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(54) A boiler

(57) The boiler comprises a roof and two side walls (22, 25) formed as membrane walls each having a lower header (23, 26) at the bottom and being connected at the top with at least one upper header (27). The boiler has at least one suspended heating surface section comprising several heating surface tubes (30) supported at the top and passed from the roof down to lower headers lying crosswise in the boiler. The roof in the boiler is a membrane wall (28), and the heating surface tubes extend uninterruptedly from one lower header up through and above the roof and return through the roof to an adjacent lower header, and have been passed in a gastight and longitudinally displaceable manner through the membrane wall of the roof.

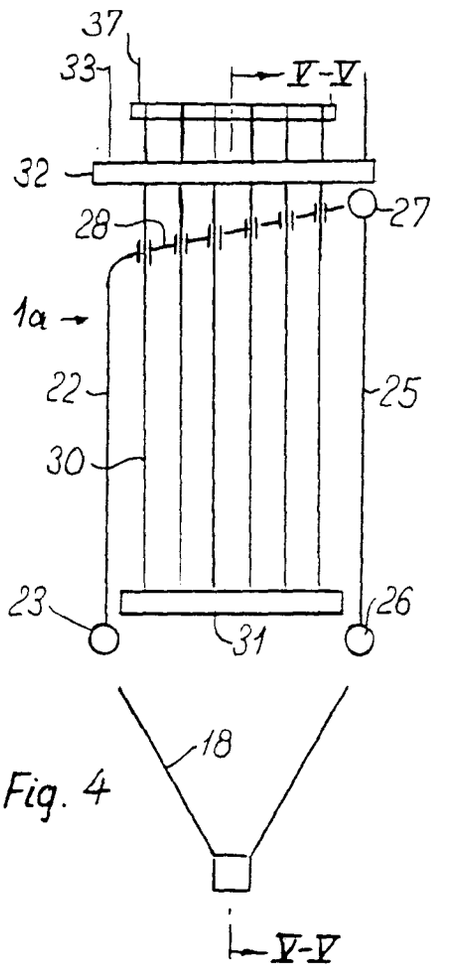

Fig. 4

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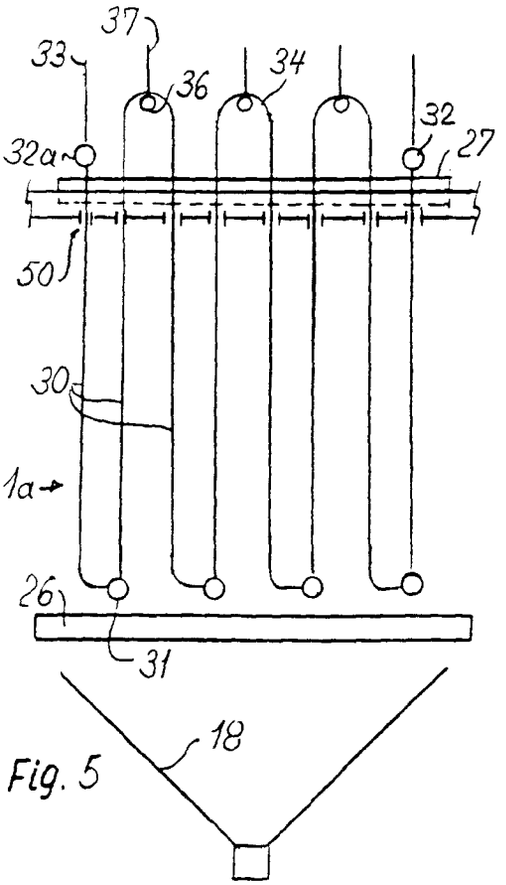

Fig. 5

Description

The present invention relates to a boiler comprising a roof and two side walls, the side walls being membrane walls each having a lower header at the bottom and being connected at the top with at least one upper header, and at least one suspended heating surface section comprising several heating surface tubes supported at the top and passed from the roof down to lower headers extending transversely in the boiler.

Boilers of this type are known in which the membrane walls of both side walls have an upper header and the heating surface sections are superheaters, the super heater tubes of which are welded into superheater upper headers arranged transversely to the flue gas flow passage above the side wall upper headers. Furthermore adjacent superheater upper headers are connected in pairs with bends welded to the top surfaces of the respective headers. Each end of the superheater upper headers is suspended from round bars bolted to girders positioned above the boiler. To protect the headers against the hot flue gas and close the upper side of the flue gas flow passage gastight, refractory material has been moulded or built up around the superheater upper headers and in the interspaces between them.

The prior-art boilers suffer from the drawback that the assembly of the superheater sections in a new boiler plant must be made *in situ,* which requires a large manual work effort owing to the many welds to be carried out to connect the superheater tubes to the upper headers and interconnect the upper headers through tube bends. Furthermore the moulding or build-up of the roof is cumbersome and time consuming.

The known boilers have another drawback in that in time the refractory material cracks and falls down. One of the reasons for this is that the superheater tubes are embedded in the refractory material in order to achieve a gastight penetration, but owing to dissimilar thermal expansions of the upper headers, the superheater tubes and the refractory materiel, stresses occur resulting in said cracks. Yet another drawback is that repairs of the parts of the boiler adjacent to or covered by refractory material requires removal and subsequent reestablishment of this material, which is both labour consuming and expensive.

Another substantial drawback is that the superheater tubes are welded into the top and lower headers such that a rigid plane grid is formed in which the individual tubes are heated dissimilarly during operation, but are prevented from expanding individually, resulting in stresses in the welds at the headers and consequent cracks.

The object of the invention is to provide a boiler of the type mentioned in the introduction that does not suffer from the drawbacks described above.

According to the invention this is achieved in a boiler of said type in which the roof is a membrane wall, in which the heating surface tubes extend uninterruptedly from a lower header up through and above the roof and return through the roof to an adjacent lower header, and in which the heating surface tubes are passed in a gastight and longitudinally displaceable manner through the membrane wall of the roof.

Forming the boiler roof as a membrane wall obviates the need for lining, because the membrane wall of the roof is cooled by through-flowing water/steam in the same manner as the membrane walls of the side walls are cooled. Because the heating surface tubes are uninterrupted and have been passed in a gastight and longitudinally displaceable manner through the membrane wall of the roof, there is no need for upper headers in the heating surface sections or for carrying out assembly welds above the boiler roof.

In a preferred embodiment, the roof may be formed by a membrane wall of one side wall being bent at the top towards the other side wall and at a slight rise is extended to and connected to at the least one upper header. The bending of the membrane wall is most expediently carried out in a workshop, which has proved not to constitute a limitation, as it is possible for a boiler according to this embodiment to manufacture with advantage whole sections of the flue gas flow passage with pre-mounted heating surface sections in the workshop, whereupon the work at the building site is reduced to welding together the individual pre-manufactured flue gas flow passage sections. At any subsequent repair of heating surface tubes it is simple to remove damaged parts and mount new heating surface tubes through the gastight penetrations in the membrane wall of the roof.

In another embodiment of the boiler according to the invention, a supporting means may be arranged above the roof for supporting at least some of the tubes of the heating surface section. Supporting of the tubes in this manner enables them to expand freely, for which reason the tubes suffer no thermal stresses. A further advantage is that because the supporting means is arranged above the cooled and gastight roof, it can be kept at a low temperature and in an atmosphere free of corrosive gases, which extends its life.

In a third embodiment the heating surface tubes supported by the supporting means may have a 180° bend above the roof and rest with the bend directly or indirectly on the supporting means. This embodiment provides a suspension which is particularly simple and rapid to mount.

In a fourth embodiment the gastight penetration may comprise a pipe stub welded into the membrane wall of the roof, the end of the pipe stud located above the membrane wall being provided with a thread, a gland nut and packing material clamped between the pipe stub and the gland nut. The clearance between the pipe stub and the tube of the heating surface section is sufficient for free movement of the tube up and down in the pipe stub, and at the same time the clearance is sufficient to absorb any lateral or angular displacements occurring during operation of the boiler. The packing material,

which is preferably braided packing yarn of a heat-resistant material, may be compressed after mounting by tightening of the gland nut. This embodiment is advantageous in that it is possible to retighten or replace the packing material in a simple manner.

In some embodiments of the boiler according to the invention the tubes of the heating surface may be arranged so close to each other that there is no room to apply the usual tightening tools for tightening the gland nut. In view of this, the gastight penetration in a fifth embodiment may comprise a pipe stub which is welded into the membrane wall of the roof and whose end located above the membrane wall comprises a socket in which packing material is inserted, and the packing material may be retained in the socket in an axially compressed state by a gland bush insertable into the socket and fastened to the socket.

According to the invention, in further embodiments the gland bush insertable into the socket may be fastened by means of several spring clips or by means of interrupted welds between the socket and the gland bush. In these cases displacement of the insertable gland bush may be made by means of a tool which requires less space as it does not have to be swung about the tube of the heating surface. To facilitate mounting of the gland bush insertable into the socket, the gland bush may in a further embodiment be composed of two halves which are welded together after being placed around the tube of the heating surface.

The invention will now be further described in detail below by means of an embodiment and with reference to the drawing, in which

Fig. 1 is a schematic cross-sectional view of a prior-art boiler,
Fig. 2 is a sectional view along the line II-II in Fig. 1,
Fig. 3 is a perspective view of the boiler of Fig. 1,
Fig. 4 is a cross-sectional view of a boiler according to the invention,
Fig. 5 is a sectional view along the line V-V in Fig. 4,
Fig. 6 is a perspective view of the boiler of Fig. 4,
Fig. 7 is a vertical sectional view through a gastight penetration with a gland nut in a boiler according to the invention,
Fig. 8 is a vertical sectional view through a gastight penetration in which the axially displaceable gland bush is retained by spring clips,
Fig. 9 is a vertical sectional view of a gastight penetration in which the axially displaceable gland bush is retained by means of welds, and
Fig. 10 is a perspective view of two halves of a displaceable gland bush.

Figs. 1-3 of the drawing show part of a prior-art boiler 1 having two side walls, each being fabricated of a membrane wall 2, a lower header 3 and an upper header 4, and a membrane wall 5, a lower header 6 and an upper header 7, respectively. The boiler 1 has a suspended superheater section consisting of superheater tubes 10 being connected at the bottom to lower headers 11 and at the top to upper headers 12. The upper headers are suspended from round bars 13 in girders, not shown. Adjacent upper headers are connected in pairs with tube bends 14. Below and between the upper headers, refractory material 15 has been placed, for example by moulding or building-up. As indicated, an ash box 18 is arranged below each superheater section.

Figs. 4 and 5 show a section of a boiler Ia according to the invention, of which one side wall consists of a membrane wall 25 with a lower header 26 and an upper header 27, and the other side wall is formed by a membrane wall 22 which is bent towards the first membrane wall 25 at the top and carried at a slight rise to the upper header 27 of the first membrane wall. The membrane wall 22 has a lower header 23 at the bottom.

At the top, each superheater section has a supply header 32 and a discharge header 32a. The superheater tubes 30 themselves are shaped like hairpins the legs of which are passed through gastight penetrations 50 in the membrane wall 28 forming the roof of the boiler and are welded to lower headers 31. The hairpin bend 34 rests on supports 36 suspended from round bars 37 in girders, not shown in detail. An ash box 18 is indicated below the superheater section.

Fig. 6 shows that the tube bends 34 of the superheater tubes 30 may be arranged at several levels above the roof 28, and that if so there may be several supports 36 located above each other and supported by the same round bar 37.

The superheater tubes 30 are passed through gastight penetrations shown in more detail in Fig. 7. In the membrane wall a pipe stub 51 is welded in, having at the top a thread on which a gland nut 52 is screwed so that inserted packing material 53 is squeezed against the tube by tightening of the nut and thus ensures that the tube penetration is closed in a gastight manner, and that at the same time the superheater tube can freely expand in its longitudinal direction.

Fig. 8 shows a gastight penetration 60 with a pipe stub 61 welded into the membrane wall 28. At the top, the pipe stub has a socket 64, which, in the case shown, is formed by a welded-on ring, but in other cases the socket could have been manufactured by, for example, forging or rolling. The socket holds packing material 63, for example of packing yarn, which is retained in a compressed state by a gland bush 62. The gland bush 62 is pressed against the packing material by two spring clips 65.

The gastight penetration 70 shown in Fig. 9 is constructed similarly to the penetration 60 of Fig. 8, but the axially displaceable gland bush 62 is retained by interrupted welds 75 between the gland bush and the socket part 64 of the pipe stub 61. As shown in Fig. 10, the axially displaceable gland bush 62 may be manufactured from two halves 62a and 62b, assembled around the tube 30 by welding after the tube has been mounted

in the gastight penetration 60 or 70.

Claims

1. A boiler comprising a roof and two side walls, the side walls being membrane walls each having a lower header at the bottom and being connected at the top to at least one upper header, and at least one suspended heating surface section comprising several heating surface tubes supported at the top and passed from the roof down to lower headers extending transversely in the boiler, **characterized** in that the roof is a membrane wall (28), that the heating surface tubes (30) extend uninterruptedly from a lower header (31) up through and above the roof and return through the roof to an adjacent lower header (31), and that the heating surface tubes (30) are passed in a gastight and longitudinally displaceable manner through the membrane wall of the roof.

2. A boiler according to claim 1, **characterized** in that the roof (28) is formed by the membrane wall (22) of one side wall being bent at the top towards the other side wall and at a slight rise is extended to and connected to the at least one upper header (27) of the other side wall (25).

3. A boiler according to claim 1 or 2, **characterized** in that a supporting means (36) is arranged above the roof for supporting at least some of the tubes (30) of the heating surface section.

4. A boiler according to claim 3, **characterized** in that the heating surface tubes (30) supported by the supporting means (36) have a 180° bend (34) above the roof (28) and rest with the bend directly or indirectly on the supporting means.

5. A boiler according to any one of the preceding claims, **characterized** in that the gastight penetration (50) comprises a pipe stub (51) welded into the membrane wall (28) of the roof, the end of the pipe stud located above the membrane wall being provided with a thread (54), a gland nut (52) and packing material (53) clamped between the pipe stub and the gland nut.

6. A boiler according to any one of claims 1 to 4, **characterized** in that the gastight penetration (60; 70) comprises a pipe stub (61) which is welded into the membrane wall (28) of the roof and whose end located above the membrane wall comprises a socket (64) in which packing material (63) is inserted, and that the packing material is retained in the socket in an axially compressed state by a gland bush (62) insertable into the socket and fastened to the socket.

7. A boiler according to claim 6, **characterized** in that the gland bush (62) insertable into the socket (64) is fastened by means of several spring clips (65).

8. A boiler according to claim 6, **characterized** in that the gland bush (62) insertable into the socket (64) is fastened by means of interrupted welds (75) between the socket (64) and the gland bush (62).

9. A boiler according to any one of claims 6 to 8, **characterized** in that the gland bush (62) insertable into the socket (64) is composed of two halves (62a, 62b) welded together after being arranged around the tube (30) of the heating surface.

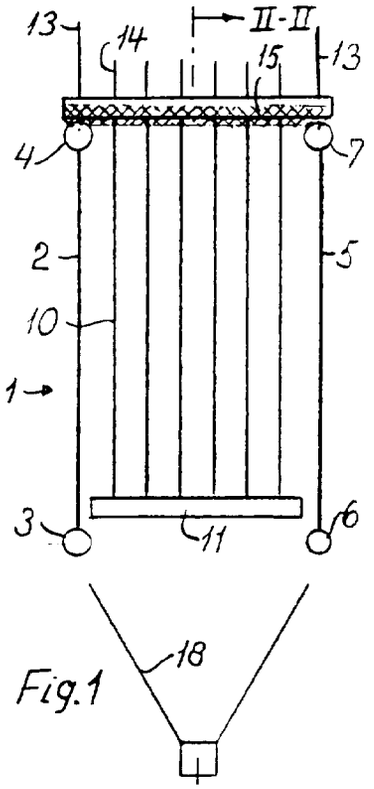

Fig.1

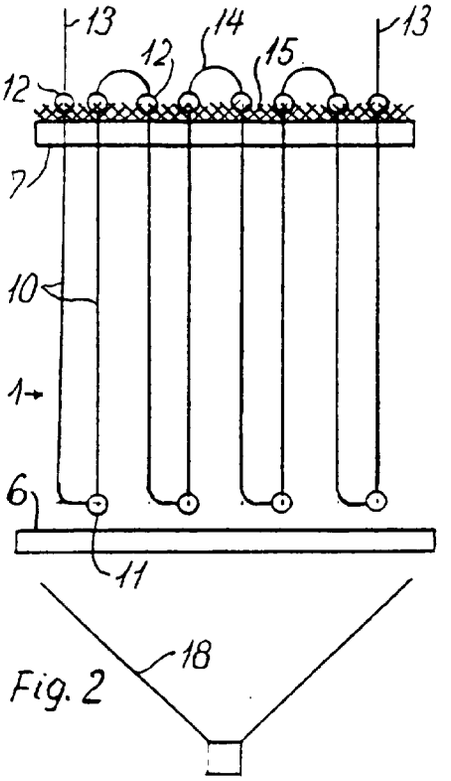

Fig. 2

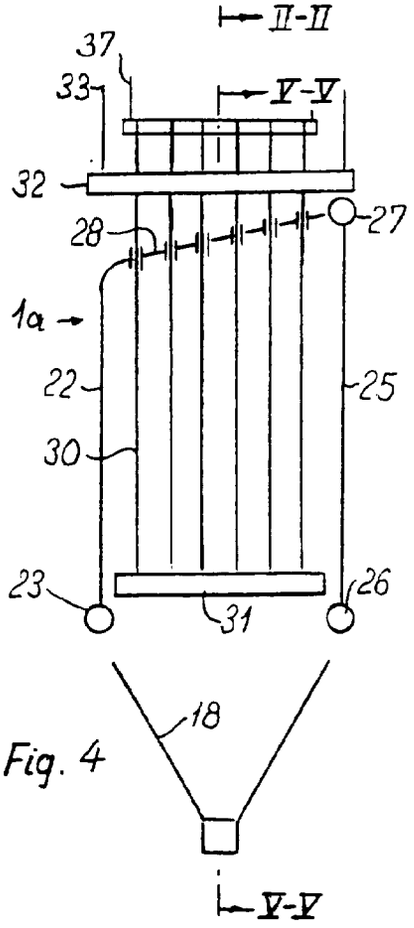

Fig. 4

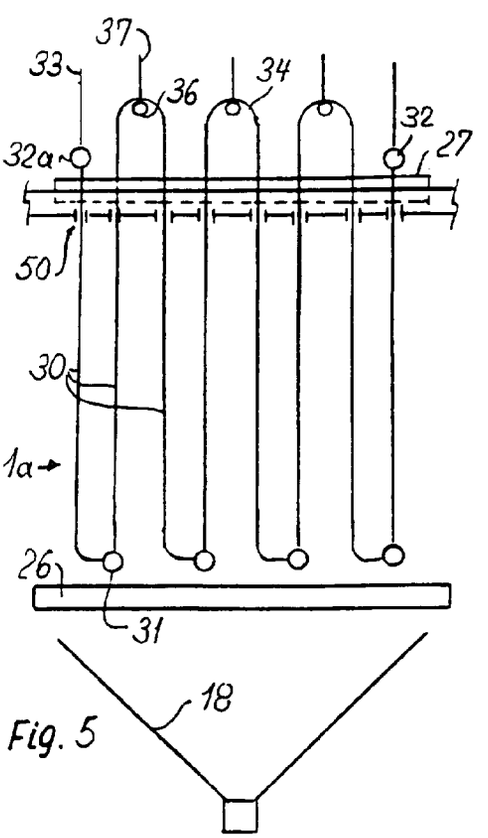

Fig. 5

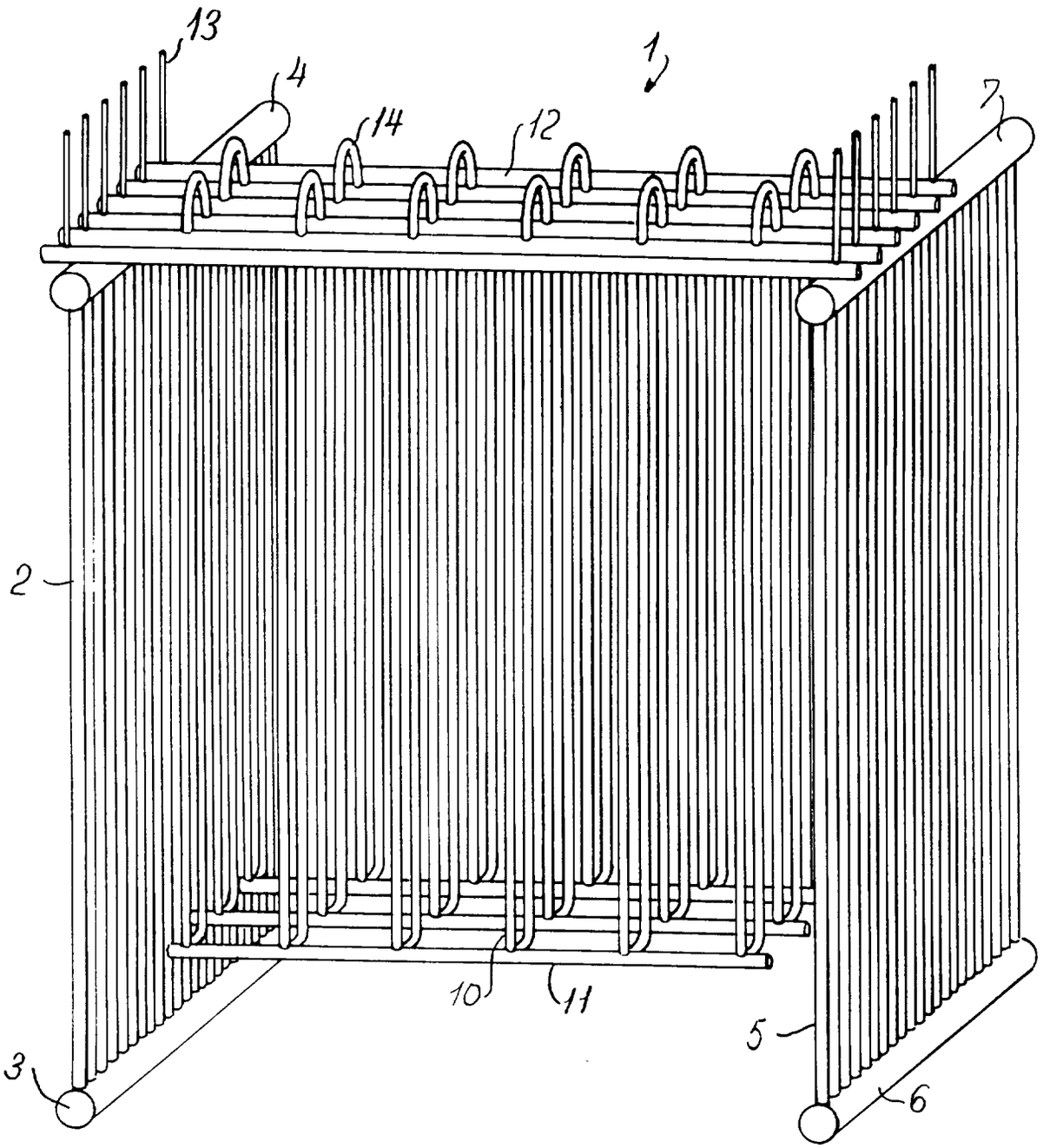

Fig. 3

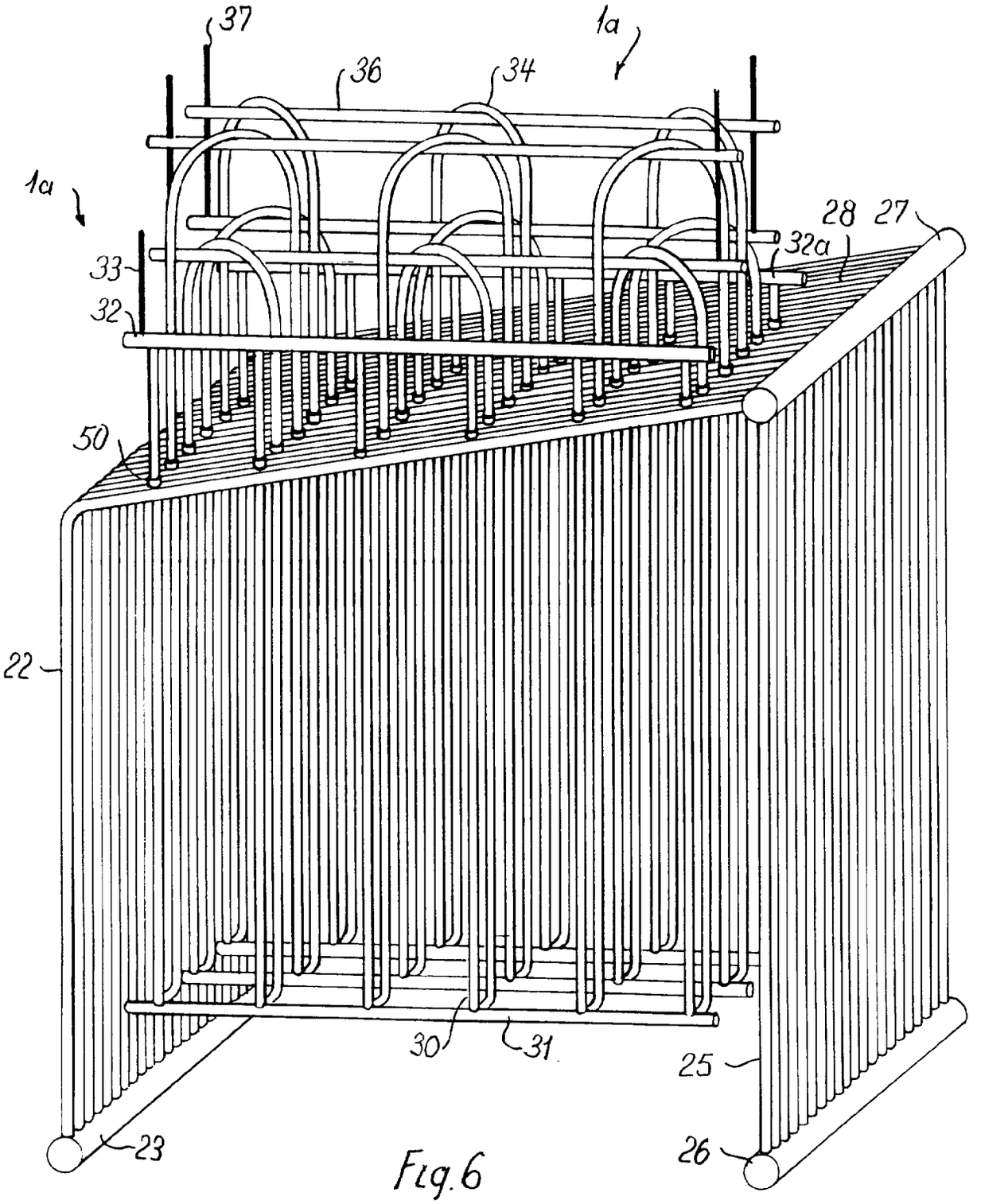

Fig.6

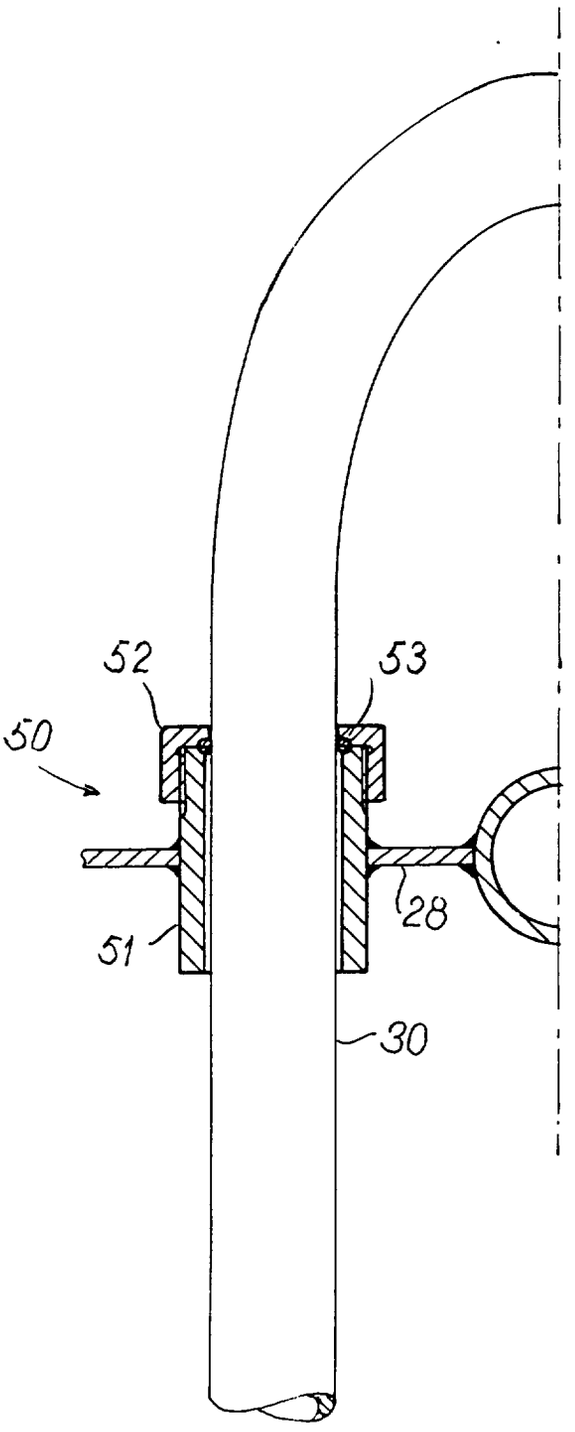

Fig. 7

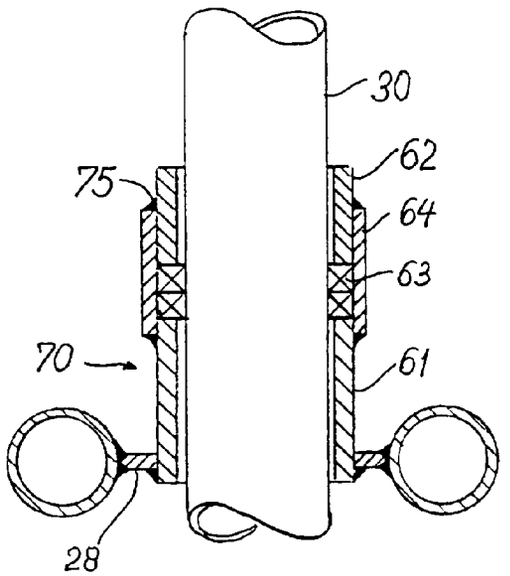

Fig. 9

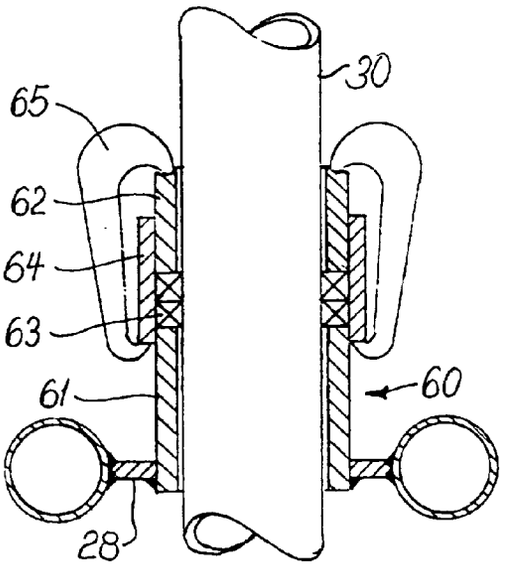

Fig. 8

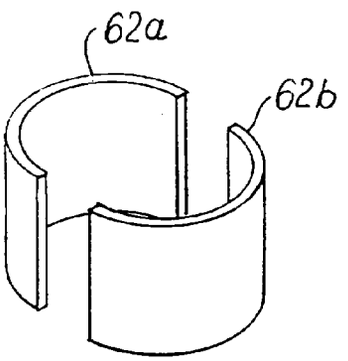

Fig. 10