(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 048 624
A2

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: 81304359.3

(22) Date of filing: 22.09.81

(51) Int. Cl.^{3}: E 04 G 11/48
E 04 G 1/14

(30) Priority: 24.09.80 CA 360925
05.02.81 US 231778

(43) Date of publication of application:
31.03.82 Bulletin 82/13

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

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(54) **Lightweight, welded aluminium shoring frame.**

(57) A vertical load supporting frame comprises a pair of spaced vertical tubular legs and interconnecting brace arrangement welded to the legs. The spaced legs have opposing areas to which the brace arrangement is welded. The opposing areas of the spaced legs are adapted to control the degree to which heat of welding affects the structural integrity of each leg, so as to substantially retain vertical load supporting capacity in each welded leg of the frame. Such load supporting frames are particularly useful in the concrete forming field.

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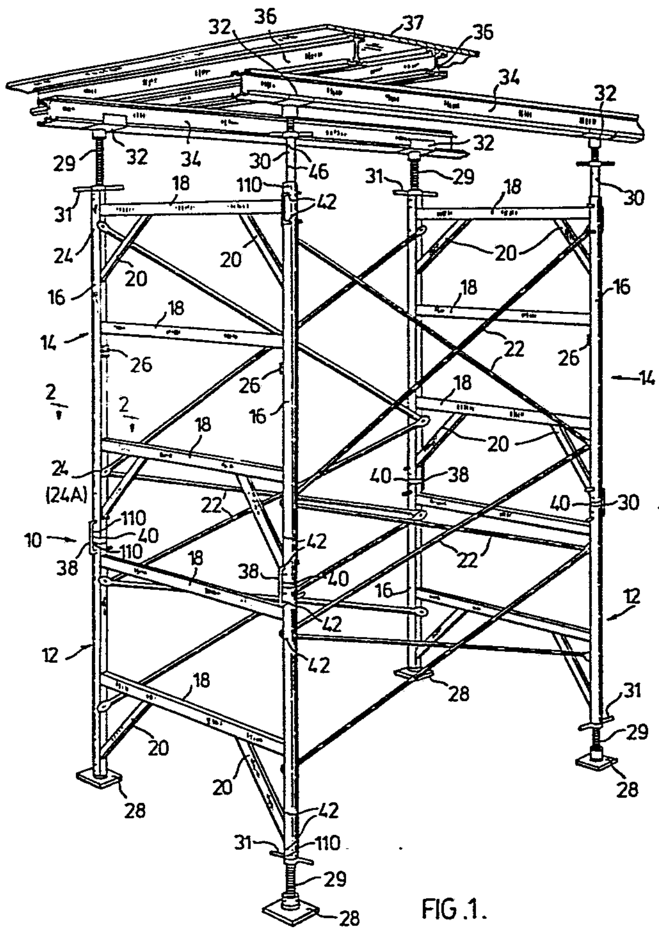
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FIG.1.

Lightweight, Welded Aluminum Shoring Frame

This invention relates to vertical load supporting frames and more particularly to welded lightweight metal alloy support frames.

Vertical load supporting frames are commonly used in the construction field and other areas which require supportive framework to support heavy objects or gain access to elevated areas outside and inside buildings. Common examples of such vertical load supporting frames, as used in the construction field, are scaffolding and concrete shoring frames. In the past such framework has been commonly made from steel; however, recently advances have been made in the use of aluminum alloys in making such frame work.

Large scale concrete forming structures are disclsoed in United States patent 3,787,020 issued January 22, 1974, in the name of Peter J. Avery, having a common assignee herewith. That patent particularly relates to concrete forming structures which can be "flown", having extruded aluminum beams and truss components, and having hinged screw jacks secured to the bottom chord members of the trusses.

There are load supporting requirements, such as in concrete shoring circumstances where the use of a lightweight shoring frame is particularly desirable. For example, construction of sub-basement or parking garage floor, below ground level, and smaller scale installations, or where cranes of suitable capacity are not readily accessible, may all call for the use of shoring frames to support stringers or primary members. Across those stringers may be placed beams or secondary members, such as those taught in the aforesaid Avery patent and is more particularly taught in United States patents 4,144,690 dated March 20, 1979 and 4,156,999 dated June 5, 1979, also both in the name of Peter J. Avery, and assigned to a common assignee herewith.

Several other shoring and support apparatus patents are of interest, insofar as they also relate to aluminum concrete shoring structures. For example, Dashew, United States patent 3,966,164, issued June 29, 1976, teaches an adjustable truss support wherein a bolted truss is shown having vertical column members forming components of the trusses, into which lower column members may be inserted so as to provide supports having height adjustment. However, not the entire truss is constructed of aluminum. In particular, the column members are constructed of steel. The choice of steel is predicated, at least in part, because aluminum has about one third the modulus of elasticity of steel.

Van Meter, in United States patent 4,036,466 dated July 19, 1977, teaches a flying concrete shoring structure which comprises corner posts, spaced in quadrilateral relationship, supporting pairs of stringers along opposed sides of the quadrilateral so formed. In this rather complex structure, a number of pins are used to secure cross braces in two different directions, and it is stated that by such arrangements, the spacing between the corner posts can be easily changed.

A commercially available structure made by Jasco Industries Inc., of Burnaby, British Columbia, Canada, is a welded aluminum shoring frame. The frame comprises tubular frame legs having circular cross-section of uniform wall thickness, with horizontal cross members and diagonal bracing members welded to the circular tubular leg walls and to each other. Cross brace lock assembilies are also welded to the frame leg wall. This shoring frame is lightweight; however, the welds to the frame are subject to failure quite frequently due to the nature of those welds and the form they take. In addition, cross brace lock assemblies are easily broken off the frame legs.

One of the principal purposes of the present invention is to provide a lightweight, welded vertical load supporting frame which can easily be manipulated by hand in the field, but which provides a higher strength frame, if it were to have substantially the same weight as the prior art frames. The frames are much less subject to failure, particularly failure of the welds by which the frame is assembled.

A particular feature of the present invention is that it provides a concrete shoring frame of aluminum which is easily and inexpensively fabricated, with a minimum of shop jigging and handling, using standard aluminum welding techniques which provide high strength welds.

The vertical load supporting frame, according to this invention, is of lightweight metal alloy. The frame comprises a pair of spaced vertical tubular legs and interconnecting brace arrangement welded to said legs and adapted to stabilize said legs when under load. The spaced legs have opposing areas to which said brace arrangement is welded. The opposing areas are adapted in a manner so as to control the degree to which the heat of welding affects the structural integrity of the leg.

The opposing areas of the spaced legs, according to an aspect of the invention, comprise a portion of leg wall having means for spacing such weld connecting a respective part of said brace arrangement to said leg outwardly of said leg relative to leg interior. A portion of said means forms part of said weld, whereby said means by virtue of its spacing such weld outwardly of leg interior accomplishes the control on the degree to which heat of welding affects structural integrity of the leg. Such control thereby substantially retains vertical load supporting capacity of the welded frame legs.

According to another aspect of the invention, the leg wall of varying wall thickness having the means for controlling the heat of welding may comprise thickened wall means to which the brace arrangement is welded. The thinnest section of the leg wall apart from the thickened wall means defines a minimum wall thickness of the leg relative to leg interior. The thickened wall means, by virtue of its thickness in spacing the weld from the minimum wall thickness, limits the degree to which heat of welding affects structural integrity of the leg minimum wall thickness to thereby substantially retain vertical load supporting capacity of the welded leg.

According to the method of this invention for welding brace members to spaced legs to make a welded load supporting frame of weldable lightweight metal alloy, the method includes a step of welding a brace member free end to a tubular leg of essentially uniform thickness and having an integral weldable reservoir of lightweight metal alloy. The step involves using a portion of the reservoir in welding the brace member end to the leg, thereby controlling the degree to which heat of welding affects the structural integrity of the uniform thickness dimension beneath the reservoir to substantially retain leg strength resistant to buckling.

Preferred embodiments of the invention are shown in the drawings wherein:

Figure 1 is a perspective view of a lightweight, welded aluminum shoring frame according to this invention;

Figure 2 is a view taken in the direction of arrows 2-2 in Figure 1;

Figure 2a is a similar view of a prior art device;

Figure 3 is a perspective view of a first embodiment of a cross brace lock, according to the present invention, showing its assembly to a frame leg;

Figure 4 is a view of the assembled cross brace lock taken in the direction of arrows 4-4 in Figure 3;

Figure 5 is a perspective view of a base plate according to the present invention;

Figure 6 is a cross section taken in the direction of arrows 6-6 in Figure 5;

Figure 7 is a perspective view of a frame connector, for use in association with the frame according to this invention;
Figure 8 is a perspective view of a second embodiment of a cross brace lock, according to the present invention, showing its assembly to a frame leg;
Figure 9 is a view of the assembled cross brace lock, looking up in the direction of arrows 9-9 in Figure 8; and
Figures 10, 11, 12 and 13 are sections of the frame leg with a brace member welded thereto demonstrating alternative embodiments for the leg shape which accomplishes a control on the heat of welding affecting the load bearing characteristics of the leg.

The following discussion has particular reference to an illustrated structure which is exemplary of the manner by which the present invention may be embodied, and also has reference to certain accessories therefor. Thus, the following discussion is not intended to be in any way restrictive of the scope of the invention described herein.

The vertical load supporting frame, as shown in the drawing, is particularly adapted for use in the field of supporting concrete form work. The term "tubular", as it applies to the members of the frame and particularly to the frame legs, implies a hollow elongated member and is in no way confined to particular cross-sectional shape other than the provision on the leg wall of the means for controlling the effect of the heat of welding on the load supporting capacity of the welded leg.

Figure 1 shows an assembly of welded shoring frames of lightweight metal alloy embodying the present invention. The lightweight metal alloy may be either aluminum alloy or magnesium alloy. The aluminum alloy may be a medium to high strength structural aluminum alloy. The assembly 10, shown in Figure 1, comprises a number of frames of aluminum alloy 12 and 14 (in this case two of each) assembled in a typical manner, showing how they may be used in a typical concrete shoring installation.

The principal difference between the frames 12 and 14 is their height, and the fact that frame 14 has an intermediate horizontal cross member and an intermediate cross brace lock base portion , all as discussed hereafter. Typical dimensions of the frames are also discussed hereafter.

Specifically, each of the frames 12 and 14 has a pair of tubular frame legs 16, the cross-section of which is shown in detail in Figure 2. Frame 12 has a brace arrangement which is adapted to stabilize the legs when the frame is loaded. In this embodiment, the brace arrangement comprises a pair of horizontal cross members 18 in combination with diagonal bracing members 20. Similarly frame 14 has three horizontal cross members 18 in its brace arrangement. All of the cross members 18 are identical, and their assembly to the frame legs 16 is discussed hereafter. The upper and lower cross members 18 of the frame 14 have diagonal bracing members 20 secured to them and to one or the other of the frame legs 16; and the lower horizontal cross member 18 of the frame 12 has diagonal braces 20 secured to it and the frame legs 16.

Between the assembly of frames on the left side of Figure 1 and the assembly of frames on the right side of Figure 1 is a plurality of cross bracing members 22. Each of the cross braces 22 is terminated at a cross brace lock assembly 24 or 24a, discussed in greater detail hereafter with reference to Figures 3, 4, 8 and 9. Each of the cross brace lock assemblies 24 or 24a is secured in a cross brace lock base 26, one of which is shown below the intermediate cross member 18 on each of the legs 16 of frame 14.

At the lower ends of the frames are base plates 28, details of which are discussed hereafter. The base plates 28 may directly terminate at the bottom ends of the frame legs 16, as shown at the far side of the structure of Figure 1; or jack screws 29, which have handles 31, may be inserted into the base plates 28, as shown at the near side of the structure of Figure 1.

At the upper ends of the shoring frames, there may be inserted jack screws 29 having handles 31, as shown at the far side of the structure of Figure 1. Alternately, there may be extension staffs 30 inserted in the upper ends of the frame legs 16, and the extension staffs 30 carry jack screws and handles therefor at their upper ends. All of the jack screws terminate in U- or J-heads 32, which support primary members which may be stringers or beams 34, as mentioned above, and across the primary members 34 are placed secondary members or beams 36 which support panel 37, in the known manner of concrete forming.

At the joint between frames, a frame leg connector 40 is placed between the upper end of the lower frame leg and the lower end of the upper frame leg, and is secured in place by a generally U-shaped lock pin 38 which has two legs, one of which is longer than the other, as clearly shown in Figure 1.

It is to be noted that an extension staff 30 may be inserted into a frame leg 16, either at the top or the bottom of the frame, and in the case of Figure 1 at the top. For these purposes, a pair of holes 42 are placed through the tubular frame legs near the top and bottom thereof; and a number of equally spaced holes 46 are placed in the extension staff. In the case where two frames are connected one to another using the frame connector 40, only one of the two holes 42 at each end of the frame leg is used, together with one of the holes 42 in the next frame leg being connected. In the case where the extension staff is placed in the frame leg, both holes 42 are used, and the placing of the extension leg is determined by the holes chosen along the length of the extension staff through which the legs of the U-shaped connector pin 38 extend in the manner shown.

Referring to Figure 2, a member 18 of the brace arrangement has its end portion 19 welded at filet welds 56 to the leg 16. Considering the spaced legs 16 of the frames 12 and 14, area 17 of leg 16 opposes a corresponding area of the other spaced leg. Each area is adapted in a manner to provide for welding of the brace end 19 to the leg 16 so as to essentially isolate or remove the weld location from the leg interior, thereby controlling the degree to which the heat of welding affects the structural integrity of the leg 16. The heat of welding generated by the process of welding forms a heat affected zone in the leg which results in the mechanical properties of such affected zone being altered. The temperatures achieved in the heat effected zone may well be above the annealing temperature of the lightweight metal alloy, thereby annealing and thus weakening metal adjacent the weld pool. With the area 17 adapted to space the welds from the leg interior, the essential load supporting section of the leg is thereby minimally affected by the heat of welding. Thus with respect to the embodiment of Figure 2, means in the form of lips or ridges 50 are provided which space the weld connection outwardly of the leg relative to leg interior. Portions of the lips 50 form part of the weld. However, by virtue of the lips spacing the weld outwardly of leg interior, this controls the degree to which heat of welding affects the minimum thickness, as designated by arrows 21, and which lies beneath the ridges to which the brace 18 is welded and which essentially determines the load bearing capacity of the leg. In spacing the heat effected zone from this minimum wall thickness 21 of the leg 16, there is very little, if any, effect on the welded legs' strength in resisting buckling under load.

To provide for a mating interfit of the end 19 of the brace, it is cut off so as to mate and abut the planar surface 48 provided between the ridges 50. The spacing between the interior sides 52 of the ridges 50 is such to receive the end 19 where the planar face portions 54 of the ridges are adjacent the sides of the end 19 of the brace member. Filet welds 56 are then formed to complete the connection of member 18 of the brace arrangement to the leg 16. This particular arrangement, for the means which controls the effect of the heat of welding on the leg strength, provides for a counter sunk fitting of brace member end 19 on the leg 16. With the face of the brace member end 19 abutting the planar face 48 of the leg and with the filet welds 56 rearwardly of the face of the brace member end, a secure interconnection is provided.

Figure 2a shows the type of welded interconnection of a brace 18p to a leg 16p of the prior art welded frame previously referred to. The leg 16p is of uniform wall thickness. The brace 18p has its end 49p machined to mate with the circular surface of the leg 16p. Welds 56p are made to join the brace 18p to the leg 16p. In this arrangement as compared to the embodiment of the invention shown in Figure 2, the weld 56p is made on the face of the leg 16p of uniform thickness. The heat affected zone produced by the weld 56p substantially penetrates the minimum or nominal thickness of the leg wall. As previously explained, this heat effected zone due to high temperature of welding anneals the surrounding leg material and may reduce the structural strength of the leg by as much as 40%. Thus with the arrangement of the prior art shown in Figure 2a, the leg is substantially weakened in the weldment areas so as to reduce its resistance to buckling when under load.

To further explain the aspect of weakening the leg section 16p, as is understood by those skilled in the art, a weld pool generally designated as 51p is formed which includes a portion of the parent metal of the leg section 16p, a portion of the side of the end 49p of the brace 18p and the filler material which is part of weld 56p. This weld pool 51p, as formed in the leg section 16p, was originally molten metal. Thus the heat effected zone radiates outwardly from this pool to cause a decrease in the strength of the metal in the area of such pool.

However, with the embodiment according to the invention of Figure 2, the corresponding weld pools designated 51 remain in the lip portions or ridges 50. Thus the weld pool remains spaced from the uniform minimum thickness dimension of the leg as determined at 21.

Alternate wall sections for the frame legs, which include means for controlling the effect of heat of welding on the strength of the leg, are shown in Figures 10 through 13. Referring to Figure 10, the frame leg 150 is circular in shape and has a minimum wall thickness at 152. Provided on the leg wall section is an area 154 which provides for a control on the penetration of the heat of welding into the leg. A brace 156 has its end 158 abutting planar end 160 of area 154. Area 154 includes a thickened wall portion which presents the planar surface 160. The end 158 of the brace is filet welded at 162 to the planar portion 160. A weld pool is formed at 164 which takes up the representative amount, as shown, of parent metal of the leg 150 . The area of weld 162 is spaced substantially from the minimum wall thickness 152 of the leg indicated in dot by line 166. Thus the heat affected zone does not migrate appreciably into the minimum wall thickness area designated by line 166, which is beneath the weld area 162. Therefore, the structural load bearing strength of the leg, as determined by this minimum wall thickness 152, is not appreciably affected by the heat of welding. It should also be noted that, with the thickened wall portion in area 154, the welding process may be carried out in a manner so as to consume more of the parent metal of the leg 150 than in the side wall of the brace 156 as demonstrated in Figure 10. Thus the thickened portion provides what may be referred to as a reservoir of weldable metal which is drawn upon in forming the weld. This enables the welding of a somewhat thinner wall portion of the brace to the substantially thicker portion of the leg, without affecting appreciably the structural strength of the leg once welded. Thus the thickened wall portion forms part of the weld as the brace 156 is connected to the leg 150.

Turning to Figure 11, an alternative shape for the leg 168 is shown. The leg has a minimum wall thickness 170 where the weld 172 is appreciably spaced from this minimum wall thickness 170. As with the embodiment of Figure 10, the heat affected zone of the weld does not spread out into the minimum wall thickness 170; therefore, the heat of welding is essentially isolated from the minimum wall thickness to substantially retain the original load bearing capacity of the leg 168. The weld pool 174, as formed, includes a portion of the parent metal of the leg 168. The end 176 of the brace

178 is machined or milled to include a radiused end portion which mates with the corresponding radiused portion 180 of the leg.

With the embodiment of Figure 12, a slightly different brace arrangement end is provided. The brace 182 has secured to its end 184 an arcuate plate 186 which becomes part of the brace arrangement. The arcuate plate 186 may be secured to the brace end 184 by way of welds 188. The arcuate plate 186 is shaped so as to mate with the face 190 of the frame leg 192. The frame leg includes raised or projecting ridges 194 which serve to space the welds 196 from the minimum wall thickness 198 of the leg 192. Thus the heat of welding, as it may affect the structural strength of the nominal wall thickness of the leg 192, is minimized and may be controlled to such an extent, depending upon the spacing of the weld from the nominal wall thickness of the leg 192, that the heat of welding has no effect on the structural strength of the leg 192.

Figure 13 shows an alternative configuration for the frame leg 200 having a minimum wall thickness 202. The leg 200 includes a projection 204 which consists of outwardly extending wall portions 206, which are integral with the wall thickness 202 of the leg 200, and a transverse portion 208 interconnecting the parallel wall portions 206. Thus the projection 204 provides a stub to which the brace 210 may be secured. Preferably the stub 208 is of a height which is less than the internal length dimension of the hollow brace 202. Further, the stub is of a width which fits inside of the sides of the brace 210. With this type of mating fit between the stub 204 and the brace 210, the end 212 of the brace may be welded at 214 to complete the interconnection. With the outwardly projecting side walls 206, the welds 214 are spaced outwardly of the minimum wall thickness 202 of the leg 200 adjacent the welds. Thus the heat of welding is isolated from the adjacent wall areas as designated at 216. Optionally the leg 200 may have a continuous internal portion which is represented by dotted line 218. Thus the leg of Figure 13 would, in that instance, include two hollow portions, where the stub 204 is provided to isolate the heat of welding from the leg wall.

From the standpoint of locating the brace members relative to the leg for purposes of welding, standard jigging techniques may be used to position the brace members relative to the face of the leg for welding. To assist in such location with an embodiment such as Figure 10, the face portion 160 may be provided with longitudinally extending ridges 161 which may be cut transversely of the face such that the hollow brace member 154 is located on the face 160, not only by the ridges 161 interacting with the sides of the brace 156, but also the upper and lower portions of the cut ridges interacting with the top and bottom of the hollow brace to locate it along the length of the leg. With the embodiments of Figures 11, 12 and 13, the projections or ridges serve to locate the brace laterally of the leg. With the legs extruded from an aluminum alloy, the portions on the face of each leg, to which the brace arrangement is welded, extend the length of the leg. For example, with the embodiments of Figures 2, 10, 11, 12 and 13, the projections and ridges, which are uniform along leg's length, provide means which not only predetermine the position laterally of the leg of components welded thereto, but also provide the benefit that components may be welded to the leg at any selected point along the leg.

The optimum arrangement for the brace members as welded to the legs, is such that all of the brace members have their axes lying in a common plane. This common plane is coplanar with the vertical axes of the legs, that is the parallel, vertical axes of the legs lie in the same plane as the common plane of the brace arrangement. Referring to Figure 11, the axis 220 of brace member 178 defines the common plane in which all of the brace members lie. The common plane, has the axis 222 of the leg 168 lying in the same plane.

It is, therefore, apparent that each of the suggested configurations for the leg of the frame has provision for a thickened wall section in the form of surfaces which, according to the preferred embodiment, are spaced on opposite sides of the common plane represented by axis 220 of Figure 11. As a result, the leg is symmetrical about the common plane when attached to the brace arrangement. In each instance, the prearranged reservoir of metal provided on each leg section may be drawn upon in welding the brace member to the leg without appreciably affecting the structural strength of the leg. It is understood that other shapes for the leg of the frame may be devised, such as rectangular, or somewhat irregular, where in each instance the wall thickness varies to the extent to provide the means to which the brace member is welded in the manner similar to that demonstrated in Figure 2 and Figures 10 through 13. This aspect of isolating the weld from the nominal thickness of the leg is entirely different from the prior art approach of Figure 2a.

A further advantage of the invention is realized from the extruded leg of aluminum. As previously explained, the areas of the legs, to which the components are welded, extend longitudinally of the leg. Such areas in the form of projections, thickened wall section, rdiges, or the like increase the amount of inertia of the leg compared to its nominal configuration. This increase in amount of inertia has a direct effect on increasing the allowable buckling load for the leg. Although the ridges, for example, of Figure 2 may be weakened at the points of welding, the pressure of these ridges on the leg between the points of welding of brace arrangement to the leg, in having increased the resistance to the buckling strength of this leg span, significantly increases the load carrying capacity of a frame having legs of Figure 2, compared to a frame having legs of the prior art of Figure 2a.

A further consideration, and a distinct advantage over the prior art approach of Figure 2a, in providing an area on the leg surface to which the brace member is welded, is that it locates the areas of welding so as to be spaced from any fusion or extrusion welds in the leg. It is appreciated that the legs and brace members of the frame may be formed of extruded aluminum alloy, such as the medium to high strength structural aluminum alloy or may be extruded from magnesium alloys. When the frame legs 16 are of extruded aluminum alloy, they may be manufactured by the "porthole" extrusion process. By this process, the aluminum as it is being extruded flows past several bridges spaced circumferentially around the cavity in the die, after which longitudinal welds or fusions are immediately formed within the aluminum extrusion. These internal welds are generally invisible to the naked eye, and normally can only be detected by etching the end of the extrusion across its cross-section. Also, it should be noted that the relative position of such internal welds is generally of no consequence when the extrusion, especially when it is being used as a frame leg for shoring in high loading conditions, is axially loaded. However, when there is an eccentric loading on the extrusion, either greater on one side of the extrusion than the other, or producing torsion within the extrusion, then the relative position of the internal welds within the extrusion become of some concern.

Thus it is possible, for example, with the embodiment of Figure 10, where extrusion welds may be located at points designated by arrows 224, 226, 228 and 230. The formed planar surface 158, therefore, locates the welds 162 away from the extrusion welds 224, 226, 228 and 230. In so doing, the heat effected zone is isolated from such extrusion welds. Thus a further provision is made in assuring that the welding process does not detract from the structural strength of the leg. However, with the prior art arrangement of Figure 2a, there is no immediate indication of where the fusion welds in the extruded aluminum leg would be located. Thus in welding the brace members to such circular leg, the weld areas at 56p may be directly on top of an extrusion weld. Therefore, the heat of welding penetrates into the fusion weld and in weakening such fusion weld, substantially decreases the load bearing capacity of that extruded leg.

It can, therefore, be gathered that various brace arrangements may be provided which are adapted to stabilize the legs when under load. With the embodiment of Figure 1, the diagonal bracing members 20 are welded to the undersides of the horizontal cross members 18 and also welded to the faces of the legs in the manner discussed. The welds formed at the ends of the diagonal members for connection to the horizontal cross members may not necessarily be filet welds. However, they are not subjected to the same stresses as the weld connections to the leg and, therefore, such welds have been found to be satisfactory. Further in locating the brace members relative to the leg and horizontals, it is possible to machine the ends of the brace members such that the brace members lie in an angle of approximately 45 degrees relative to the horizontal member, which is perpendicular to the leg member.

It has been noted above that cross brace lock assemblies 24 or 24a are placed near the upper and lower ends of each of the frame legs 16, and that a further cross brace lock base portion 26 is placed in an intermediate position on the taller shoring frames 14. Reference is now made to Figures 3 and 4, and to Figures 8 and 9, where details of cross brace assemblies 24 and 24a are shown.

It will be understood that either the cross brace lock assembly 24 of Figures 3 and 4, or the cross brace lock assembly 24a of Figures 8 and 9, can be the embodiment of all of the cross brace lock assemblies which are used on any one frame, so that either the assembly 24 or the assembly 24a, but not both, will be supplied on any given frame 12 or 14.

Turning first to the cross brace lock assembly 14 of Figures 3 and 4, each of which includes a lock base portion 26, it is noted that the lock base portion 26 has a generally U-shaped portion 57 with substantially straight parallel side legs 60, and a front face 62. The distance between the outside surfaces of the side legs 60 is substantially the same as the thickness of the horizontal cross members 18 or the diagonal brace members 20, so that the lock base portion 26 may be accommodated between the side surfaces 52 of the lips 50. More importantly, it is seen that the lock base portion 26 may be welded to the frame leg by a filet weld 56 in the same manner as the cross members 18 and diagonal braces 20 are secured to the frame legs. The weld formed at 56 in connecting the base portion of the locking devices to the leg is again isolated or spaced from the leg interior to thereby retain leg strength after the base portion 26 is welded to the leg.

Each cross brace lock assembly 24 comprises a bolt 64 having a head 66 which has a shape such that it may pass through an opening 68 in the front face 62 of the base portion 26, but such that when the bolt 64 is turned, the head 66 is behind the front face of the base portion 26 and will not pass back through the opening 68. Shoulders 69 are formed adjacent the bold head 66, and extend into the opening 68 so as to preclude the bolt 64 from turning when the nut 65 is tightened against the washer 67, as discussed hereafter. Generally, the shape of the bolt head 66 is, as indicated, such that two opposite corners are rounded with the other two corners being sharp, so that the cross dimension in one direction is shorter than the cross dimension in the other direction. The shape of the opening 68 is elongated, being long enough to accommodate the bolt head 66 when it is oriented in one direction and narrow enough to preclude its passage when the bolt is oriented in the other direction, but wide enough to accommodate the shoulders 69. A slot 70 is formed at the outer end of the bolt 64, lenghtwise of the bolt and a pin 72 is placed in the bolt across the slot with a lug 74 mounted over the pin 72 in the slot 70.

The assembly of the cross brace lock 24, therefore, comprises inserting the bolt head 66 through the opening 68, and passing the bolt head far enough behind the back surface of the base 26 that it may be turned 90 degrees and then bringing the bolt head slightly forward so that the shoulders 69 are accommodated within the opening 68. The washer 67, having tangs 71 which enter the opening 68, is then placed over the bolt 64. The purpose of the tangs 71 is such as to assure that the bolt 64 is centered in the lock channel 26. The nut 65 is then placed over the bolt; of course, the lug 74 is swung about the pin 72, in the manner discussed hereafter, and the nut 65 is tighetned on the threads 73 to secure the bolt 164 to the channel 26.

The lug 74 has a slot 76 formed along its length, with the pin 72 extending through the slot 76, so that the lug 74 is slidable and rotatable on the pin 72. When the lug is vertically oriented in the slot 70 of the bolt 64, as shown in solid lines in Figure 4, it is in a locking position; i.e., the end of any cross brace or other member which is placed over the shank of the bolt 64 between the lug 74 and the base 26 is precluded from sliding outwards along the shank of bolt 64 by the lug 74. In order to place the end of a cross brace or other element on the bolt 64, the lug 74 is slid upwards on the pin 72 along the slot 76, and then rotated in the direction of arrow 75 shown in Figure 3. In the rotated position, the end of the lug 74 interferes with the end of the slot 70, thereby precluding further rotation, so that the lug 74 is then rotatable about the pin 72 only in one direction from the horizontal to the vertical orientation; i.e. in the opposite direction to arrow 75, namely counterclockwise, as seen in Figure 4.

The advantage in the use of the lock base portion 26 is that it can be used with other types of locking devices. With reference to Figure 8, the lock base portion 26 is secured to the leg 16 in the manner as with Figure 3 by use of filet weld 56. The relationship of the weld to the leg 16 is also shown in the section of Figure 9. The base portion 26 includes two raised projections 78 which extend outwardly from the face portion 62. This defines a channel opening outwardly relative to the adjacent U-shaped channel defined by legs 60 and rear face 57, which opens inwardly toward the face 48 of leg 16. A slide type locking device 24a may be mechanically secured to the lock base portion 26. The slide lock portion comprises a slide portion 80 with an integral tranverse portion 82 which is stepped at 84 to define a lower surface 86. At the outer extremity of lower transverse surface 86 is depending front portion 88 which is bifricated to provide an open ended slot 90, which is of sufficient width to slide over the bolt 92. The bolt 92 has the same head arrangement 66 as that of Figure 3. Inwardly of heads 66 are shoulders 69 which interfere with the opening 68 to locate it in its second position to prevent turning thereof as the nut 94 is tightened down onto the washer 95.

The retaining washer 95 includes depending tang portions 97 which act as locating means and cooperate with the edges 99 of the base portion 26 to locate its aperture 101 relative to the opening 68 in the face 62 of the base portion 26. Such arrangement, therefore, locates the bolt 92 relative to the secured base portion 26. With the nut tightened onto the washer 95, a sleeve generally designated 103 is provided through which the slide 88 of the locking member may slide upwardly and downwardly. The slide 80 includes a slot, as shown in dot at 81, which is of sufficient width to accommodate the bolt diameter 92. The sleeve 103 is defined by the face portion 62 of the base 26 by the ridges 78 and the interior surface of the retaining washer 95.

When the locking member 24a is in its second position, as shown, the ends of cross brace members may be freely removed from or placed onto the bolt 92. When it is desired to retain the ends of the cross brace members on the bolt 92 for interconnecting frames in the manner shown in Figure 1, the locking member 24a is lowered usually under the influence of gravity to its first position which captures the ends of the cross brace members on bolt 92 by virtue of the front portion 88 overlying on the bolt 92, as determined by the location of the slot end at 87. The reason for the stepped portion in the transverse part of the locking slide member is that, depending upon whether there are two or four cross brace members placed on bolt 192, the first two would be captured between face portion 84 and retaining washer 95 as the face portion 88 drop until the end of slot 87 rested on bolt 92. However, when four cross brace members are placed over bolt 92, transverse portion 86 rests on top of the two additional brace members to locate the face portion 88 slightly higher, where the slotted portion 90 remains over bolt 92 to hold the brace ends on bolt 92. Therefore, the stepped arrangement restricts horizontal travel of either two or four captured brace ends.

The base plate 28 is shown in detail in Figures 5 and 6. It comprises a plate member 96 and two tubes 98 and 100. The diameter or configuration of tube 98 is such that it may fit into the interior of a frame leg 16. The diameter and configuration of tube 100 is such that it will not fit into a frame leg 16, so that the upper end 102 of the tube 100 will abut against the bottom end of a frame leg 16. The assembly of the base plate 18 is particularly shown in Figure 6. Tubes 98 and 100 may be secured to the base plate in various ways. For example, tube 98 may be secured to the tube 100 by a weld 104 which is placed between the bottom end of tube 98 and the inner surface of the tube 100. Thereafter, the tube 100 may be welded to the plate 96 by a weld 106 placed around its outer periphery.

Holes 108 are formed in the tube 98 of the base plate assembly 28 and holes 110 are formed quite near the bottom and top ends of the frame legs 16. When it is desired to lock a base plate 28 to a frame leg 16, a pin may be passed through the holes 110 and one set of holes 108, depending upon the orientation of the base plate. Likewise, a jack screw 29 will fit into the interior of the tube 98 and may be locked thereto by a pin passed through a hole suitably placed in the jack screw and one of the pairs of holes 108.

Holes 112 are drilled through the plate 96, so that the base plate assembly 18 may be secured to mud sills or other members such as inverted beams 36, especially if an assembly such as that shown in Figure 1 may be rolled or flown.

The frame connectors 40, shown in Figure 7, comprise a length of extruded aluminum tube 114, which is of a diameter and configuration that will fit into the interior of a frame leg 16. A collar 116 is secured to the tube 114 by a pair of rivets 118, or other convenient securing means. The dimensions and profile of the collar 116 are such that it will abut against an end of a frame leg 16. The end of the frame connector are chamfered at 120 to permit easier insertion of the tube 114 into a frame leg 16. Holes 122 are formed in the tube 114 and are positioned so that when the frame connector is in place in the manner shown in Figure 1, the legs of the pin connector 38 pass through holes 42 in the frame leg 16 and the holes 122 in the tube 114 of the frame connector 40.

Typically, a short frame 12 has a spacing of 1.22 m between the centre lines of the frame legs 16 and a nominal height of 4 feet (1.22 m) of each frame leg. The taller frame 14 also, of course, has the same spacing between the frame legs and has a nominal height of 6 feet (1.83 m) of each frame leg. The shorter frame 12 has a total weight of approximately 22 pounds (10 kg.) and the taller frame has a total weight of approximately 33 pounds (15 kg).

The shoring frame, according to an embodiment of this invention, may be constructed from extruded aluminum members. The extruded legs include the provision for welding without significantly, if at all, weakening the load bearing strenght of the leg and may preferably be arranged to locate the welds in positions which are spaced from extrusion welds in forming the leg. Such welded aluminum shoring frames exhibit superior characteristics compared to the prior art frames in providing greater strength and, therefore, higher load rating. Depending upon the end use of the frame, the shapes and sizes of the legs may be varied, for example, a smaller section for the leg would be used in situations where the frames constitute part of an access scaffolding arrangement, compared to the significantly larger legs which would be used in concrete shoring frames. The brace arrangements for the legs may take on several configurations, the purpose of which as appreciated by those skilled in the art is to stabilize the vertical legs when under load. The shape for the face portions of the legs to which the brace members are welded also accommodate the welding thereto of base portions for locking devices. Several of these base portions may be welded to the face of each leg to enable the use of a greater number of cross braces or in situations where the extra locking devices are not used, then spares are provided for repair to locking devices which are damaged in the field.

The frame components, as welded according to this invention, may also be made from lightweight magnesium alloys, since magnesium alloy when welded behaves in a similar manner to aluminum alloy. The provision on faces of the legs of means, which isolates or spaces the welds sufficiently apart from the leg interior, is adapted to retain the load bearing capacity of the welded leg.

CLAIMS

1. A vertical load supporting frame of lightweight metal alloy comprising a pair of spaced vertical tubular legs and interconnecting brace arrangement welded to said legs and adapted to stabilize said legs when under load, said spaced legs having opposing areas to which said brace arrangement is welded, characterized in that said opposing areas of said spaced legs each comprise a portion of leg wall having means for spacing such weld connecting a respective part of said brace arrangement to said leg outwardly of said leg relative to leg interior, a portion of said means forming part of said weld, whereby said means, by virtue of its spacing such weld outwardly of leg interior, controls the degree to which heat of welding affects structural integrity of said leg to substantially retain vertical load supporting capacity of said welded leg.

2. A frame according to claim 1, characterized in that said portion of leg wall having said means comprises thickened wall means to which said brace arrangement is welded, the thinnest portion of said leg wall defining a minimum wall thickness of said leg relative to leg interior, whereby said thickened wall means, by virtue of its thickness spacing such weld from said minimum wall thickness to limit the degree to which heat of welding affects structural integrity of said leg minimum wall thickness to substantially retain vertical load supporting capacity of said welded leg.

3. A frame according to claim 2, characterized in that said thickened wall means is sufficiently thick to

essentially isolate heat of welding detrimental to load bearing capacity of said leg from said minimum wall thickness of said leg beneath said thickened wall means.

4. A frame according to any one of claims 1, 2 or 3, characterized in that said legs and brace arrangement are made of a lightweight metal alloy selected from the group of metals consisting of aluminum alloy and magnesium alloy.

5. A frame according to claim 1, characterized in that said brace arrangement lies in a common plane about which each said leg is symmetrical as welded to said brace arrangement.

6. A frame according to claim 3, characterized in that said brace arrangement lies in a common plane about which each said leg is symmetrical as welded to said brace arrangement, said thickened wall means having portions equally spaced on opposite sides of said common plane and to which said brace arrangement is welded.

7. A frame according to claim 6, characterized in that said brace arrangement comprises at least one member extending between and welded at its ends to opposing thickened wall means of said spaced legs, additional members in combination with said at least one member for stabilizing said spaced legs, all brace members having their axes in said common plane.

8. A frame according to claim 6, characterized in that said thickened wall means comprises two longitudinally

extending raised portions which are equally spaced to each side of said common plane, a planar portion being provided between said raised portions against which an end of a component member of said brace arrangement abuts as welded to said raised portions.

9. A frame according to claim 6, characterized in that said thickened wall means comprises a longitudinally extending thickened wall portion which defines a planar surface exterior of said leg, an end of a component member of said brace arrangement abutting said planar surface with such end welded to said planar surface.

10. A frame acording to any one of claims 1 through 9, characterized in that said means to which said brace arrangement is welded locates weld penetration away from extrusion welds along said leg which were formed during the extrusion of said leg from aluminum alloy.

11. A frame according to claim 8, characterized in that said raised portions are spaced-apart outwardly projecting ridges with an intermediate longitudinally extending planar surface, said brace arrangement comprising rectangular component members, an end of said component member to be welded abuts said planar surface and has its parallel sidewalls contacting and being welded to said ridges.

12. A frame according to claim 11, characterized in that said ridges present planar outer surfaces to facilitate fillet welding of portions of said ridges to corresponding sidewall portions of said brace component member.

13. A frame according to claim 1, characterized in that said portion of leg wall having said means comprises a projection to which said brace arrangement is welded.

14. A frame according to claim 13, characterized in that components of said brace arrangement are hollow, said projection being a stub over which the hollow portion of a corresponding end portion of said brace arrangement fits with such end welded to said stub.

15. A method of welding brace members to spaced legs to make a welded load supporting frame, where such legs and brace members are of weldable lightweight metal alloy, said method being characterized by the step of welding a brace member free end to a tubular leg of essentially uniform thickness and having an integral weldable reservoir of lightweight metal alloy, by using a portion of said reservoir in welding the brace member end to said leg thereby controlling the degree to which heat of welding affects the structural integrity of the uniform thickness dimension beneath said reservoir to substantially retain leg strength resistant to buckling.

16. A method according to claim 15, for welding a brace member of thinner wall section than said reservoir on said leg characterized by using a portion of said reservoir in welding the brace to the leg.

17. A method according to claim 16 for welding a rectangular brace member having its parallel sides adjacent two reservoirs of metal alloy characterized by welding along parallel sides of said brace using respective portions of said reservoirs of metal alloy.

18. A method according to any one of claims 15, 16 or 17, characterized by said lightweight metal alloy being selected from the group of metal alloys consisting of aluminum alloy and magnesium alloy.

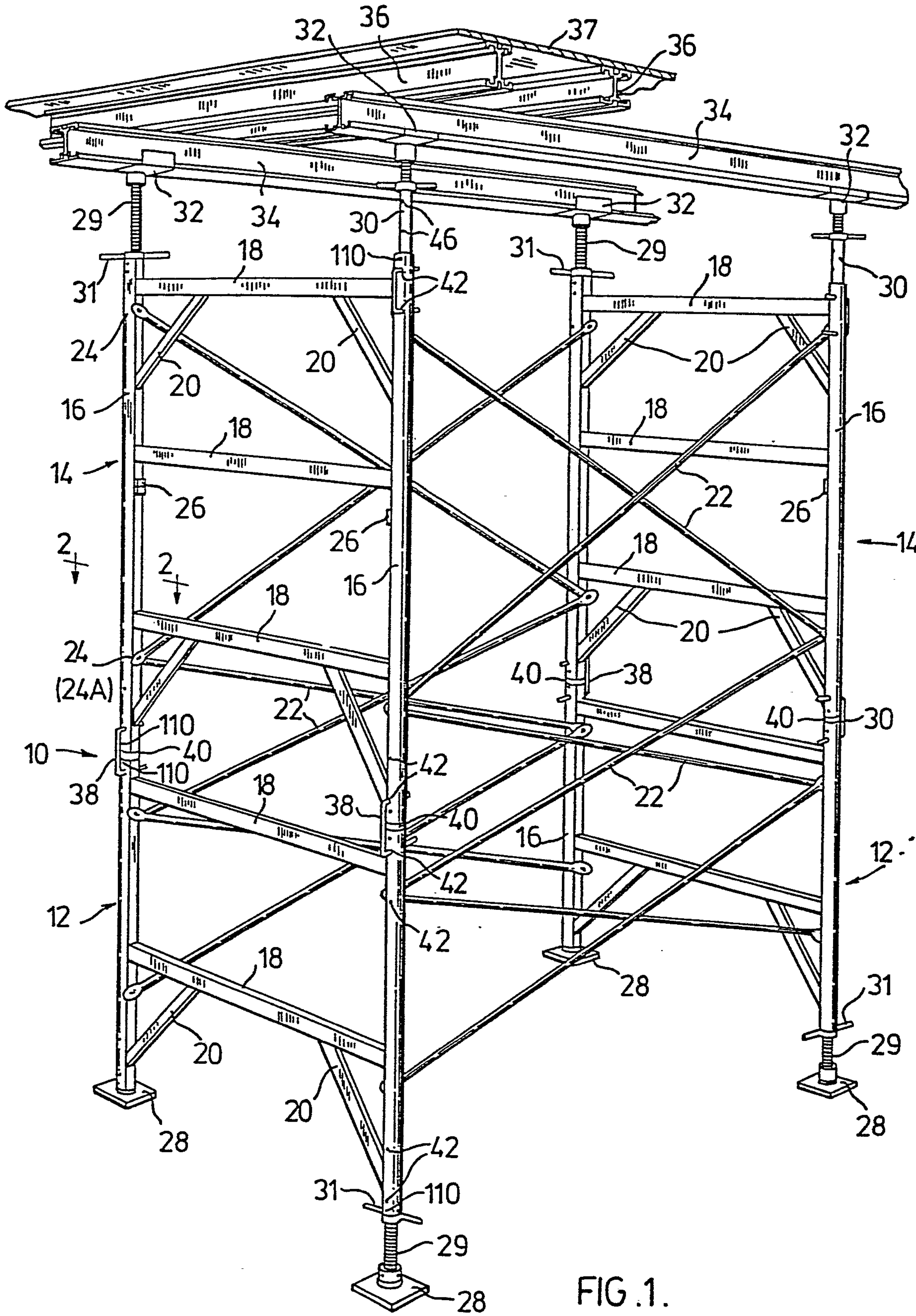
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FIG.1.

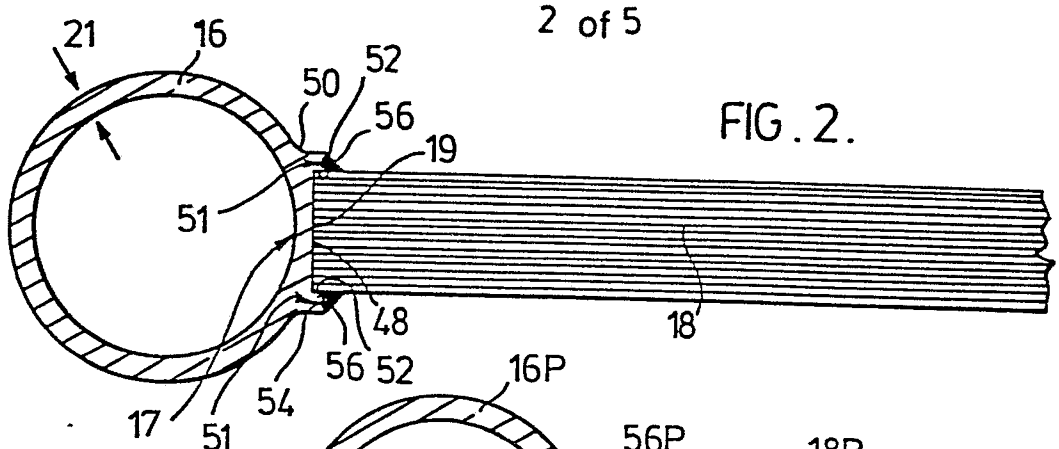


FIG. 2.

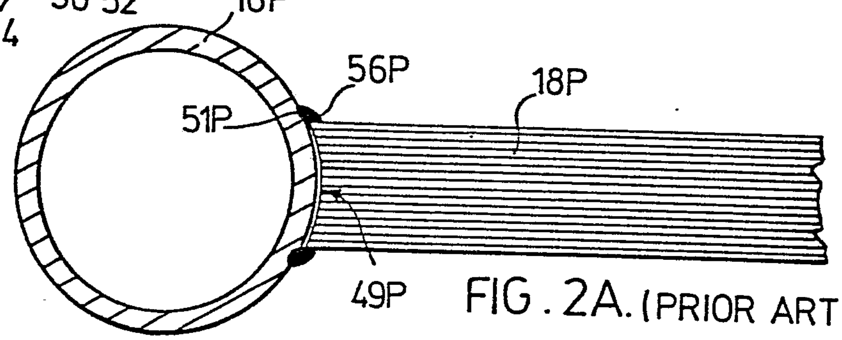


FIG. 2A. (PRIOR ART)

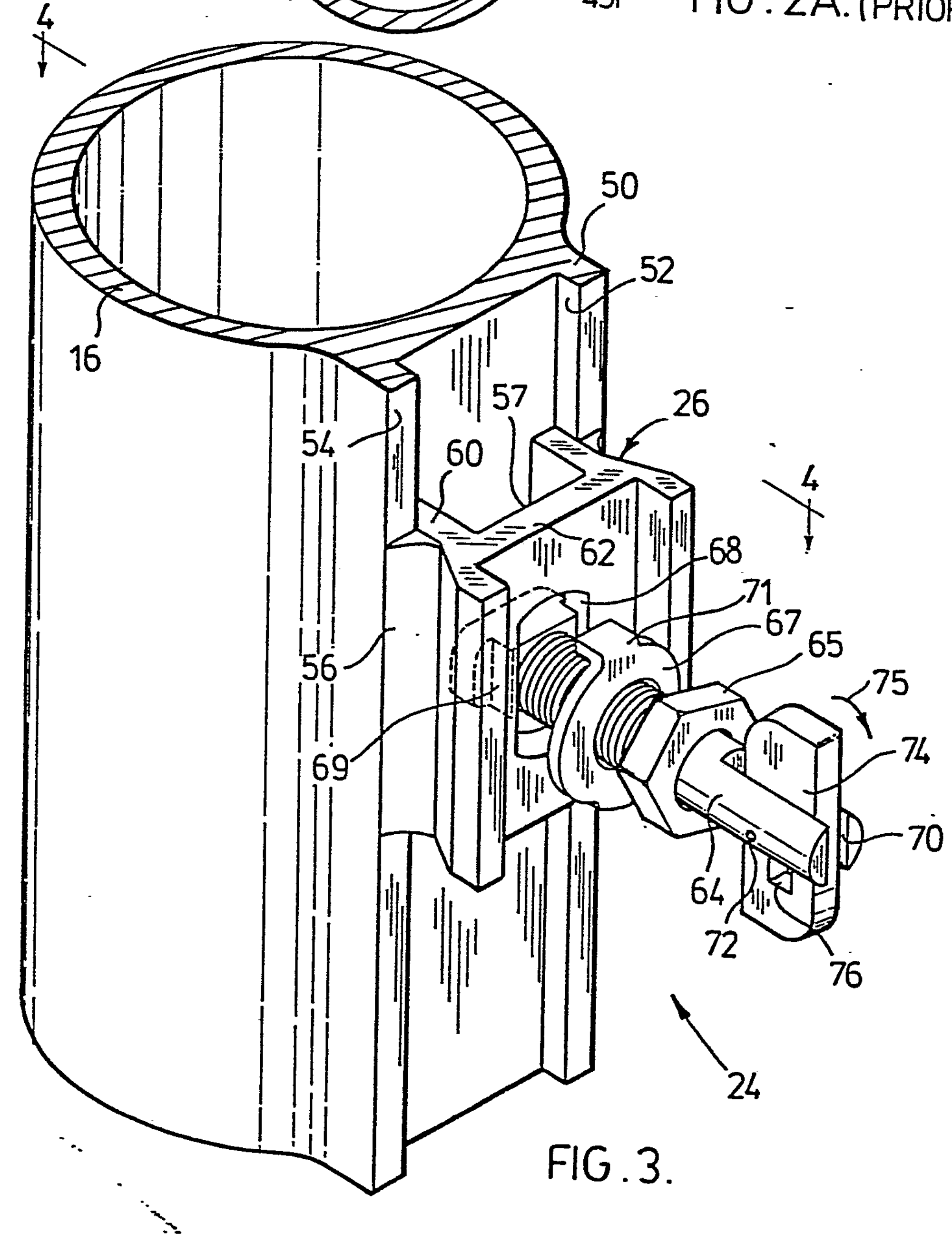


FIG. 3.

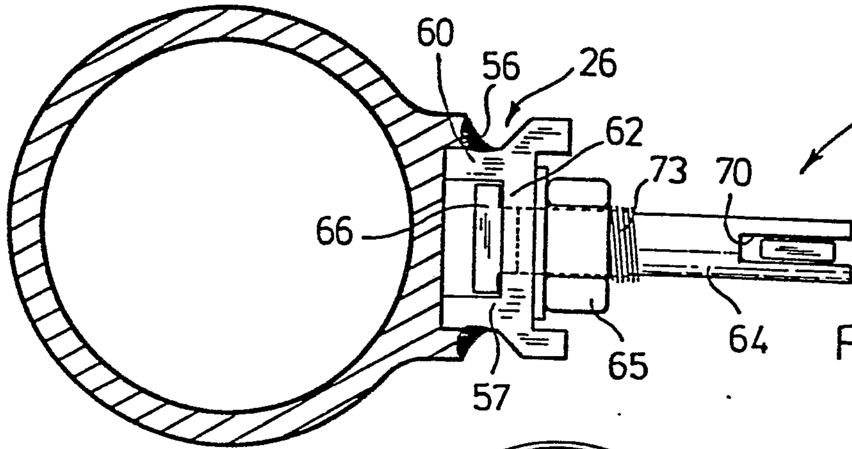


FIG .4.

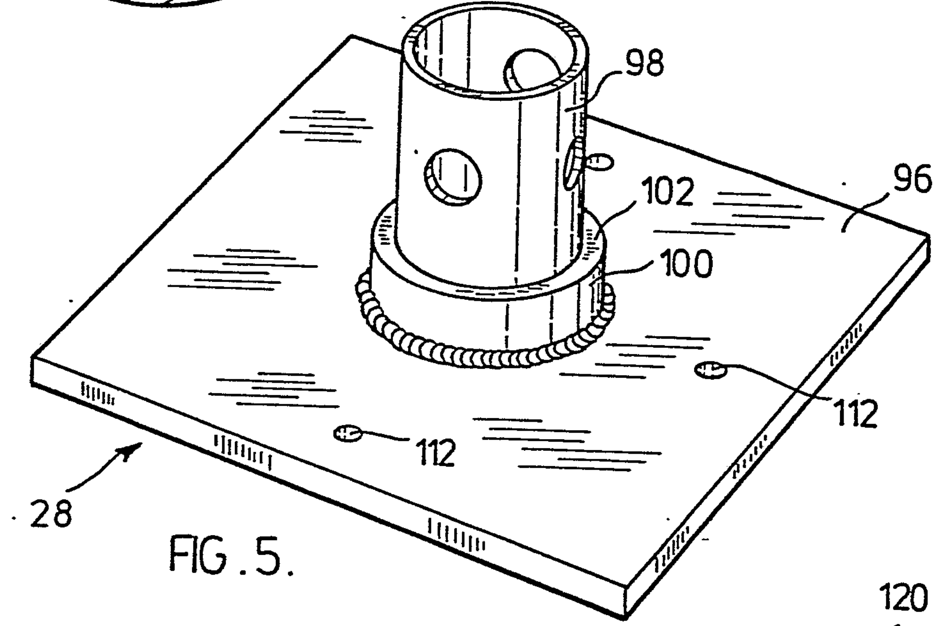


FIG .5.

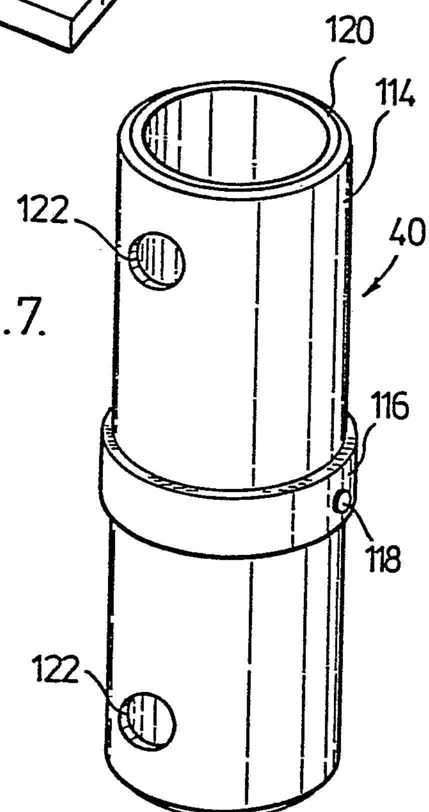
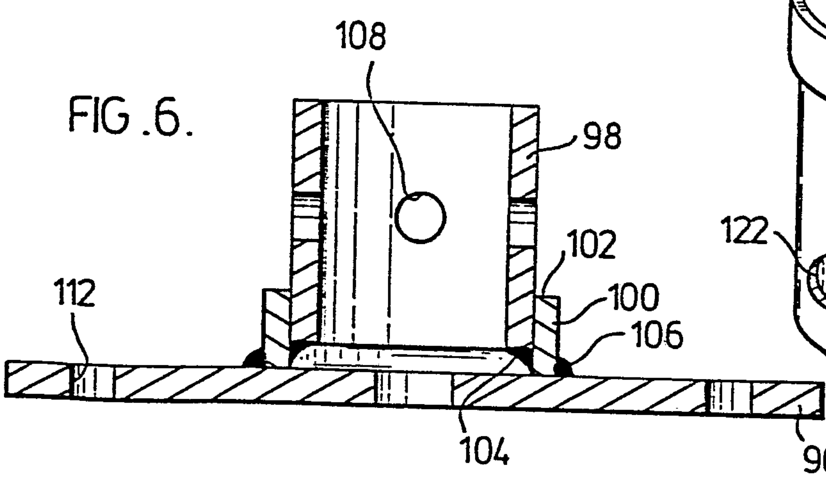
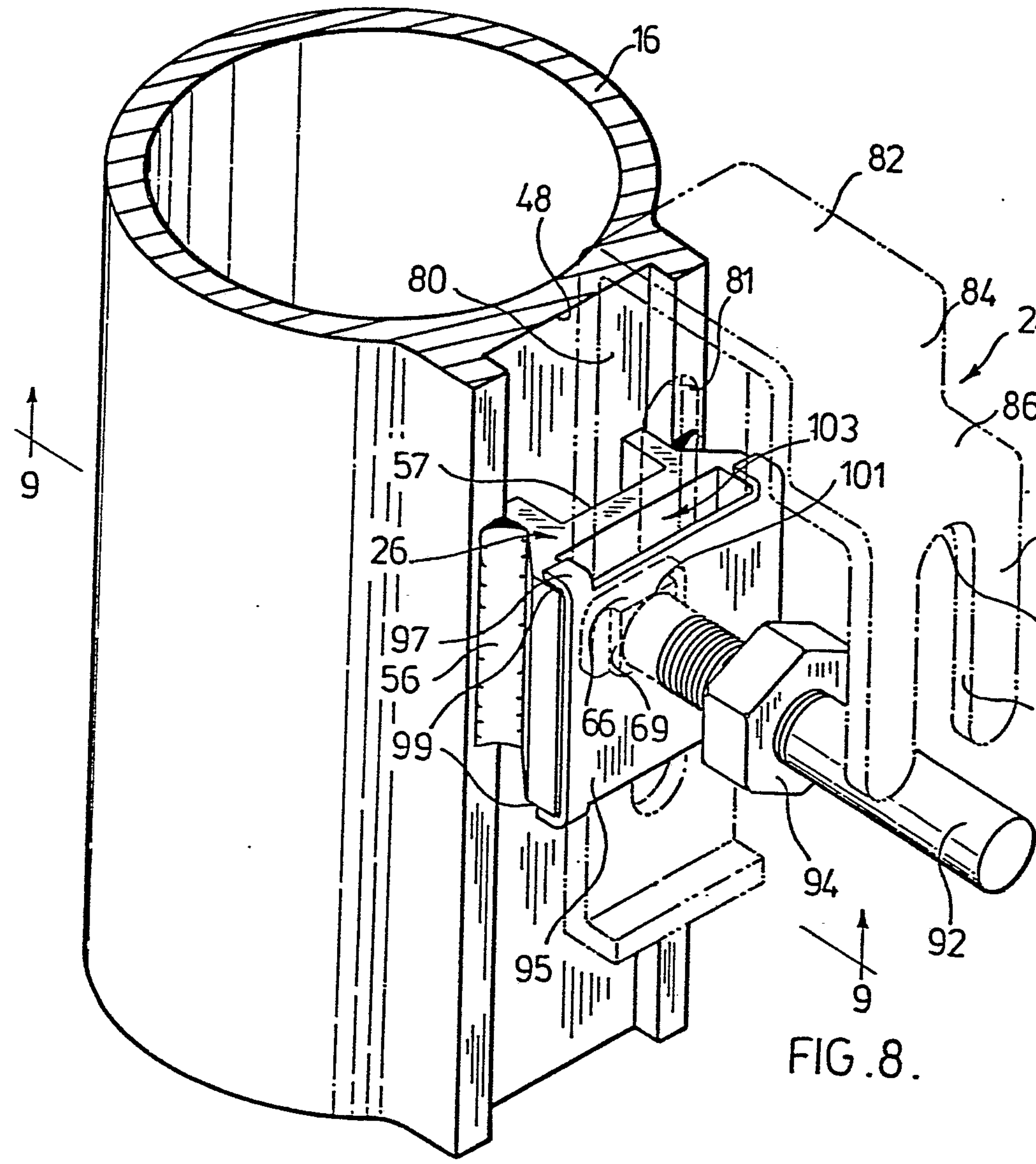


FIG .7.

FIG .6.

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24A
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FIG.8.

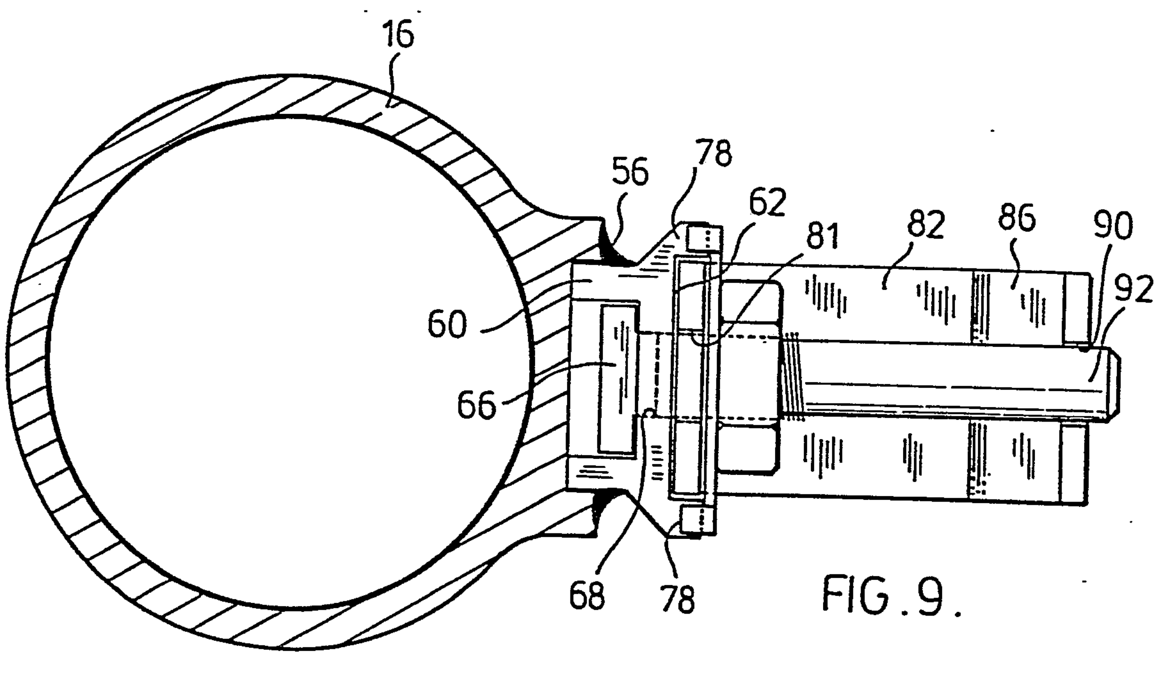
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FIG.9.

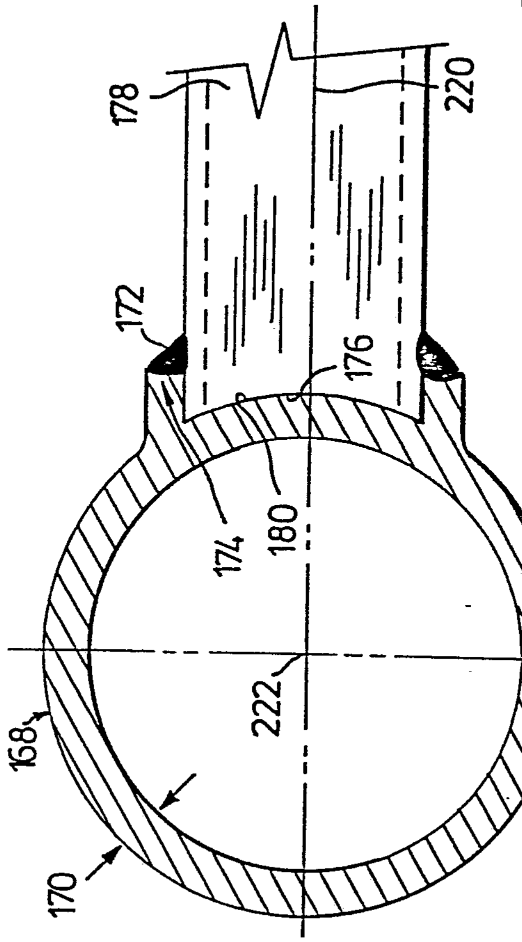

FIG.11.

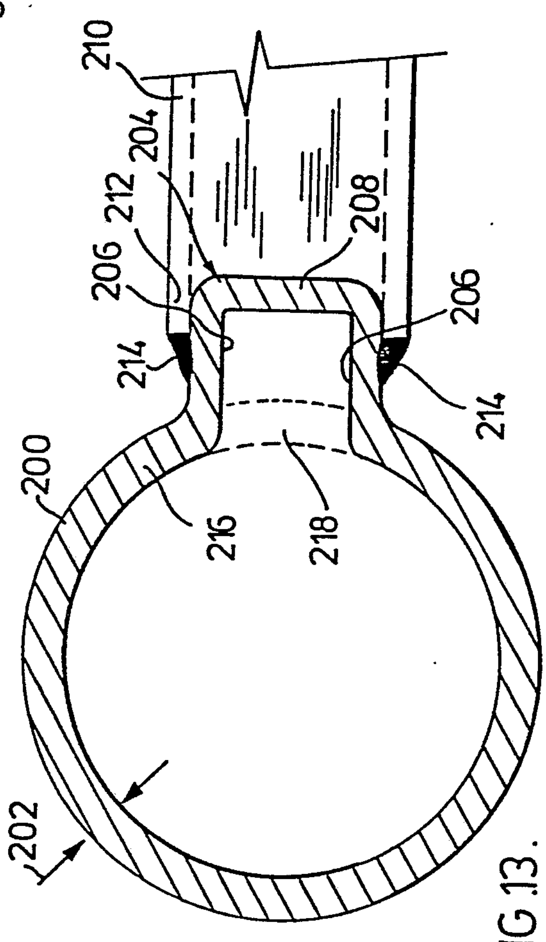

FIG.13.

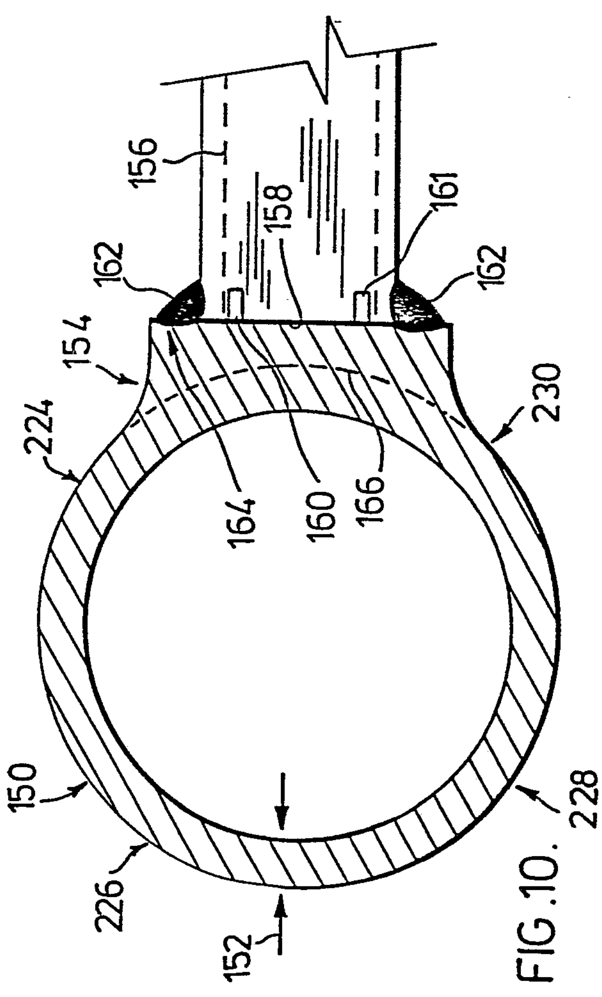

FIG.10.

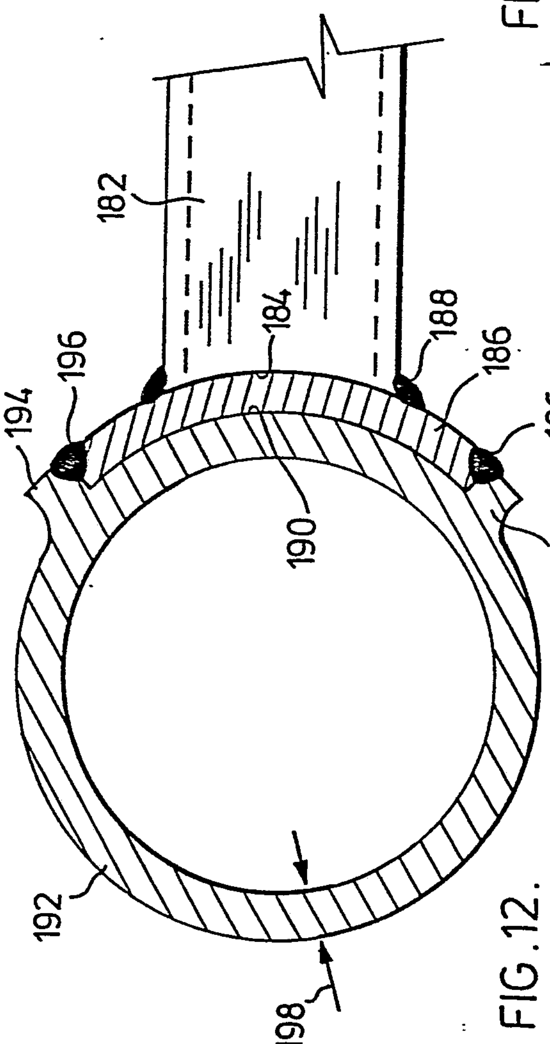

FIG.12.