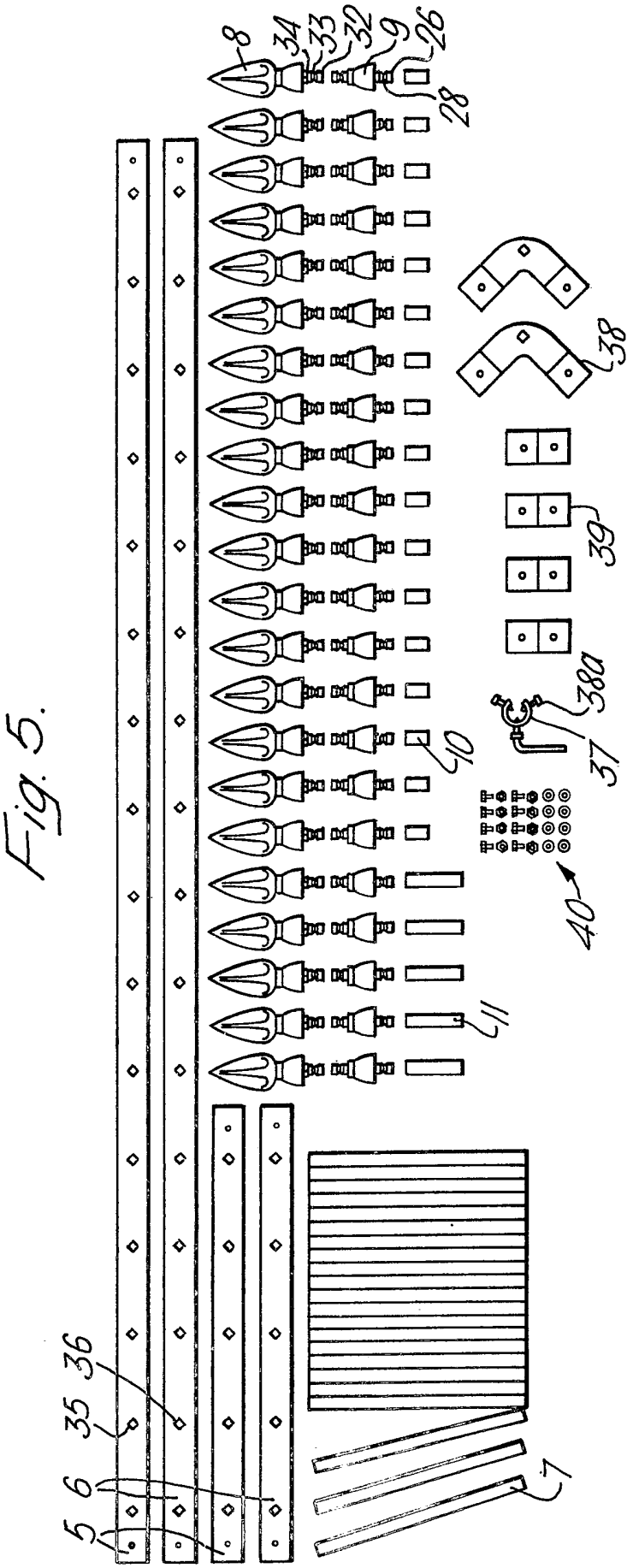


Fig. 5.

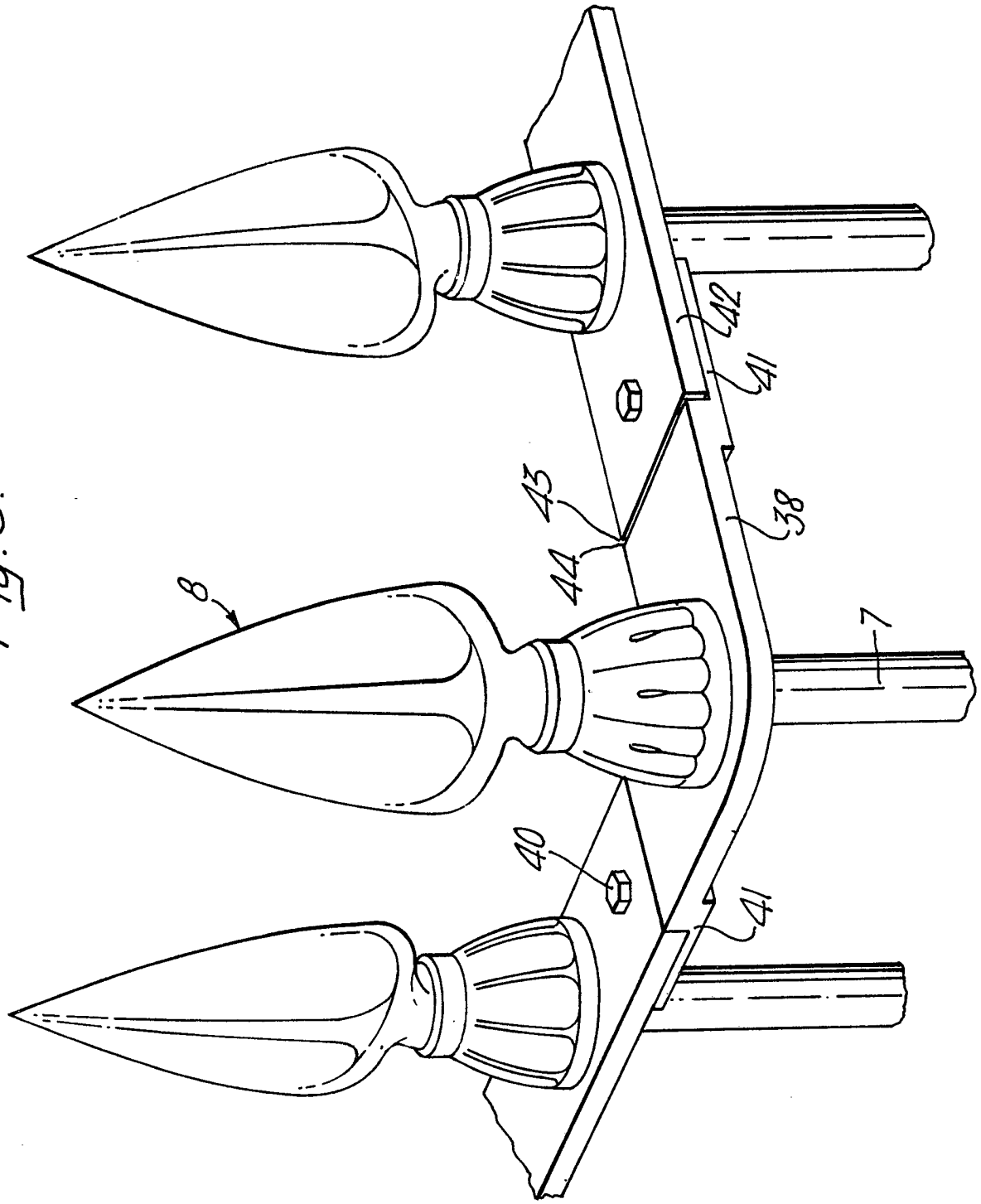
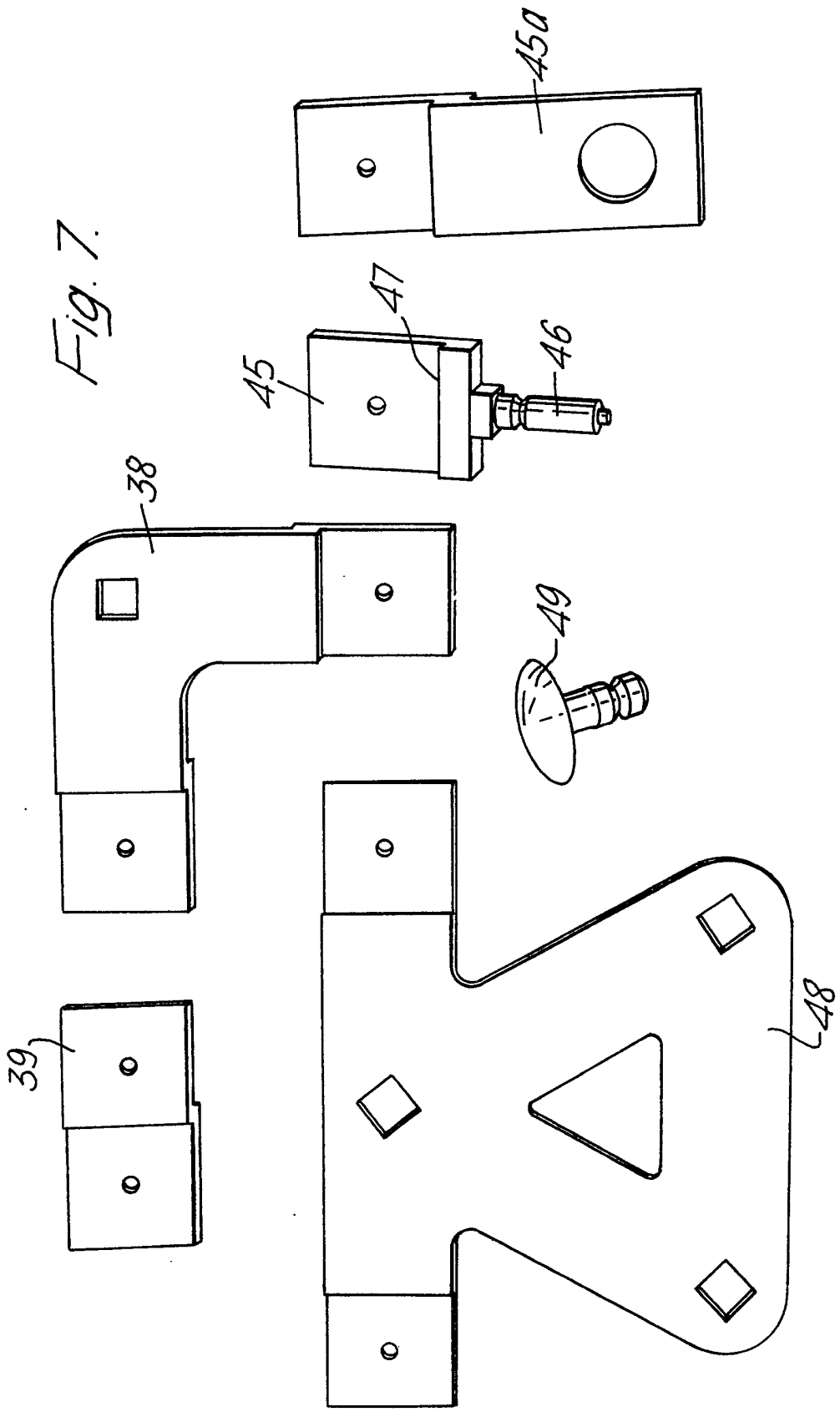


Fig. 6.

Fig. 7.



SPECIFICATION

A connection

This invention relates to a spigot and socket connection for the end-to-end connection of elements in axial alignment. The invention also relates to a railing in which end fittings are assembled with tubular members and are connected to them by means of a spigot and socket connection. The invention further relates to a kit of parts from which a railing may be constructed by assembling the parts and in which end fittings are connected to tubular elements by means of a spigot and socket connection.

Cast iron railings are known but the construction of such a railing is costly. Apart from the expense of the material and the castings, the assembling of the parts involves connecting techniques requiring the application of heat to at least some of the parts. It is an object of the invention to provide an improved method of connecting elements end-to-end in axial alignment, and to provide an improved spigot and socket connection by which elements may be connected end-to-end in axial alignment. It is also an object of the invention to provide a railing in which end fittings are connected to tubular elements by means of an improved spigot and socket connection. It is a further object of the invention to provide a railing in which materials of light weight may be used, and to provide a kit of parts from which a railing may be assembled. It is another object of the invention to provide a tool suitable for use in connecting elements in end-to-end axial alignment.

According to the invention, there is provided a spigot and socket connection for the end-to-end connection of elements in axial alignment, wherein the spigot has a portion of reduced cross-sectional area intermediate its ends and is adapted to be a light force fit in the socket when assembled therewith and the socket is adapted for non-removable connection to the spigot, by deformation of the socket in a region thereof corresponding to the portion of the spigot of reduced cross-sectional area when the spigot and socket are assembled together. The spigot may form part of an end fitting for connection to a vertical tubular member in a railing and the socket may be an end portion of the tubular member.

The connection according to the invention is easy to assemble and complete, and is firm and rigid in service. Its use in a railing allows light materials such as aluminium to be used so that the railing is suitable for so-called "do-it-yourself" installation. In appearance an aluminium railing using the connection according to the invention is indistinguishable, when painted, from a cast iron railing, and has the advantage of being rustproof.

An embodiment of the invention will now be more particularly described, having regard to the drawings, of which:

Fig. 1 shows a completed section of a railing using the connection according to the invention;

Fig. 2 is a part section through a connection according to the invention, in the course of deforming the socket;

Fig. 2A is a detail view of a part of one form of the deformed socket and the spigot;

Fig. 2B is a sectional view of a detail of the spigot;

Fig. 3 is an exploded view of a boss as used in the railing of Figure 1, a tube and a connecting tool;

Fig. 4 shows a spear as used in the railing of Fig. 1;

Fig. 5 shows a kit of parts for assembling to form a section of railing as shown in Fig. 1;

Fig. 6 shows a corner and corner fitting of the railing of Fig. 1;

Fig. 7 shows a number of fittings for use in assembling a railing similar to that shown in Fig. 1; and

Fig. 8 shows a reinforcing arrangement for use in a linear run of railing.

In Fig. 1, there is shown a railing in which the spigot and socket connection according to the invention is employed. The railing 1 is of generally conventional appearance and extends along the top of a low wall 2 between an end pillar 3 of the wall and a further pillar 4. The railing consists of an upper longitudinal member or rail 5, of generally rectangular cross-section, and a similar lower rail 6. Vertical upright members or bars 7 extend between the horizontal rails 5 and 6, and in the case of the railing using the present invention, these bars are tubular, and preferably of circular cross-section, although tubes of generally rectangular cross-section may also be employed. Where tubes of generally rectangular cross-section are used, they may be provided with sections having a circular cross-section, in the regions of their ends, or the ends may be closed by a plate having a circular aperture therethrough. The tubes are preferably aluminium and a suitable diameter is 18 mm ($\frac{3}{4}$") with a wall thickness of 1.5 mm. Ordinary soft aluminium for general use may be employed or alternatively aluminium of a higher grade, having a higher tensile strength, where such a property may be required. Other materials and tube sizes may also be employed. At its upper end, each tube is connected to an upper end fitting 8 of suitable ornamental appearance. These fittings are frequently in the form of a spear head, and will be referred to herein as "spears", but it will be understood that the fitting, or "spear", may be for example, also in the form of a fleur-de-lis. In the railing described, the spears are preferably die castings in aluminium, but traditional materials for such fittings may also be used, and they may also be formed by methods other than die casting. The spear 8 is provided with a spigot adapted to enter into the tube 7 for connection thereto, and it is this spigot and socket connection which forms one subject of the present invention and which will be hereinafter described. The upper rail 5 is provided with apertures through which the spigots of the spears can pass and is clamped between the spear 8 and the tube 7 when these

are connected together. The lower end of the tube 7 is similarly connected to a lower end fitting 9, herein referred to as a "boss", but in this instance, the lower rail 6 which is provided with apertures similar to those in the rail 5, is not clamped between the boss and the tube 7. The low rail is clamped to the boss by providing a further spigot on a lower face of the boss, to project through one of the apertures in the lower rail, and to which a further short tube 10 is connected using the connection according to the invention, the rail 6 being interposed between the boss and the tube 10 and thereby gripped between the two when the connection is formed. As well as tubes 10, longer tubes 11 are provided at spaced apart intervals, also connected to the boss and clamping the lower rail in the same way, but having their lower end portions set into the wall so as to support the railing on the wall. End fittings are provided on the rails 5 and 6 for setting into the pillars 3 and 4 to similarly support the railing with respect to the pillars. These and other aspects of the railing will be further described hereinafter.

Turning now to Fig. 2, the connection according to the invention will be described. As shown in Fig. 2, the connection is between the spigot of a boss 9 and a tube 7, but as will be described, the connections between the tubes 7 and the spears 8, and between the tubes 10 and 11 and the lower spigots of the bosses 9 are generally similar. As shown in Fig. 2, the boss 9 has an upright spigot 12 adapted to enter the end of the tube 7. The spigot 12 is a light force fit in the tube and to ensure this, the spigot 12 is provided with narrow raised flutes or splines along its length, parallel to its axis. The nature of these flutes 13 is shown in the part-cross-sectional view of the spigot 12 in Fig. 2A. Other means of achieving the force fit may also be used. Movement of the spigot 12 into the end of the tube 7 is limited by a face 14 of the boss, surrounding the inner end of the spigot, against which the end face of the tube abuts. The spigot 12 is provided with a portion 15 of reduced cross-sectional area intermediate its ends. As shown in Fig. 2, this portion consists of a substantially V-shaped notch therein, as seen in transverse cross-section, but other shapes of the portion are also possible. The proportions shown in the Figs. are also by way of example only.

The tube is most suitably of a readily deformable material such as aluminium, and the connection according to the invention is completed by applying localised pressure to the outside surface of the tube 7 in a region thereof corresponding to the portion 15 of the spigot of reduced cross-sectional area when the spigot and the tube are fitted together, so that deformation of the tube takes place and at least a part of the wall of the tube enters into the V-shaped notch comprising the portion 15, thus forming a non-removable connection between the spigot 12 of the boss and the tube 7. A tool for bringing about this deformation and a method of using it will now be described.

The deforming tool 16 consists of a block 17 having a slot 18 in it, of a size adapted to accommodate a tube 7. The slot 18 extends from one side of the block and has a profiled inner end, shaped to receive the curved wall of the tube. These aspects of the tool 16 are shown more clearly in Fig. 3. A threaded hole 19 (Fig. 3) extends through the block 17 from an outer face thereof to the slot 18 and a screw 20 is mounted in the hole. The inner end of the screw is pointed, 21, and the outer end is provided with an Allan-type head. The screw 20 may be screwed in and out by means of an Allan key 23, and when the pointed end 21 impinges on the wall of the tube 7, it causes it to deform and presses a portion of it into the V-shaped notch comprising the portion 15 of the spigot. The block is so dimensioned that when the face 24 of the block is held against the face 14, the apex 25 of the end 21 of the screw is not directly aligned with the apex of the V-shaped notch in the spigot. During the deformation of the wall of the tube, one side of the deformed area is pressed hard against one side of the V-shaped notch, thus causing a firm connection to be obtained. As can be seen in Fig. 2, the dimensioning of the tool is therefore such that the deformation of the tube causes the tube to be tensioned slightly and creates a firm connection between the tube and the boss. Fig. 2B is a fragmentary view of a deformed portion of the tube and the V-shaped notch showing the spacing 26 between the apices of the notch and the deformed portion resulting from the non-alignment of the apices of the screw and the notch. An additional bond between the spigot and the socket, to strengthen that form by the force fit and the deformation, may be obtained by the use of a suitable epoxy resin or other adhesive.

Fig. 3 shows the boss, tube and tool in perspective view, and requires little further description. It will be seen that the boss 9 has a further or lower spigot 26, generally similar to the spigot 12, and onto which the tube 10 or 11 may be fitted, for connection in similar manner to that already described. In this instance, the rail 6 is clamped between the face 27 of the spigot and the end of the tube 10 or 11, and it is provided with a suitably dimensioned hole through which the spigot will pass. The dimensions of the spigot 26 and in particular the spacing of the portion 28 of reduced cross-sectional area from the ends of the spigot must, of course, differ from those of the spigot 12 in order to allow for the thickness of the rail 6.

Fig. 4 shows a spear 8 in more detail. As shown in the drawings, it comprises a decorative upper portion 29, which may take a variety of forms. As shown in the drawings, it is generally planar with suitable embellishments. The spear has a lower portion 30 which is of circular cross-section, the diameter of the cross-section increasing dowwardly, and the lower portion has a face 31 on its lower side which bears against

the upper surface of the rail 5 in the assembled railing. The spear has a spigot 32 extending downwardly from this lower face with a portion 33 of reduced cross-sectional area intermediate its ends. This portion 33 and the spigot 32 are generally similar to the spigot 12 and portion 15 of the boss 9 and the connection of the spear 8 to the tube 7 is achieved in the same way as already described for the boss. In order to keep the planar decorative portion of the spear in alignment with the longitudinal direction of the railing, the portion of the spigot 32 immediately adjacent the face 31 is of square cross-section and the holes or apertures in the rail 5 are also square, so that when a spear is mounted on the rail and fixed in position by the connection of the tube 7 to it, it cannot rotate, with respect to the rail 5.

The lower spigot 26 of the boss 9 is also provided with a square section immediately adjacent the face 27 and the holes or apertures in the lower rail 6 are likewise square, so that the bosses 9 are also prevented from rotating. In the preferred construction of the railing, both rail 5 and rail 6 are provided with square holes or apertures for the spigots, and are in fact interchangeable with each other and identical. The diagonal dimension of the holes is preferably parallel to the longitudinal direction of the rail in each case.

In Fig. 5, there is shown a kit of parts suitable for assembling a section of a railing similar to that shown in Fig. 1. The various parts will be clear from the drawing. It will be seen that the upper rails 5 are provided with square holes 35, through which the spigots 32 of the spears pass and in which the square spigot sections 34 are located. The rails 6 are also shown as having square holes 36 and as already mentioned, the spigots 26 of the bosses are also provided with suitable square locating portions. The rails 5 and 6 are interchangeable. Another embodiment of the tool for connecting the spears and bosses to the tubes 7, 10 and 11 is shown at 37. This has three screws 38a and provides for more precise and convenient securing together of these elements. The tool could also be hydraulically operated, to allow speedier operation, and the deforming elements would then be the ends of pistons, or suitable attachments for pistons. The deforming ends of these elements or of the screws may have different profiles depending on the shape of the portions of reduced cross-sectional area on the spigots. Also shown are corner pieces 38, rail connectors 39 and fixing elements such as nuts and bolts 40 for use with these.

The function of the corner piece will be clear from Fig. 6. The piece 38 has an extension section 41 at each end which extends from and is parallel to the main body of the piece 38 to provide a face 42 against which the end of a section of rail may lie so that the end face 42 of the rail will abut the end face 44 of the main body of the corner piece. Suitably a small gap is left between the end faces 43 and 44 for expansion purposes. The extension sections 41 are preferably integral with the main body of the corner piece and may be welded to it. The corner piece is connected to the rail by a bolt 40 passing through the rail and the extension section. The holes for the bolts in both the rail and the corner piece are preferably provided in the parts as supplied. It will be understood that other configurations of corner piece may be provided, within the scope of the invention.

Fig. 7 shows in more detail, a corner piece 38, a rail connector 39, a pillar connector 45 having an end part 46 which is attached to a section of tube 46a to be sunk into the pillar and fixed thereto and a face 47 against which the end of the rail abuts, as already described in regard to the corner piece, a build-in pillar connector 45a and a reinforcement fitting 48 with a plug 49 for use with it.

The tube 46a is fitted to the end part or spigot 46 of the connector 45 in the same manner as already described for the spear 8 and the boss 9. The tube 46a is sunk into the pillar in the same way as the tubes 11. The cross-sectional dimensions of the tubes 46a are identical with those of the tubes 7 and 11, thus the same connection tool 16 or 37 can be used for all spigot to tube connections and a single size of masonry drill can be used for drilling the wall and pillars to receive the tubes 11 and 46a. These features are of particular advantage in the case of "do-it-yourself" assembly of the railing.

The function of the fitting 48 will now be described having regard to Fig. 8. The fitting 48 is used where it is desired to give additional strength and rigidity to a railing in a long run between pillars. Two fittings 48 are used, and are interposed between sections of upper and lower rails respectively. Three tubes 7 extend vertically between the fittings and are secured to them at the top and bottom as already described in relation to the spears and bosses. Three tubes 11 are provided, extending below the lower fitting 48, to be sunk into the wall. Thus a firm support may be provided for the railing section. To avoid spoiling the visual aspect of the railing, the rear two tubes are not secured to the upper fitting 48 by means of spears but by means of the plug 49 as shown in the drawings, which has a spigot generally similar to those of the spears and bosses. Where long runs of rails are to be connected without reinforcement fittings, connecting plates or connectors 45a are used, as shown in Figs. 5 and 7, which are bolted to each of two adjoining sections of rail in the same way as the corner piece 38.

A gate of generally similar construction to match the railings may also be provided. However, a gate is not suitable for full "do-it-yourself" construction from a kit of parts, and thus at least a frame part of the gate, including cross-bracing members, is provided in predetermined sizes, to suit each particular design of railing. Portions of the gate may be assembled from a "do-it-yourself" kit as desired and as suitable.

Claims

1. A spigot and socket connection for the end-to-end connection of elements in axial alignment, wherein the spigot has a portion of reduced cross-sectional area intermediate its ends and is adapted to be a light force fit in the socket when assembled therewith and the socket is adapted for non-removable connection to the spigot by deformation of the socket in a region thereof corresponding to the portion of the spigot of reduced cross-sectional area when the spigot and socket are assembled together.

2. A spigot and socket connection according to claim 1, wherein the portion of the spigot of reduced cross-sectional area comprises a circumferential V-shaped notch in the spigot.

3. A kit of parts suitable for assembly to form a railing, comprising at least one rail having a plurality of apertures therethrough, a plurality of fittings, each having a spigot adapted for insertion through a said aperture, and a plurality of tubular members, wherein each spigot has a portion of reduced cross-sectional area intermediate its ends and is adapted to be a light force fit in an open end of a tubular member when assembled therewith, and each said open end is adapted for non-removable connection to one of the said spigots by deformation of the tubular member in a region thereof corresponding to the portion of the spigot of reduced cross-sectional area when the spigot and tubular member are assembled together.

4. A railing assembled from a kit of parts according to claim 3, wherein the spigot of each said fitting passes through one of the said apertures and is connected to one of the said tubular members.

5. A method of forming a non-removable connection between the spigot and socket of a spigot and socket connection according to claim 1, wherein the spigot is inserted in the socket and the socket is deformed in at least a part of its said region.

6. A tool suitable for use in the method according to claim 5, having at least one support surface adapted to bear against at least a part of an external surface of the socket in its said region and a movable member adapted to selectively extert a concentrated force on a further part of the said external surface.

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