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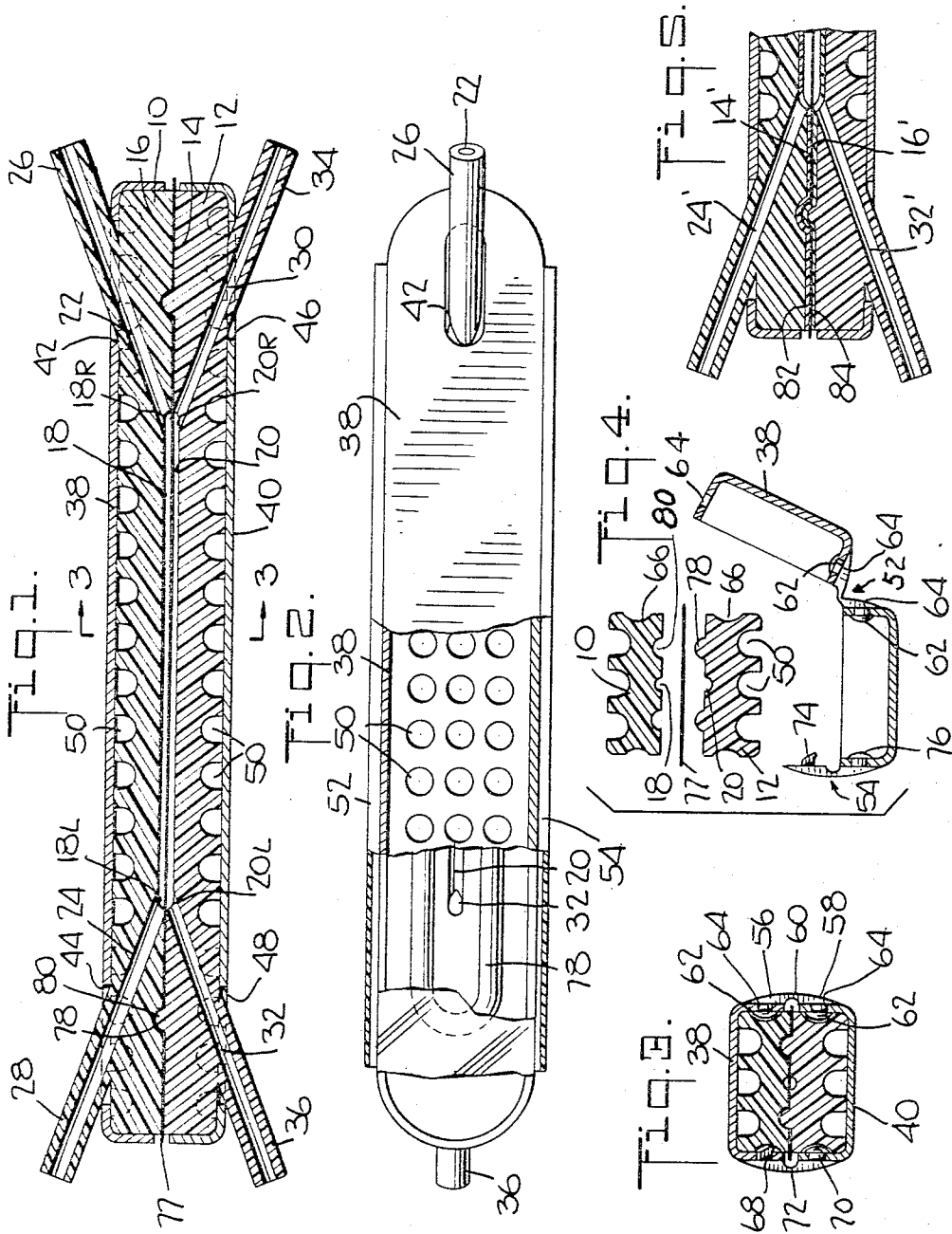
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3,333,706

DIALYZER ASSEMBLING MEANS

Filed Oct. 6, 1965

2 Sheets-Sheet 1



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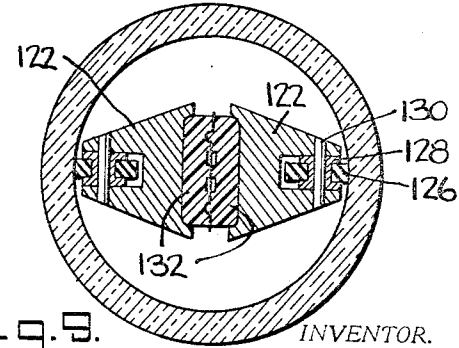
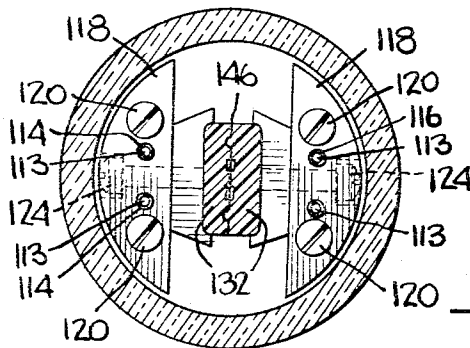
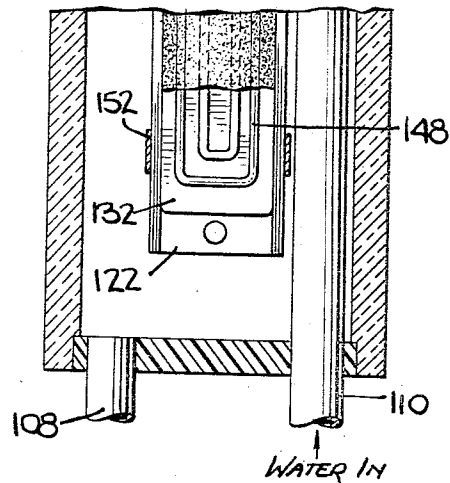
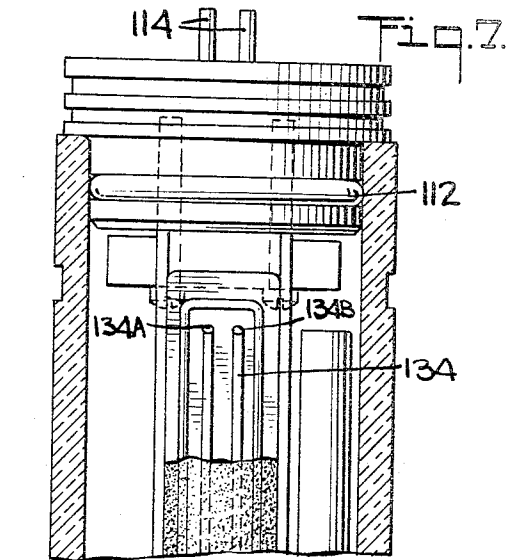
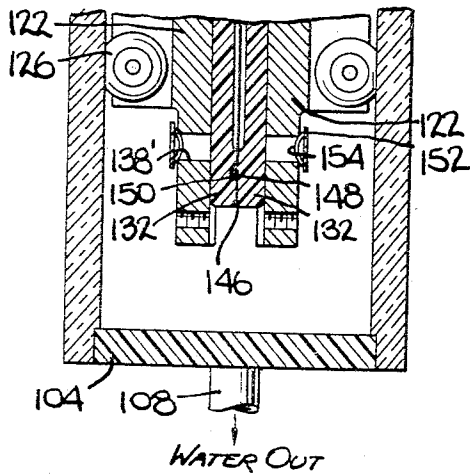
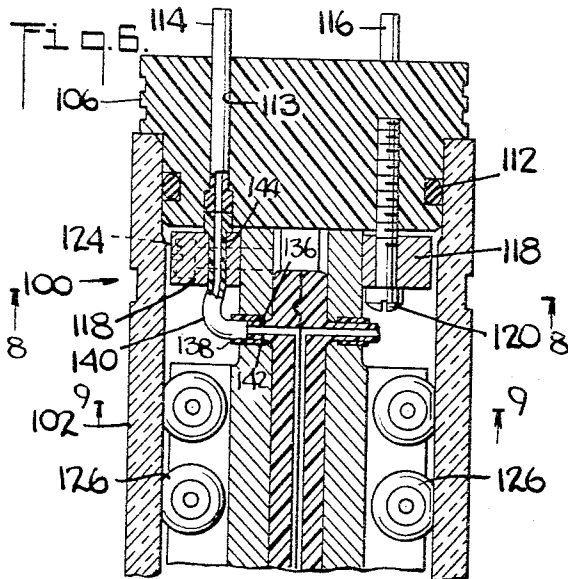


Fig. 6.

Fig. 7.

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DIALYZER ASSEMBLING MEANS

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7 Claims. (Cl. 210—321)

This application is a continuation-in-part of Ser. No. 411,223, filed Nov. 16, 1964.

This invention relates to the separation of liquids and especially to an apparatus for dialysis.

An apparatus for the dialysis of liquids is shown in the U.S. patent to Andres Ferrari, U.S. 3,211,645, issued Oct. 12, 1965. In that apparatus the dialyzer includes two matching plates, each having a counterpart groove which together form the chamber, and membrane disposed between the two grooves. The membrane must be taut for proper dialysis, and, therefore, is tautened prior to the plates being clamped together. Customarily, such a dialyzer is supported in a constant temperature bath to maintain the rate of dialysis constant.

It is an object of this invention to provide a dialysis apparatus which automatically tautens the membrane during assembly.

It is another object of this invention to provide a dialysis and constant temperature bath apparatus, wherein the insertion of the dialyzer into the bath container automatically tautens the membrane.

It is still another object of this invention to provide a dialyzer which may be easily and rapidly manually assembled without tools.

A feature of this invention is a dialysis apparatus including a pair of dialyzer plates having a mating annular rib and groove surrounding the dialysis chamber for automatically stretching a membrane disposed therebetween as the plates are clamped together; and means for clamping the plates together.

An additional feature of this invention is a bath container which is adapted to receive the above-mentioned dialyzer plates and to serve as the means for clamping these plates together.

These and other objects, features and advantages of this invention will become apparent from the following description of the invention considered in connection with the accompanying illustrative drawings of the presently preferred embodiments of the invention in which:

FIG. 1 is a longitudinal transverse section of a dialyzer embodying this invention;

FIG. 2 is a plan view, partially broken away, of the dialyzer of FIG. 1;

FIG. 3 is a lateral transverse section of the dialyzer of FIG. 1, taken along the plane 3—3 of FIG. 1;

FIG. 4 is an exploded view of the section of FIG. 3, but showing the dialyzer disassembled;

FIG. 5 is a portion of a longitudinal transverse section of a second embodiment of this invention;

FIG. 6 is a front view in section of a third embodiment of this invention showing a bath receptacle for clamping the dialyzer plates together;

FIG. 7 is a side view partially in section of the apparatus of FIG. 6;

FIG. 8 is a transverse section of the apparatus of FIG. 6, taken along the plane 8—8 of FIG. 6; and

FIG. 9 is a transverse section of the apparatus of FIG. 6, taken along the plane 9—9 of FIG. 6.

The dialyzer of FIG. 1 comprises two plates 10 and 12 having mating confronting surfaces 14 and 16 respectively. Two mating confronting grooves 18 and 20 are respectively formed into the mating surfaces 14 and 16 to form a chamber. Two passageways 22 and 24 are integrally formed in the plate 10 to respectively interconnect

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one end 18R of the groove 18 with an integral tube fitting 26, and the other end 18L of the groove 18 with an integral tube fitting 28. Two passageways 30 and 32 are integrally formed in the plate 12 to respectively interconnect one end 20R of the groove 20 with an integral tube fitting 34, and the other end 20L of the groove 20 with an integral tube fitting 36.

The plate 10 is disposable within a box-like shell 38 and the plate 12 is disposable with a box-like shell 40. The shell 38 has two apertures 42 and 44 therein to respectively receive therethrough the fittings 26 and 28. The shell 40 has two apertures 46 and 48 therein to respectively receive therethrough the fittings 34 and 36. The outer surface of the plates 10 and 12 are formed with a plurality or grid of cavities 50 therein to provide the plates with flexibility to enable full contact between the confronting surfaces 14 and 16 when the plates 10 and 12 are clamped together by the shells 38 and 40. In this regard the plates may advantageously be made of "Tygon" polyvinyl plastic and the shells of stainless steel.

The shells are joined together and aligned by a hinge strip 52 and are joinable by a lock strip 54. The hinge strip 52 comprises an elongated strip of resilient plastic, such as polypropylene, having a cross-section which is best shown in FIG. 2. The cross-section includes two relatively thicker end portions 56 and 58 and a relatively thinner medial portion 60. Each of the end portions is provided with a longitudinal row of integral mushroom-like projections 62, which are disposed through a longitudinal row of mating apertures 64 formed along the margin of the shell. Each of the plates is also formed with a longitudinal row of cavities 66 to accommodate the heads of the projections 62. The lock strip 54 similarly comprises an elongated strip of resilient plastic, such as polypropylene, having a cross-section which includes two relatively thicker end portions 68 and 70 and a relatively thinner medial portion 72. The end portion 68 is provided with a longitudinal row of integral hook-like projections 74 which are disposable through and snap-lockable behind a longitudinal row of mating apertures 64 formed along the margin of the adjacent shell. The end portion 70 is provided with a longitudinal row of mushroom-like projections 76 which are disposed through a longitudinal row of mating apertures 64 formed along the margin of the shell. Each of the plates is also formed with a longitudinal row of cavities 66 to accommodate the heads of the projections 74 and 76.

A semi-permeable membrane 77 is disposable between the plates 10 and 12 and has an outline which is slightly greater than the periphery of the adjacent surfaces 14 and 16 of the plates, so that a margin of the membrane will extend beyond the plates when the assembly is clamped together. The mating edges of the shells are spaced apart, when the shells are locked about the plates to clear this peripherally extending margin of membrane. Further, the medial portions 60 and 72 of the hinge and the lock strips are each formed with a concave groove to clear this margin of membrane. Thus the full annulus of the margin of membrane is exposed to the liquid of a heating bath when and if the dialyzer is disposed therein.

The plate 12 has a rib 78 formed from the surface 16 as an annulus around the groove 20. The plate 10 has a groove 80 formed into the surface 14 as an annulus around the groove 20, mating with the rib 78. In assembly, the plate 12 is interfitted within the shell 40, and the plate 10 is interfitted within the shell 38. The membrane is then laid on one of the faces 14 and 16, and the two plates are swung together and inter-locked by means of the hook-like projections 74 being snapped into their mating apertures 64. As the plates are squeezed together the membrane 77 is stretched around the rib 78 by the groove 80, thereby tautening the portion of the membrane bounded by

this rib and the groove. It will be appreciated that this tautening action is automatic as the plates are clamped together by the shells, and thus the membrane need not be pretautened prior to the clamping operation.

When it is desired to change membranes, or to clean the dialyzer, the assembly can be opened by peeling the portion 68 of the locking strip 72 away from the adjacent shell, releasing the hook-like projections 74 from their mating apertures 64.

It is often desirable to provide a dialyzer with non-wetting surfaces where the liquid being dialyzed will be contacted. In the embodiment shown in FIG. 5 the dialyzer is provided with two preformed liners 82 and 84 of a suitable non-wetting material. For example, the liners may be die-formed from .005 inch sheets of "Teflon." The liner 82 conforms to the irregularities of the surface 14' and the liner 84 conforms to the irregularities of the surface 16'. The liners are apertured adjacent the passageways such as 24' and 32' to place the chamber in fluid flow communication with the four passageways. If desired, tubing made of similar non-wetting material may be fitted into each of the four passageways up to the liners, to completely line the dialyzer.

The dialyzer and bath container apparatus 100 of FIG. 6 comprises a tube 102 having a lower plug 104 connected thereto, and a removable upper plug 106. The lower plug has two bores which respectively receive, cemented thereto, a short conduit 108 for bath water outflow, and a long conduit 110 for bath water inflow. The upper plug has an annular groove into which a gasket 112 is disposed. The upper plug also has four bores 113 which respectively receive two conduits 114 for the inflow and outflow of the liquid to be dialyzed, and two conduits 116 for the inflow and outflow of the carrier liquid which receives the dialyzate through the membrane. The lower ends of these four bores are respectively counter-bored, and the lower ends of these conduits are enlarged to seat within these counter-bores respectively. Two elements 118 are mounted respectively to the lower face of the upper plug 106 by two machine screws 120. Two carriage blocks 122 are respectively secured to the two elements 118 by a machine screw 124. The medial portion of each of the carriage blocks 122 is of substantially triangular cross-section as best seen in FIG. 9. The apex of each triangle is bifurcated to receive a plurality of rollers 126, advantageously made of india rubber, on a nylon bushing 128, journaled on a nylon or stainless steel shaft 130. The base of each triangle is recessed to receive a dialyzer plate 132.

Each dialyzer plate 132 has a U shaped counterpart groove 134 having a communicating inlet bore 134A and outlet bore 134B. Each bore has a respective nipple 136 formed as an upstanding projection from the respective plate 132. Each nipple 136 passes into a respective bore 138 through the carriage block 122. One end of a resilient conduit 140 is held in end-abutment with each nipple 136 respectively by a splice tube 142. The other end of each conduit 140 passes through a respective bore 144 in the element 118, and has an end enlargement which enters into the respective bore 113 in the upper plug 106 into end-abutment with the conduit 114. The machine screws 120 serve to releasably clamp the carriage blocks to the plug 106 and the conduits 140 to the respective conduits 114 and 116.

A semi-permeable membrane 146 is disposed between the two dialyzer plates 132, and has an outline which is slightly greater than the periphery of the membrane-adjacent-surfaces of the plates. One of the plates 132 has a rib 148 formed from the membrane-adjacent-surface as an annulus around the respective groove 136. The other one of the plates 132 has a groove 150 formed into the membrane-adjacent-surface, which is the counterpart of the rib 148.

The carriage blocks 122 are advantageously formed symmetrically about a transverse axis, and have a respective bore 138' formed in their respective other ends.

During the assembly of the apparatus, a spring clip 152 may be snapped about said other ends of the plates, to initially hold the plates together in alignment. The clips have projections 154 which may engage the bores 138'.

In assembly, the membrane 146 is disposed between a pair of plates 132, 132, which plates are disposed between a pair of carriage blocks 122, 122, which may be held together by a clip 152. The flexible conduits 140 are passed through their respective bores in the respective clamp elements 118 and screwed in end-abutment with the respective nipples 136 by the respective splice tubes 142. The pair of elements 118, 118 is fixed to the carriage blocks 122, 122 by the respective screws 124. The conduits 114, 116 are disposed through their respective bores 113 in the upper plug 106, and the pair of clamp elements 118, 118 are secured to the upper plug 106 by the respective screws 120, clamping the conduits 140 into end-abutment with the respective conduits 114, 116. The assembly of membrane 146, plates 132, 132, and carriage blocks 122, supported by the plug 106 is thrust into the tube 102, the rollers 126 riding on the inner wall of the tube. The rollers are compressed and the load is uniformly transmitted by the carriage block along the length and width of the plates, uniformly clamping the plates together. As the plates are clamped together, the membrane is distorted by the rib 148 and groove 150 and tautened. The plug 106 seals the bath container. Water at a constant temperature is pumped in through the conduit 110, and out through the conduit 108. The liquid to be dialyzed is pumped in through one tube 114 and out through the other tube 114. A carrier liquid to receive the dialyzate is pumped in through one tube 116 and out through the other tube 116.

While I have shown and described the preferred embodiments of my invention, it will be understood that the invention may be embodied otherwise than as herein specifically illustrated or described, and that certain changes in the form and arrangement of parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

What is claimed is:

1. A dialyzer comprising: two companion plate members, each having a surface with a groove therein; means for clamping said members with said surfaces in confronting face-to-face relation, with said groove in mutual register to form a chamber; a membrane disposed between said members; complementary rib means and groove means formed on the respective said surfaces of said plate members for engaging said membrane around said chamber and for tautening the included portion of said membrane when said members are clamped in confrontation; said means for clamping including a rigid, outer frame means adapted to receive said plate members therein, intermediate, resiliently compressible means, adapted to be compressed between said frame means and said plate members when said plate members are inserted into said frame means, thereby clamping said plate members together.

2. A dialyzer comprising: two companion plate members, each having a surface with a groove therein; means for clamping said members with said surfaces in confronting face-to-face relation, with said groove in mutual register to form a chamber, complementary rib means and groove means formed on the respective said surfaces of said plate members for engaging around said chamber a membrane disposed between said members and for tautening the included portion of such membrane when said members are clamped in confrontation; said means for clamping including a rigid, outer frame means adapted to receive said plate members therein, intermediate, resiliently compressible means, adapted to be compressed between said frame means and said plate members when said plate members are inserted into said frame means, thereby clamping said plate members together.

3. A dialyzer comprising: two companion plate members, each having a surface with a groove therein; means

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for clamping said members with said surfaces in confronting face-to-face relation, with said grooves in mutual register to form a chamber; complementary rib means and groove means formed on the respective said surfaces of said plate members for engaging, around said chamber, a membrane disposed between said members and for tautening the included portion of such membrane when said members are clamped in confrontation; said means for clamping including a rigid tube adapted to receive said plate members therein; two intermediate members, each having a surface adapted to abut a respective plate member, and each having a resiliently compressible member adapted to abut the inner wall of said tube, whereby when said plate members and said intermediate members are disposed within said tube, said resiliently compressible members are deformed and said intermediate members clamp said plate members together.

4. A dialyzer comprising: two companion plate members, each having a surface with a groove therein; means for clamping said members with said surfaces in confronting face-to-face relation, with said grooves in register to form a chamber; means for engaging, around said chamber, a membrane disposed between said members and for tautening the included portion of such membrane when said members are clamped in confrontation; said means for clamping including a tube adapted to receive said plate members therein; two intermediate members each having a surface adapted to abut a respective plate member, and each having a plurality of resiliently compressible rollers adapted to abut the inner wall of said tube, whereby when said plate members and said intermediate members are disposed within said tube, said resiliently compressible rollers are deformed and said intermediate members clamp said plate members together.

5. A dialyzer comprising: two companion plate members, each having a surface with a groove therein; means for clamping said members with said surfaces in confronting face-to-face relation, with said grooves in register to form a chamber; a membrane disposed between said members; means for engaging said membrane around said chamber and for tautening the included portion of said membrane when said members are clamped in confrontation; said means for clamping including a tube, closed at one end, adapted to receive said plate members therein; two intermediate members, each of substantially triangular cross-section, having a base surface adapted to abut a respective plate member, and each having a plurality of resiliently compressible rollers adapted to abut the inner wall of said tube, a plug secured to said intermediate members and adapted to close the other end of said tube, a first pair of conduits coupled to the ends of said groove of one of said plate members, a second pair of conduits coupled to the ends of said groove of the other of said plate

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members, said first and second pairs of conduits passing through said plug, whereby when said plug closes said tube and said plate members and said intermediate members are disposed within said tube, said resiliently compressible rollers are deformed and said intermediate members clamp said plate members together.

6. A dialyzer comprising: two companion plate members, each having a surface with a groove therein; means for clamping said members with said surfaces in confronting face-to-face relation, with said grooves in register to form a chamber; said means for clamping including a tube adapted to receive said plate members therein; two intermediate members, each having a surface adapted to abut a respective plate member, and each having a plurality of resiliently compressible rollers adapted to abut the inner wall of said tube, whereby when said plate members and said intermediate members are disposed within said tube, said resiliently compressible rollers are deformed and said intermediate members clamp said plate members together.

7. A dialyzer comprising: two companion plate members, each having a surface with a groove therein; means for clamping said members with said surfaces in confronting face-to-face relation, with said grooves in register to form a chamber; a membrane disposed between said members; said means for clamping including a tube, closed at one end, adapted to receive said plate members therein; two intermediate members, each of substantially triangular cross-section, having a base surface adapted to abut a respective plate member, and each having a plurality of resiliently compressible rollers adapted to abut the inner wall of said tube, a plug secured to said intermediate members and adapted to close the other end of said tube, a first pair of conduits coupled to the ends of said groove of one of said plate members, a second pair of conduits coupled to the ends of said groove of the other of said plate members, said first and second pairs of conduits passing through said plug, whereby when said plug closes said tube and said plate members and said intermediate members are disposed within said tube, said resiliently compressible rollers are deformed and said intermediate members clamp said plate members together.

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