

[54] COILED TUBE BANKS

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[58] Field of Search 122/250, 510; 138/103, 106, 138/111-113; 248/68 R, 74 R; 165/67, 162, 178

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[57]

ABSTRACT

A tube bank arrangement comprising a plurality of concentric coils provided with spacing means and including, for each coil, at least one spacer bar extending parallel to the axis of the tube bank. The spacer bar being aligned with the spacer bar of the next adjacent coil and including radially extending lugs mounted on one of the two adjacent spacer bars and straddling the coil segments passing therebetween. The lugs maintaining the spacing between adjacent spacer bars and cooperating with a locking strip to secure the coil segments to the associated spacer bar.

4 Claims, 11 Drawing Figures

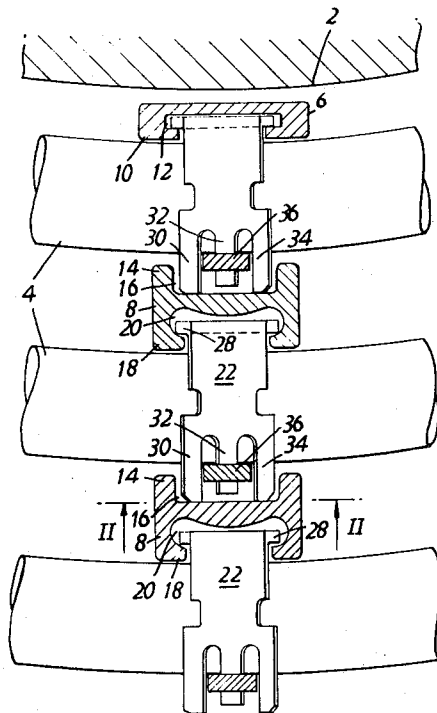
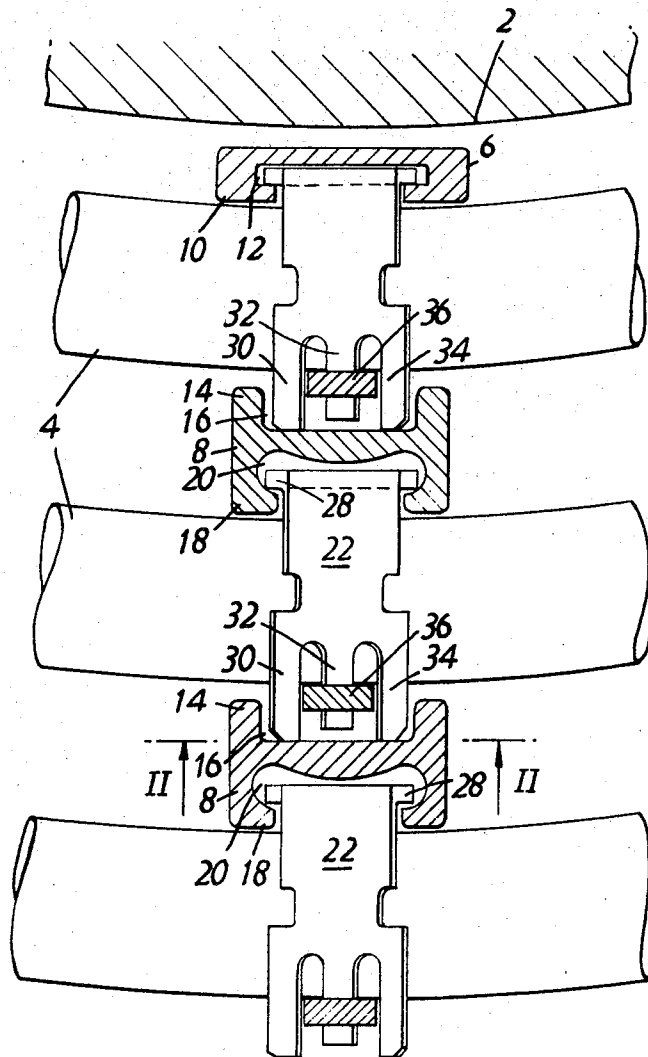


FIG. 1.



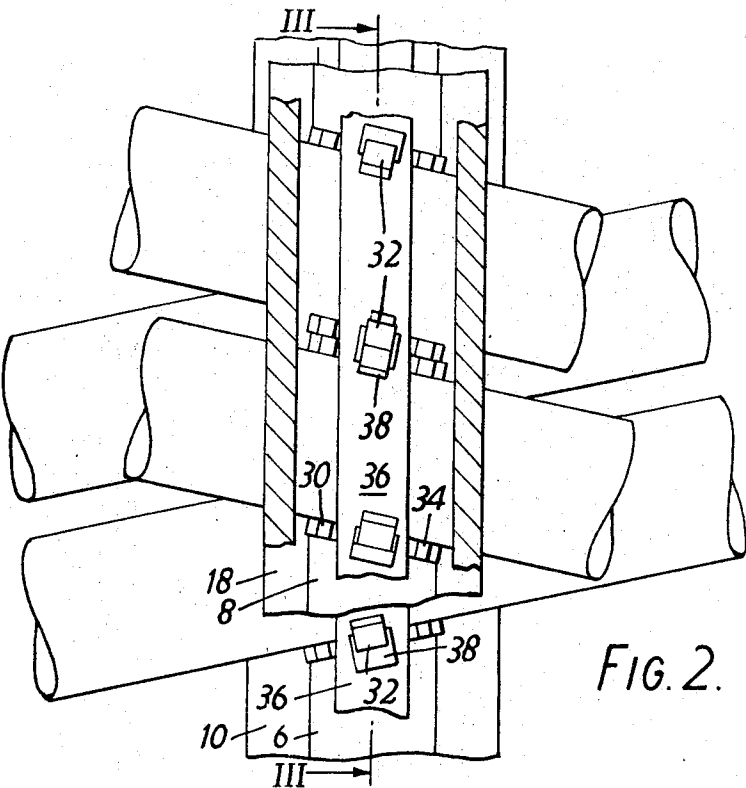
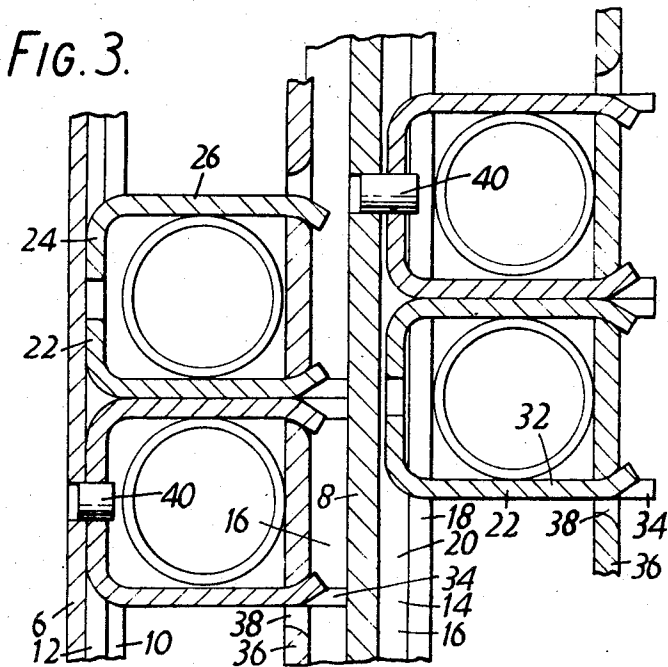


FIG. 4

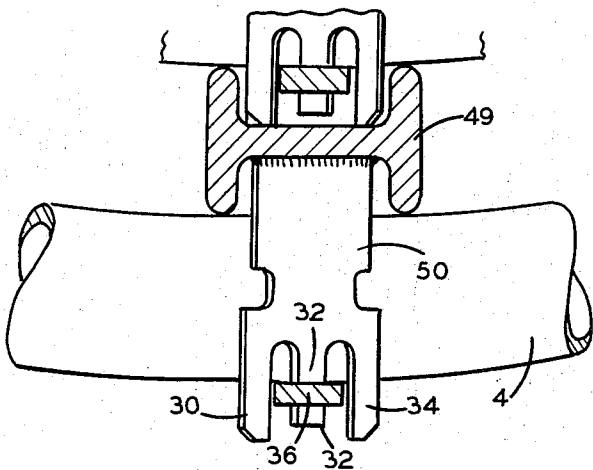


FIG. 5

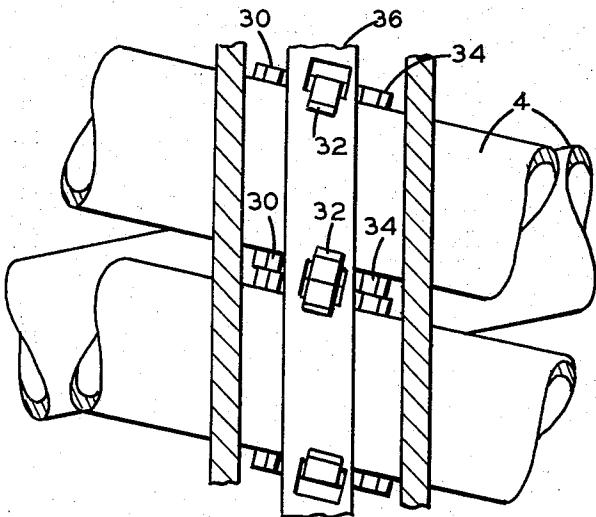


FIG. 6

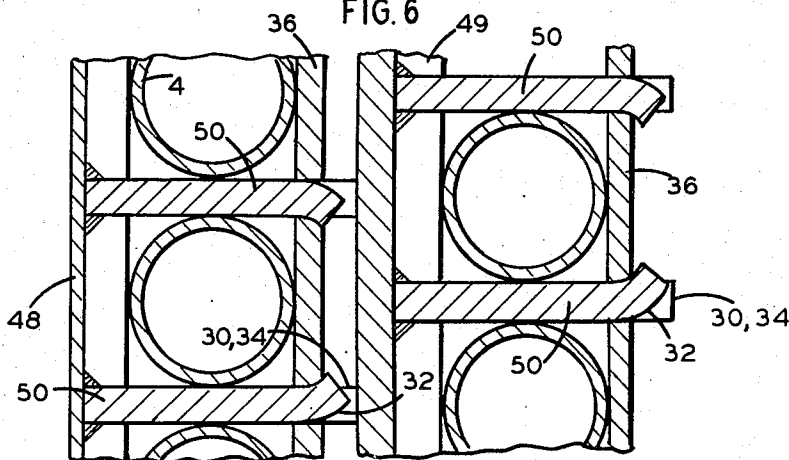


FIG. 7

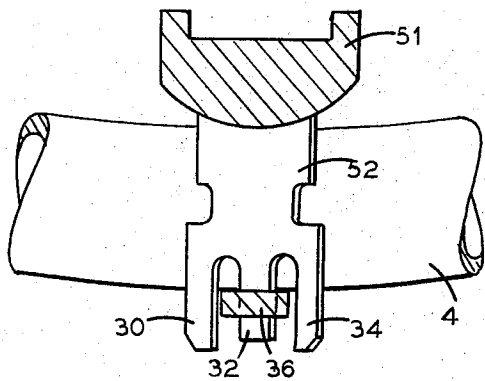


FIG. 8

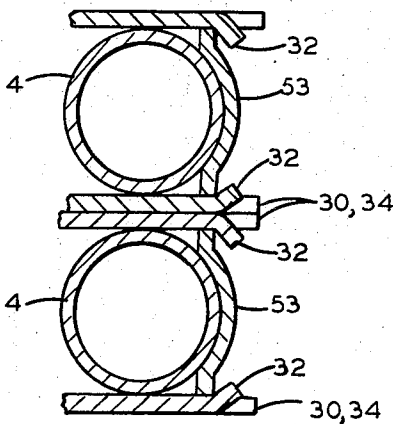


FIG. 9

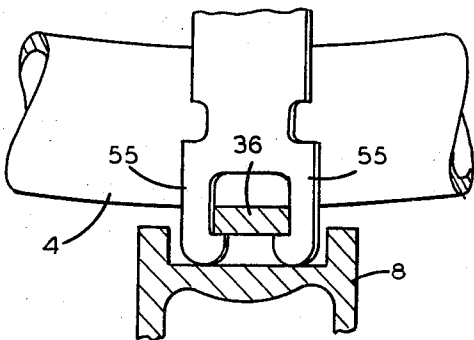


FIG. 10

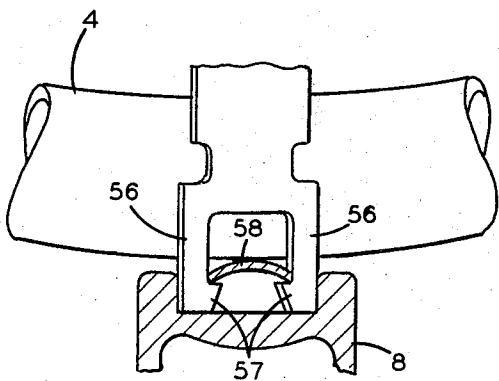
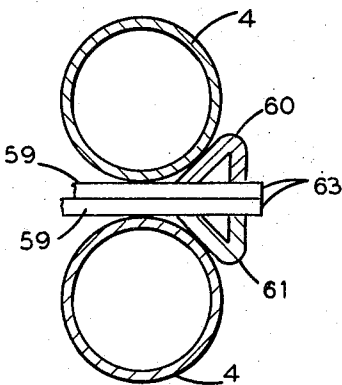


FIG. 11



COILED TUBE BANKS

This invention relates to coiled tube banks and, more particularly, to spacer bars arranged to be positioned between adjacent coils of tubes to locate the coils relative to each other.

Our co-pending application, U.S. patent application Ser. No. 827,625 filed on May 26, 1969, describes apparatus for and a method of forming coiled tube banks in which there is provided a machine arranged to rotate a removable cylindrical core for the coiled tube bank, anchoring means for securing tubes relative to the core on tube coil spacer bars and traversable guide rollers for the tubes adapted to retard passage of tubes therethrough by an amount sufficient to overcome the effect of spring-back forces arising during a coiling operation.

Further layers are wound on the respective adjacent layer by positioning spacer bars on the radially inward adjacent spacer bars, locating the spacer bars with steel strapping, securing a tube or tubes relative to the cylindrical core, positioning back-up shoes intermediate the spacer bars to define an inner curved surface for the tube coils to bear against, rotating the cylindrical core helically to wind a layer of the tube or tubes onto the spacer bars and moving the back-up shoes axially and removing the steel strapping as the winding proceeds along the cylindrical core.

According to the present invention, there is provided a coiled tube bank having respective tube coils spaced apart by spacer bars each including a bar extending axially of the coils having tube spacing lugs mounted on the radially outer face thereof at spacings equal to the tube overall outside diameter and provided with flanges at the radially inner face to co-act with and locate radially outer end portions of lugs mounted on a radially inwardly adjacent spacer bar and means for securing the respective portions of the tube coils to the associated spacer bar.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a plan view of the main embodiment and illustrates a portion of a counter coiled tube bank;

FIG. 2 is an elevation taken on the line II—II of FIG. 1;

FIG. 3 is a sectional elevation taken on the line III—III of FIG. 2;

FIG. 4 is a detail plan view of an alternative embodiment of the invention;

FIG. 5 is a detail elevation view of the alternative embodiment illustrated in FIG. 4;

FIG. 6 is a detail sectional elevation view of the alternative embodiment illustrated in FIG. 4;

FIG. 7 is a detail plan view of another alternative embodiment of the invention;

FIG. 8 is a detail sectional elevation of still another alternative embodiment of the invention;

FIG. 9 is a detail plan view of a further embodiment of the invention;

FIG. 10 is a detail plan view of still a further embodiment of the invention; and

FIG. 11 is a detail sectional elevation view of still another further embodiment of the invention.

Referring to the drawings, the tube bank is wound on to a cylindrical former 2 in a manner such as that described in the specification of our co-pending application U.S. patent application Ser. No. 827,625 filed on May 26, 1969, the former 2 being removable, if required, subsequent to the coiling operation. As shown, adjacent layers of tube coils 4 are wound in opposite directions, but, if desired, the coils may all be wound in one direction. The innermost tube coil 4 is wound against inner spacer bars 6 spaced around the former 2, while spacer bars 8 are positioned intermediate the remaining layers of tube coils 4 in register with the inner spacer bars 6, the spacer bars 6, 8 extending over the axial length of the tube bank.

The inner spacer bars 6 are formed with lipped flanges 10 on one face to form an axially extending groove 12 at that face. The spacer bars 8 are of basically I-shaped section, being provided with flanges 14 on one face to form a flat-bottomed

axially extending groove 16 at that face and lipped flanges 18 on the other face to form an axially extending groove 20 at that face. The form of the spacer bar 8 and the lipped flanges 18 is such that the groove 20 is of curved cross-section.

The tube coils 4 are positioned axially by U-shaped tube clips 22 having a flat base portion 24 and upstanding arms or lugs 26. The base portion 24 has the shape of a parallelogram with the sides displaced from perpendicular by an amount corresponding to the angle of coil of the tube coils and are formed with shoulders 28 extending beyond the side edges of the lugs 26. The shoulders 28 co-act with the lipped flanges 10 and 18 to retain the tube clips 22 in the grooves 12 and 20. End portions of the lugs are cut away to form three tongues 30, 32 and 34. The outer tongues 30, 34 are bevelled at the outer corners thereof and carry the adjacent spacer bar 8. A locking strip 36 formed with slots 38 in register with the inner tongues 32 is positioned over the inner tongues to bear against the adjacent portion of the tube coils 4 and, when the locking strip 36 is in position, the pairs of inner tongues 32 of a tube clip are bent inwardly to secure the locking strip.

In order to locate the tube clips 22 axially of the spacer bars 6, 8 spaced tube clips are secured to the respective spacer bar by dowels 40 passing through the spacer bar and the base portion 24 of the tube clip and are welded to the spacer bar.

In assembling the coiled tube bank, the inner spacer bars 6 are first positioned on the cylindrical former 2 with tube clips 22 positioned in the groove 12 and secured at intervals by dowels 40 to the spacer bars. A first tube coil layer is then wound on between the lugs 26 of the tube clips 22, locking strips 36 positioned over the tongues 32 and the tongues 32 bent over to secure the portions of coiled tube against the spacer bars 6. A layer of spacer bars 8 and tube clips 22 is then positioned with the flat bottomed grooves 16 in register with the end faces of the outer tongues of the tube clips secured to the spacer bars 6 and a second tube coil layer is wound on in register with the tube clips 22 on the spacer bars 8. Locking strips 36 are then positioned over the inner tongues 32 and the tongues bent over to secure the portions of coiled tube against the spacer bars 8. These steps are repeated for subsequent tube coil layers with the spacer bars 8 being supported upon the immediately inwardly adjacent tube clips 22.

The curved cross-section of the grooves 20 permits slight movement of the tube clips 22 to accommodate minor inaccuracies in assembly and thermal expansion.

In an alternative embodiment of the invention, as shown in FIGS. 4, 5 and 6, the tube clips 22 are replaced by lugs 50 welded to the spacer bars 48 and 49 at spacings equal to the tube overall outside diameter and disposed at an angle to the spacer bar equivalent to the coil angle of the coiled tubes. In another alternative embodiment as shown in FIG. 7, the spacer bars 51 and lugs 52 are machined out of solid bar stock. The outer end of each of the lugs is formed with three tongues 30, 32 and 34 in a manner similar to the lugs 26 of the tube clips 22 to receive a locking strip 36 and to locate the immediately outer spacer bar by co-acting with a groove provided on the inner face thereof.

In still another alternative embodiment, as shown in FIG. 8, the locking strip 53 has an undulating form with alternating flat and part cylindrical portions positioned with the part cylindrical portions in register with the respective portions of the tube coils 4 and the flat portions engaging with the tongues 32.

In a further embodiment of the invention, as shown in FIG. 9, the three tongues 30, 32 and 34 are replaced by a pair of tongues 55 which are bent inwardly to secure the locking strip 36, the bent over portions registering in the groove of the immediately outwardly adjacent spacer bar to effect location thereof and also thereby ensuring that the tongues remain in the bent-over position. In still a further embodiment as shown in FIG. 10, instead of bending the tongues over, the tongues 56 are formed with detents 57 at the outer ends thereof. A resilient strip 58 of arcuate cross-section is sprung into the notch by a combination of forcing the tongues apart and

decreasing the cross-sectional radius of the strip 58 until the edges of the strip pass the detents 57 on the tongues 56. The tongues then spring back or are compressed to their original position and retain the strip 58. Upon placing the immediately outwardly adjacent spacer bar 8, the groove in the flat bar co-acts with the outer end portions of the tongues 56 to prevent any subsequent outward movement thereof thereby positively locking the strip 58. The central portion running axially of the strip bears against respective portions of the coiled tubes 4 to retain and locate the tubes 4 against the associated flat bar.

In still another further embodiment of the invention, as shown in FIG. 11, the locking strip is replaced by individual retaining means positioned on the respective lugs. Shoulder pieces 60 and 61, in the form of a short strip having the end portions bent over to form a triangular cross-section are placed over lugs 59 having notched ends with the central portion of each strip in the notch and the end portions to either side of the lugs 59 and bearing against the adjacent portions of the tube coils with an action wedging the tubes 4 into the gaps between the lugs 59. The shoulder pieces 60 and 61 are secured in position by bending over the tongues 63 on the lugs 59. The tongues 63 in the bent over position co-act with the grooved portion of the immediately outwardly adjacent spacer bar and are thus locked against relaxation from their deformed condition.

Each of the foregoing arrangements ensures positive location of the tube turns in relation to the respective spacer bars both during coiling and in service while permitting normal tolerance variations in the tube outside diameter and accommodating any surface corrosion film build-up during service. The resilient nature of the various retaining arrangements tends to ensure that any vibrations developing are rapidly damped out.

We claim:

1. A tube bank arrangement comprising a plurality of concentric coils provided with spacer means, wherein the spacer means includes, for each coil, at least one spacer bar extending in a direction substantially parallel to the axis of said tube bank, said spacer bar being aligned with a spacer bar of the next adjacent coil so that a row of spacer bars extends radially of the concentric coils, the interval between adjacent spacer bars including, for each coil segment passing therebetween, a pair of spacing lugs contiguously straddling the coil segment, each of the lugs having an end connectively associated with one spacer bar and an opposite end abutting a portion of the adjacent spacer bar, and means for securing respective coil segments to said associated spacer bar, said lug abutting end being formed with a plurality of tongues and the securing means including a locking strip interposed between the coil segments and said adjacent spacer bar, the locking strip being engaged with at least one of the tongues of each of said lugs to secure the respective coil segments to said associated spacer bar.

2. A tube bank arrangement according to claim 1 wherein the locking strip includes a generally flat bar having perforations along its length for receiving the free-end of said engaged tongues in locking relationship therewith.

3. A tube bank arrangement according to claim 2 wherein said free-end is bent-over the radially outer face of the flat bar.

4. A tube bank arrangement according to claim 1 wherein the locking strip includes a resilient bar of arcuate cross-section, said bar being engaged with two tongues of each of said lugs and being in rebounding contact with the respective coil segments.

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