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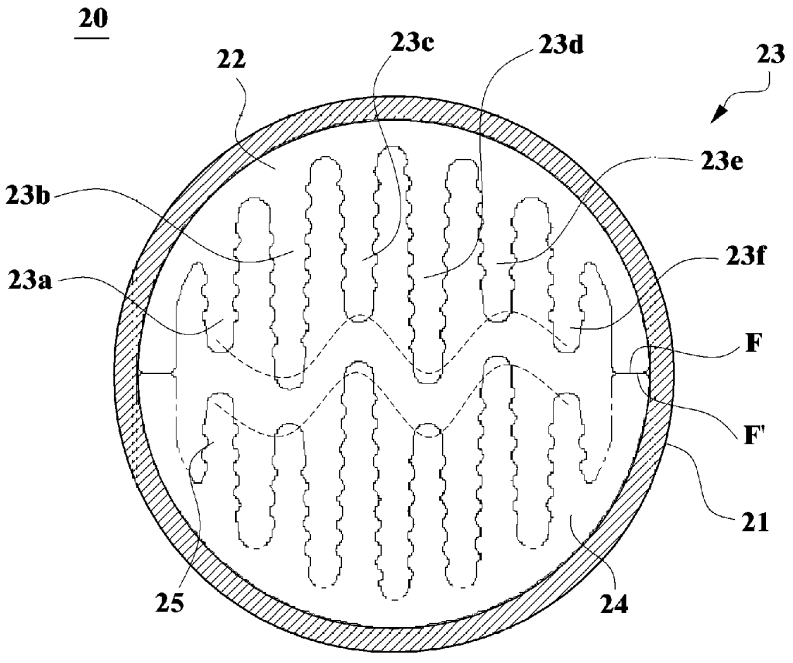
(54) HEAT EXCHANGE PIPE AND MANUFACTURING METHOD THEREOF

(57) The present invention pertains to a heat exchanger pipe and a manufacturing method thereof, wherein heat exchange is carried out between fluid which flows along the inside of a pipe and fluid which exists outside the pipe. In particular, the flow of the fluid flowing in the pipe becomes more active and the amount of contact is increased so as to improve heat exchange efficiency. Furthermore, the manufacturing of the heat exchanger pipe is simple while the contact characteristics and sealing characteristics between an outer pipe and an object to be inserted into the inside of the outer pipe are improved.

[Fig. 3]



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Description

[Technical Field]

[0001] The present invention relates to a heat exchanger pipe and a manufacturing method thereof, wherein heat exchange is carried out between fluid which flows along the inside of a pipe and fluid which exists outside the pipe. In particular, the flow of the fluid flowing in the pipe becomes more active and the amount of contact is increased so as to improve heat exchange efficiency. Furthermore, the manufacturing of the heat exchanger pipe is simple while the contact characteristics and sealing characteristics between an outer pipe and an object to be inserted into the inside of the outer pipe are improved.

[Background Art]

[0002] Heat exchanger pipes are used for various cooling/heating apparatuses such as boilers, heat pumps, and air conditioners. The heat exchanger pipe is used to provide warm air and cold air as well as hot water or warm water by carrying out heat exchange between a fluid which flows along the inside of a pipe and a fluid which exists outside the pipe.

[0003] The fluid which flows along the inside of a pipe is a gas such as high-temperature combustion gas, and the fluid which exists outside the pipe is a liquid such as direct water. In general, heat of the high-temperature combustion gas is exchanged with that of direct water while the high-temperature combustion gas is flowing along the inside of the heat exchanger pipe, but the fluid which exists inside and outside the pipe is not specifically limited to a liquid or a gas.

[0004] Meanwhile, as shown in FIG. 1, "Heat exchanger tube for a heating boiler" disclosed in Korean Patent Registration No. 10-217265 includes a cylindrical outer tube 1, and a pair of half shells 3 and 4 installed inside the outer tube 1 to make contact with the cylindrical outer tube 1.

[0005] Further, a plurality of ribs 5 are disposed in the form of a comb inside the half shells 3 and 4 to increase an inner surface area of the half shells 3 and 4. The half shells 3 and 4 are provided with groove shaped recesses 7 and rib shaped projections at their contacting longitudinal edges 6 to improve a sealing force.

[0006] However, in the above heat exchanger tube (that is, the heat exchanger pipe), lengths of the ribs 5 are controlled such that longitudinal ends of the ribs 5 are aligned at the same position (on the same line) so that a fluid simply flows along the inside of the pipe. Accordingly, a heat contact between the fluid serving as a heat source and the ribs 5 is not sufficient.

[0007] Further, the outer tube 1 and the half shells 3 and 4 are assembled by uniformly pressing the whole outer peripheral surface of the outer tube 1 such that the outer tube 1 adheres to the half shells 3 and 4. In this case, since an actual force Fr is applied in a direction perpendicular to outer peripheral surfaces of the outer tube 1 whereas a force Fn necessary to adhere the rib shaped projections 8 closely to the groove shaped recesses 7 does not coincide with a direction of the actually applied force so that a gap is formed between the groove shaped recesses 7 and the rib shaped projections 8.

[Technical Solution]

[0008] The present invention has been made in view of the above problems, and provides a heat exchanger pipe where heat exchange is carried out between fluid which flows along the inside of a pipe and fluid which exists outside the pipe so that the flow of the fluid flowing in the pipe becomes more active and the amount of contact is increased so as to improve heat exchange efficiency, and the manufacturing of the heat exchanger pipe is simple while the contact characteristics and sealing characteristics between an outer pipe and an obj ect to be inserted into the inside of the outer pipe are improved, and a manufacturing method thereof.

[Technical Solution]

[0009] According to the embodiment, there is provided heat exchanger pipe including: an outer pipe having a cylindrical shape; a first half shell and a second half shell having a semi-cylindrical shape, outer peripheral surfaces of the first half shell and the second half shell making contact with an inner peripheral surface of the outer pipe when the first half shell and the second half shell are coupled to face each other inside the outer pipe; and a first rib and a second rib extending from inner peripheral surfaces of the first half shell and the second half shell toward an inner space part, and disposed in a direction perpendicular to an imaginary boundary partitioning the first half shell and the second half shell, wherein the first rib is plural in number, and lengths of the first ribs are controlled so that an 'S' shape is formed when ends of the first ribs are sequentially connected to each other through an imaginary line, wherein the second rib is plural in number, and lengths of the second ribs are controlled so that the 'S' shape is formed when ends of the second ribs are sequentially connected to each other through the imaginary line, and wherein the ends of the first ribs are spaced apart from the ends of the second ribs.

[0010] A first half insertion member including the first half shell and the first rib and a second half insertion member including the second half shell and the second rib may be formed through an extrusion process to have a same shape, and the first half insertion member and the second half insertion member may be assembled to have sectional shapes which are transversely symmetrical to each other.

[0011] Both ends of the first half shell and both ends of the second half shell may have flat surfaces, respectively, the first half shell may include a first bending por-

tion which is bent toward the outer pipe from the flat end of the first half shell by a predetermined length and the second half shell comprises a second bending portion which is bent toward the outer pipe from the flat end of the second half shell by a predetermined length, and when the outer pipe is pressed after the first half shell and the second half shell are inserted into the outer pipe to face each other, the first bending portion and the second bending portion are spread inward, and the flat end of the first half shell and the flat end of the second half shell adhere to each other and are bonded to each other.

[0012] A plurality of first concavo-convex patterns may be formed in a section of the first half shell, and a plurality of second concavo-convex patterns are formed in a section of the second half shell, so that the first concavo-convex patterns engage with and adhere to the second concavo-convex patterns when the outer pipe is pressed and assembled.

[0013] A heat exchange groove may be formed in a surface of the outer pipe to increase a surface area.

[0014] Latch protrusions protruding inward may be formed in regions corresponding to both longitudinal ends of the insertion member in the outer pipe, respectively, to prevent the first half shell and the second half shell from being separated from the outer pipe.

[0015] According to the embodiment, there is provided a method of manufacturing a heat exchanger pipe including: preparing an insertion member by uprightly placing a first half shell and a second half shell coupled to face each other on an upper support having a diameter identical to diameters of the first half shell and the second half shell; preparing an outer pipe which is uprightly placed on a lower support supporting a lower end of the upper support and having a diameter larger than the diameter of the upper support such that the first half shell and the second half shell are placed at an inner side of the outer pipe; disposing a die mold at an upper portion of the outer pipe, in which the die mold comprises a taper part provided at a lower portion in the die mold and a pressing part provided at an upper side in the taper part, a diameter of a bottom end of the taper part is identical to an external diameter of the outer pipe, and a diameter of the pressing part is identical to a sum of diameters of the first half shell and the second half shell; and moving down the die mold such that the outer pipe is inserted into the die mold and pushing down the die mold to press the outer pipe by the pressing part such that an inner peripheral surface of the outer pipe adheres to outer peripheral surfaces of the first half shell and the second half shell.

[Advantageous Effects]

[0016] As described above, according to the heat exchanger pipe of the present invention, since lengths of ribs are controlled such that ends of the ribs provided in the first half shell and the second half shell form an 'S' shape, a flow of the fluid flowing in the pipe can become more active and an amount of contact can be increased so as to improve heat exchange efficiency.

[0017] Further, according to the method of manufacturing the heat exchanger pipe of the present invention, there is provided the bending portion which is bent in the direction of the actually applied force when the outer pipe is pressed, so the contact characteristics and sealing characteristics between an outer pipe and an inserted object can be improved. In addition, the outer pipe can be closely fitted with the inserted object by simply inserting and pushing dies so that the heat exchanger pipe can be easily manufactured.

[Description of Drawings]

[0018]

FIG. 1 is a sectional view showing a heat exchanger pipe (heat exchanger tube) according to the related art.

FIG. 2 is a perspective view showing a heat exchanger pipe according to a first embodiment of the present invention.

FIG. 3 is a sectional view showing the heat exchanger pipe according to the first embodiment of the present invention.

FIG. 4 is a sectional view showing a heat exchanger pipe according to a second embodiment of the present invention.

FIG. 5 is a partially sectional view showing a heat exchanger pipe according to a third embodiment of the present invention.

FIG. 6 is a partially sectional view showing a heat exchanger pipe according to a fourth embodiment of the present invention.

FIG. 7 is perspective view showing a heat exchanger pipe according to a fifth embodiment of the present invention.

FIG. 8 is a perspective view showing a heat exchanger pipe according to a sixth embodiment of the present invention.

FIG. 9 is a view showing a method of manufacturing the heat exchanger pipe according to an embodiment of the present invention.

[Best Mode]

[Mode for Invention]

[0019] Hereinafter, a heat exchanger pipe and a method of manufacturing the same according to exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0020] First, a heat exchanger pipe 20 according to a first embodiment of the present invention includes a cylindrical outer pipe 21, first half insertion members 22 and 23 and second half insertion members 24 and 25 which are inserted into the outer pipe 21 as illustrated in the

perspective view of FIG. 2 and the sectional view of FIG. 3. For example, the outer pipe 21 is formed of a metallic material such as steel, and the first half insertion members 22 and 23 and the second half insertion members 24 and 25 are formed of an aluminum material.

[0021] In this case, the first half insertion members 22 and 23 include a first half shell 22 having a semi-cylindrical shape obtained by longitudinally cutting a cylinder in a lengthwise direction thereof, and a plurality of first ribs 23 provided in the first half shell 22 and having an elongate pin shape. Similarly, the second half insertion members 24 and 25 include a second half shell 24 and a plurality of second ribs 25.

[0022] Further, since an end F of the first half shell 22 and an end F' of the second half shell 24 have flat surfaces, respectively, the end F of the first half shell 22 and the end F' of the second half shell 24 facing each other are tightly assembled in a surface contact manner to prevent the fluid flowing along the insides of the first half shell 22 and the second half shell 24 from being leaked into a gap between first half shell 22 and the second half shell 24.

[0023] The first ribs 23 spaced apart from each other by a predetermined interval extend from an inner peripheral surface of the first half shell 22 toward an inner space thereof. The second ribs 25 spaced apart from each other by a predetermined interval extend from an inner peripheral surface of the second half shell 24 toward an inner space thereof. The first ribs 23 and the second ribs 25 are disposed in a direction perpendicular to an imaginary boundary partitioning the first half shell 22 and the second half shell 24.

[0024] In particular, lengths of the first ribs 23 and lengths of the second ribs 25 are controlled to form 'S' shapes, respectively when ends of the first ribs 23 are sequentially connected to ends of the second ribs 25 by imaginary lines. The end of the first rib 23 and the end of the second rib 23 facing each other are spaced apart from each other so that the end of the first rib 23 and the end of the second rib 23 do not make contact with each other.

[0025] For example, the first rib 23 includes the first to sixth sub-rib 23a to 23f sequentially arranged from the left to the right in the drawing. A length of the second sub-rib 23b is longer than a length of the first sub-rib 23a, and a length of the third rib 23c is shorter than a length of the second sub-rib 23b.

[0026] In addition, a length of the fourth sub-rib 23d is longer than a length of the third sub-rib 23c, a length of the fifth sub-rib 23e is shorter than a length of the fourth sub-rib 23d, and a length of the sixth sub-rib 23f is shorter than a length of the fifth sub-rib 23e.

[0027] Accordingly, if ends of the first to sixth sub-ribs 23a to 23f are sequentially connected by imaginary lines, two "S" shapes (marked by dotted lines) overlapped with each other may appear.

[0028] The second rib 25 includes six sub-ribs similar to the first rib 23. If ends of the first to sixth sub-ribs 25 are sequentially connected by imaginary lines, two "S" shapes (marked by dotted lines) overlapped with each other may appear. The first rib 23 is spaced apart from the second rib 25 so that the first rib 23 does not overlap the second rib 25.

[0029] Therefore, according to the related art, ends of the ribs 5 (see FIG. 1) of the heat exchanger tube are disposed at the same position so that the ribs 5 of the heat exchanger tube form a comb shape, simplifying the flow of the fluid flowing inside the tube. In contrast, the present invention further includes a flow part having an S shape so that the flow of the fluid is significantly fluctuated, thereby increasing a heat contact between the fluid and the first rib 23 or the second rib 25.

[0030] As the heat contact created when the fluid serving as a heat source such as high-temperature combustion gas makes contact with the first rib 23 or the second rib 25 increases, a heat transfer to the outer pipe 21 in contact with the first half shell 22 and the second half shell 24 also increases, increasing heat exchange efficiency with a direct water disposed outside the outer pipe 21.

[0031] The first half insertion members 22 and 23 are formed by integrally extruding the first half shell 22 and the first rib 23, and the second half insertion members 24 and 25 are formed by integrally extruding the first half shell 24 and the first rib 25. Thus, a manufacturing cost can be reduced if the first half shell 22 and the first rib 23, and the second half insertion members 24 and 25 are formed by using the same mold.

[0032] In this case, the first half shell 22 and the first rib 23, and the second half insertion members 24 and 25 should be assembled in such a manner that sectional shapes thereof are transversely symmetrical to each other.

[0033] Hereinafter, a heat exchanger pipe according to a second embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0034] As shown in FIG. 4, the heat exchanger pipe 30 according to the second embodiment of the present invention includes a cylindrical outer pipe 31 as well as first half insertion members 32 and 33 and second half insertion members 34 and 35 which are inserted into an inner side of the outer pipe 31.

[0035] The first half insertion members 32 and 33 include a first half shell 32 and a plurality of first ribs 33, and the second half insertion members 34 and 35 include a second half shell 34 and a plurality of second ribs 35. These constituent elements are the same as those of the first embodiment.

[0036] However, the first rib 33 includes first to fifth sub-ribs 33 sequentially arranged from the left to the right in the drawing. The second rib 35 includes five sub-ribs. If ends of the five sub-ribs 33 are sequentially connected to each other by imaginary lines, one "S" shape is formed. In the same manner, the second rib 25 has an S shape.

[0037] That is, although the first embodiment of the

present invention described with reference to FIG. 3 includes six ribs 23 and 25, the second embodiment of the present invention includes five ribs 33 and 35, and the 'S' shape is slightly changed according to the number of ribs. However, the present invention can increase flow of the fluid even in this case to improve heat exchange efficiency.

[0038] Hereinafter, a heat exchanger pipe according to a third embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0039] The third embodiment of the present invention basically the same as the second embodiment of the present invention. Only parts different from the first embodiment will be illustrated and described.

[0040] As shown in FIGS. 5A and 5B, the heat exchanger pipe according to the third embodiment of the present invention includes first half insertion members 22 and 23 and second half insertion members 24 and 25 inserted into the cylindrical outer pipe 21 (see FIG. 2). The first half insertion members 22 and 23 include a first half shell 22 and a plurality of first ribs 23, and the second half insertion members 24 and 25 include a second half shell 24 and a plurality of second ribs 25. These constituent elements are the same as those of the first embodiment.

[0041] However, the third embodiment of the present invention includes a first bending portion 22a and a second bending portion 24a used when both ends of the first half shell 22 are assembled to both ends of second half shell 24. The third embodiment of the present invention is different from the first embodiment of the present invention in that the first bending portion 22a and the second bending portion 24a are bent outward with respect to a first bending surface 22a' and a second bending surface 24a'.

[0042] That is, both ends of the first half shell 22 and both ends of the secondhalf shell 24 have flat surfaces, respectively. In this case, as shown in FIG. 5A, the first half shell 22 includes the first bending portion 22a bent toward the outer pipe 31 from the flat end of the first half shell 22 by a predetermined length, and the second half shell 24 includes the second bending portion 24a is bent toward the outer pipe 31 from the flat end of the second half shell 24 by a predetermined length.

[0043] Accordingly, as shown in FIG. 5B, when the outer pipe 21 is compressed and adheres to outer peripheral surfaces of the first half shell 22 and the second half shell 24 during the assembling process, the first bending portion 22a and the second bending portion 24a are pressed and spread inward, and the flat end of the first half shell 22 and the flat end of the second half shell 24 are slightly pressed and deformed so that they strongly make surface-contact with each other.

[0044] Therefore, the problem of the related art, in which an actual force Fr' of FIG. 1 is applied in a direction perpendicular to outer peripheral surfaces of the outer tube 1 during the assembling process and force Fn necessary to tightly make rib shaped projections 8 contact with groove shaped recesses 7 does not match with a direction of the actually applied force so that a gap is formed between the groove shaped recesses 7 and the rib shaped projections 8, can be solved.

[0045] In addition, as the fourth embodiment illustrated in FIG. 6, if a plurality of first concavo-convex patterns 22b are formed in a flat section of the first half shell 22, and a plurality of second concavo-convex patterns (not shown) are formed in a flat section of the second half shell 24, the first concavo-convex patterns 22b engage with and adhere to the second concavo-convex patterns, so that sealing characteristics are significantly improved.

[0046] If cutaway grooves 22c are formed in a bending surface of the first bending portion 22a and a bending surface of the second bending portion 24a, respectively, a spread direction of the first bending portion 22a and the second bending portion 24a is guided by uniformly pressing and assembling the whole outer pipe 21 so that the assembling may be easily achieved.

[0047] Hereinafter, a heat exchanger pipe according to a fifth embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0048] As shown in FIG. 7, the heat exchanger pipe according to a fifth embodiment of the present invention includes an outer pipe 41 and an insertion member 42 having a first half insertion member and a second half insertion member. This configuration has been already described above.

[0049] However, in the fifth embodiment of the present invention, a heat exchange groove for increasing a surface area is formed in a surface of the outer pipe 41 so that heat in fluid (high-temperature combustion gas) flowing through an inside of the outer pipe 41 may be efficiently transferred to fluid (direct water) existing outside the pipe.

[0050] Although it has been described as an example that a plurality of linear heat exchange grooves 41a having linear shapes and formed in a longitudinal direction of the outer pipe 41 are arranged in a circumferential direction of the outer pipe 41, a plurality of heat exchange grooves having a circular shape and formed in a circumferential direction of the outer pipe 41 may be arranged lengthwise along the outer pipe 41 at a predetermined interval or the heat exchange grooves may be spirally formed on an outer peripheral surface of the outer pipe 41.

[0051] Hereinafter, a heat exchanger pipe according to a sixth embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0052] As shown in FIG. 8, the heat exchanger pipe 50 includes an outer pipe 51 and an insertion member having a first half insertion member and a second half insertion member as described above.

[0053] Latch protrusions 51a are formed at both ends of the outer pipe 51. The latch protrusions 51a protrude

into an inner side into which the insertion member 52 is inserted. The latch protrusions 51a are formed in regions corresponding to both longitudinal ends of the insertion member 52 in the outer pipe 51, respectively.

[0054] Accordingly, since the insertion member 52 is not moved to one end or another end of the open outer pipe 51 but is firmly fixed, after the outer pipe 51 is assembled by pressing the whole outer pipe 51 such that an inner peripheral surface of the outer pipe 51 makes contact with an outer peripheral surface of the insertion member 52, the insertion member 52 can be prevented from being separated from the outer pipe 51.

[0055] Hereinafter, a method of manufacturing a heat exchanger pipe according to embodiments of the present invention will be described. In the following description, a method of manufacturing the heat exchanger pipe according to the first embodiment of the present invention, which has been described above with reference to FIG. 2, will be described as an example.

[0056] First, as shown in FIG. 9A, in order to manufacture the heat exchanger pipe according to the present invention, supports T and T' are prepared. The supports T and T' include a lower support T and an upper support T' fixed on the lower support T.

[0057] The upper support T' has the same diameter as those of the first half shell 22 and the second half shell 24 coupled with each other. Thus, the first half shell 22 and the second half shell 24 can be stably placed on the upper support T'. The lower support T has a diameter greater than that of the upper support T' so that the outer pipe 21 may be placed on the lower support T.

[0058] Next, as shown in FIG. 9B, the first half shell 22 and the second half shell 24 coupled to face each other are stood on the upper support T'. That is, first half shells 22 and 23 and second half shells 24 and 25 are prepared (step of preparing an insertion member).

[0059] Thereafter, as shown in FIG. 9C, after an outer pipe 21' of a prototype is stood on the lower support, the first half shell 22 and the second half shell 24 are placed at an inner side of the outer pipe 21' (a step of preparing the outer pipe) . A diameter of the outer pipe 21' of a prototype before processing is greater than a sum of diameters of the first half shell 22 and the second half shell 24 which are coupled with each other so that the outer pipe 21' may be inserted through top ends of the first half shell 22 and the second half shell 24.

[0060] Next, as shown in FIG. 9D, a taper part is provided at a lower inner side. In this case, a width of the taper part becomes gradually reduced in the direction of an upper side of the taper part. A pressing part is provided at an upper inner side of the taper part. A diameter of a bottom end of the taper part is the same as (or is slightly greater than) an external diameter of the outer pipe 21. Dies D including a pressing part having a diameter the same as a sum of external diameters of the first half shell 22 and the second half shell 24 are arranged at an upper side of the outer pipe 21 (a step of preparing pressurization).

[0061] Thereafter, as shown in FIG. 9E, if the dies D are lowered and the circular outer pipe 21' is pressed by a pressing part in a state in which a circular outer pipe 21' is inserted into the dies D by lowering the dies D, the circular outer pipe 21' is pressed so that a compressed inner peripheral surface of the outer pipe 21 adheres to outer peripehral surfaces of the first half shell 22 and the second half shell 24, so the heat exchanger pipe can be conveniently and simply manufactured.

[Industrial Applicability]

[0062] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure.

[0063] The present inventive concept may, however, be embodied in many different forms and should not be construed as limited to the example embodiments set forth herein. Rather, these example embodiments are provided so that this description will be thorough and complete, and will fully convey the scope of the present inventive concept to those skilled in the art.

Claims

1. A heat exchanger pipe comprising:

an outer pipe having a cylindrical shape;

a first half shell and a second half shell having a semi-cylindrical shape, outer peripheral surfaces of the first half shell and the second half shell making contact with an inner peripheral surface of the outer pipe when the first half shell and the second half shell are coupled to face each other inside the outer pipe; and

a first rib and a second rib extending from inner peripheral surfaces of the first half shell and the second half shell toward an inner space part, and disposed in a direction perpendicular to an imaginary boundary partitioning the first half shell and the second half shell,

wherein the first rib is plural in number, and lengths of the first ribs are controlled so that an 'S' shape is formed when ends of the first ribs are sequentially connected to each other through an imaginary line,

wherein the second rib is plural in number, and lengths of the second ribs are controlled so that the 'S' shape is formed when ends of the second ribs are sequentially connected to each other through the imaginary line, and

wherein the ends of the first ribs are spaced apart from the ends of the second ribs.

2. The heat exchanger pipe of claim 1, wherein a first half insertion member including the first half shell and the first rib and a second half insertion member including the second half shell and the second rib are formed through an extrusion process to have a same shape, and the first half insertion member and the second half insertion member are assembled to have sectional shapes which are transversely symmetrical to each other.

3. The heat exchanger pipe of claim 2, wherein both ends of the first half shell and both ends of the second half shell have flat surfaces, respectively,
the first half shell comprises a first bending portion which is bent toward the outer pipe from the flat end of the first half shell by a predetermined length and the second half shell comprises a second bending portion which is bent toward the outer pipe from the flat end of the second half shell by a predetermined length, and
when the outer pipe is pressed after the first half shell and the second half shell are inserted into the outer pipe to face each other, the first bending portion and the second bending portion are spread inward, and the flat end of the first half shell and the flat end of the second half shell adhere to each other and are bonded to each other.

4. The heat exchanger pipe of claim 3, wherein a plurality of first concavo-convex patterns are formed in a section of the first half shell, and a plurality of second concavo-convex patterns are formed in a section of the second half shell, so that the first concavo-convex patterns engage with and adhere to the second concavo-convex patterns when the outer pipe is pressed and assembled.

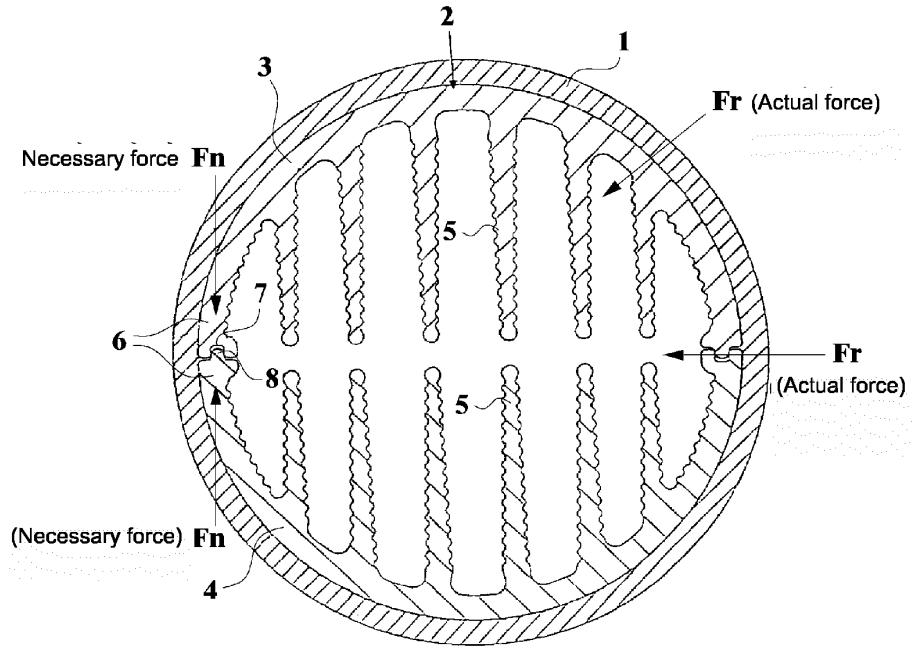
5. The heat exchanger pipe of claim 1, wherein a heat exchange groove is formed in a surface of the outer pipe to increase a surface area.

6. The heat exchanger pipe of claim 1, wherein latch protrusions protruding inward are formed in regions corresponding to both longitudinal ends of the insertion member in the outer pipe, respectively, to prevent the first half shell and the second half shell from being separated from the outer pipe.

7. A method of manufacturing a heat exchanger pipe according to one of claims 1 to 6, the method comprising:

preparing an insertion member by uprightly placing a first half shell and a second half shell coupled to face each other on an upper support having a diameter identical to diameters of the first half shell and the second half shell;
preparing an outer pipe which is uprightly placed on a lower support supporting a lower end of the upper support and having a diameter larger than the diameter of the upper support such that the first half shell and the second half shell are placed at an inner side of the outer pipe;
disposing a die mold at an upper portion of the outer pipe, in which the die mold comprises a taper part provided at a lower portion in the die mold and a pressing part provided at an upper side in the taper part, a diameter of a bottom end of the taper part is identical to an external diameter of the outer pipe, and a diameter of the pressing part is identical to a sum of diameters of the first half shell and the second half shell; and
moving down the die mold such that the outer pipe is inserted into the die mold and pushing down the die mold to press the outer pipe by the pressing part such that an inner peripheral surface of the outer pipe adheres to outer peripheral surfaces of the first half shell and the second half shell.

[Fig. 1]


2
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7
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(Actual force)
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(Necessary force) Fn
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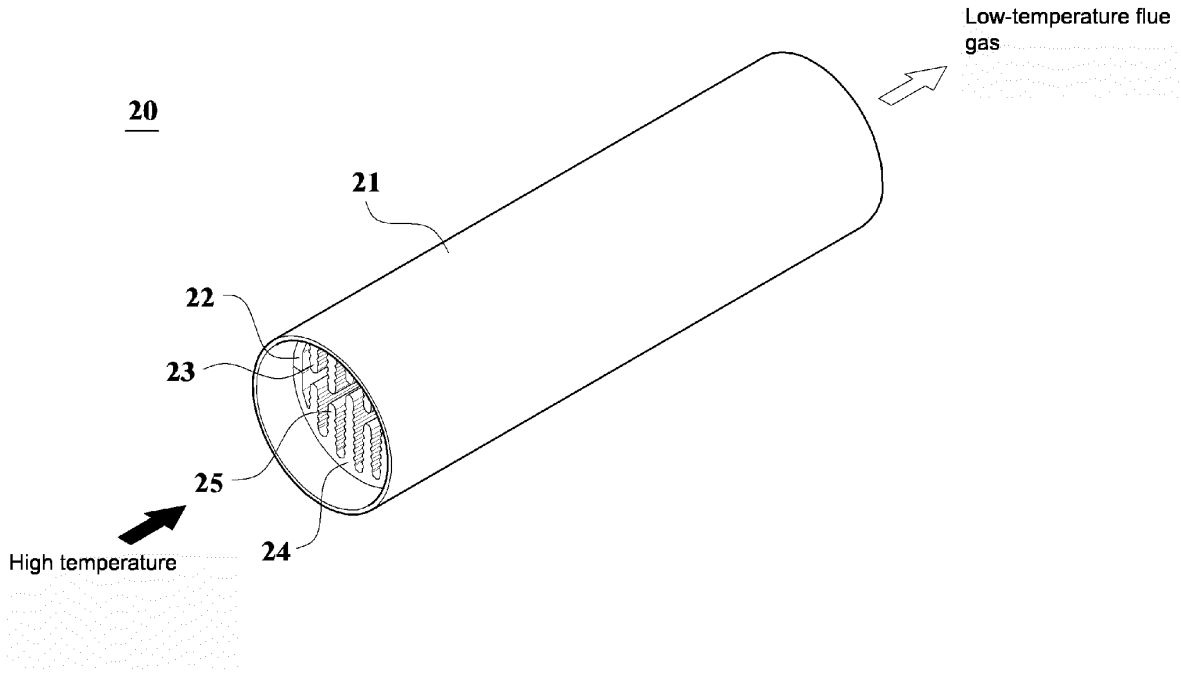
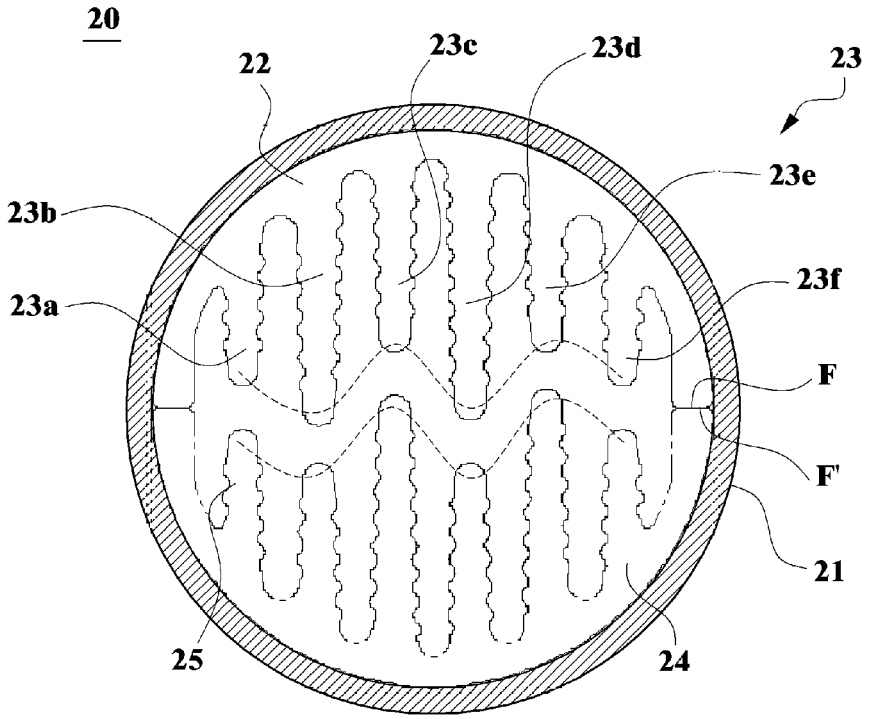
[Fig. 2]


Low-temperature flue gas
20
21
22
23
25
24
High temperature

[Fig. 3]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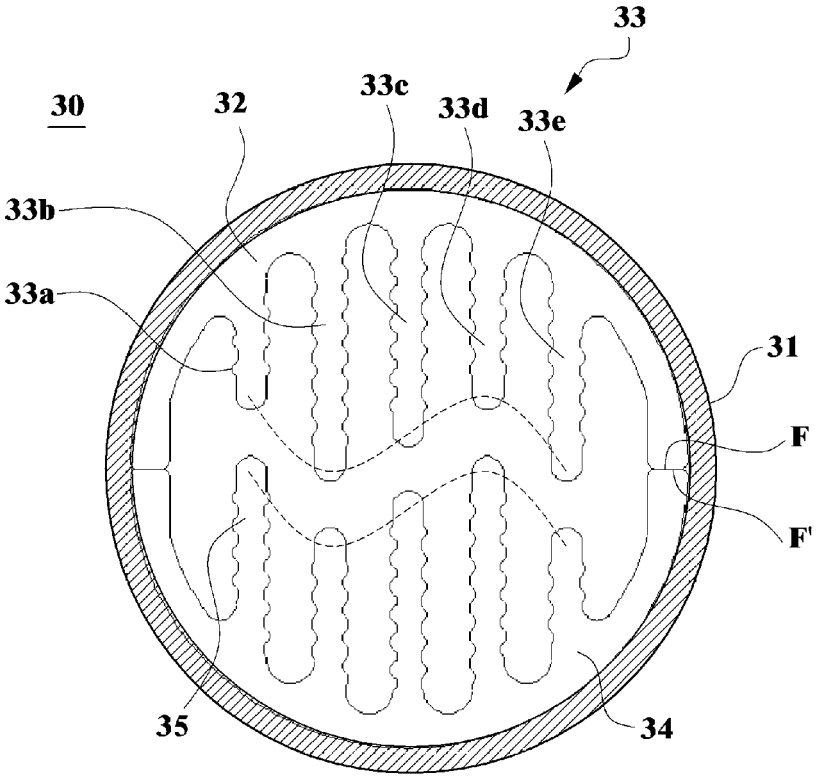
[Fig. 4]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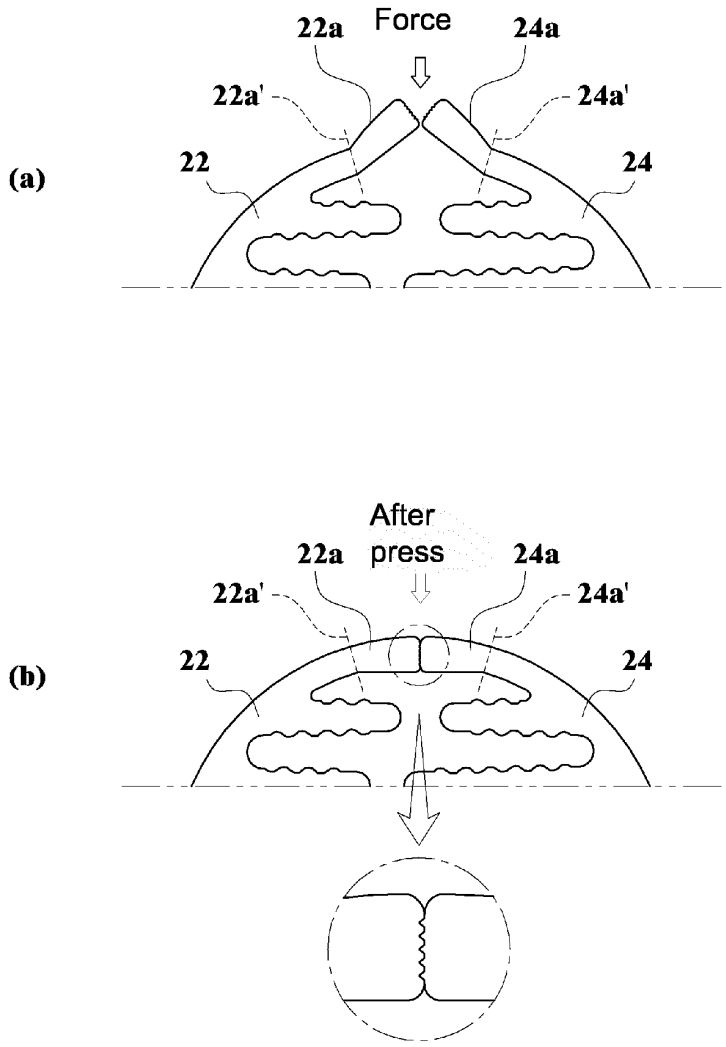
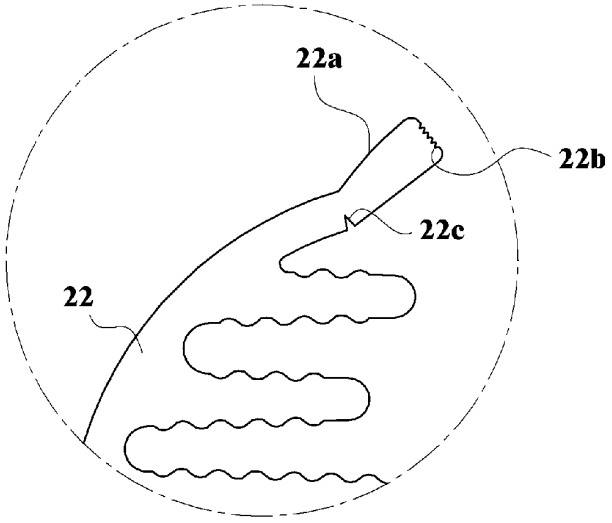
35
34

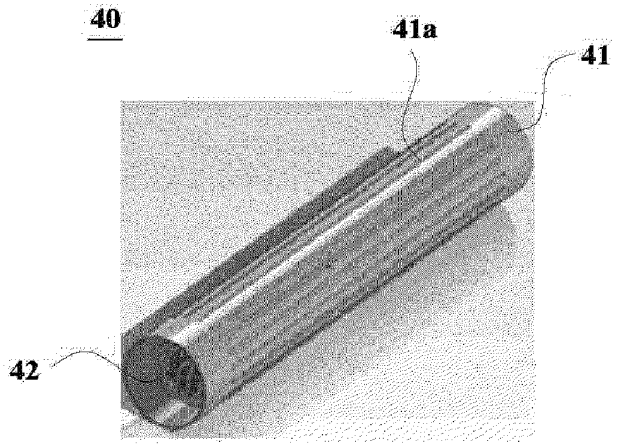
[Fig. 5]


(a)
22a
Force
24a
22a'
24a'
22
24
(b)
After
press
22a
24a
22a'
24a'
22
24

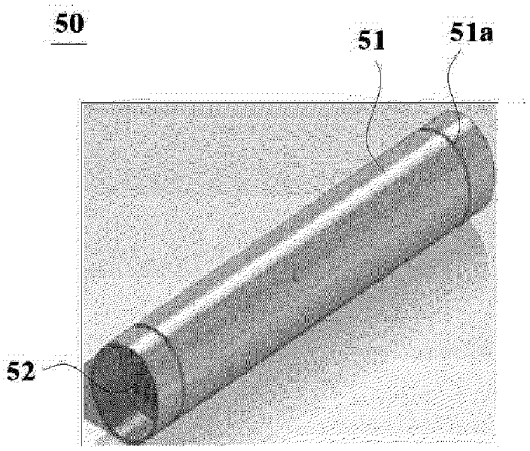
[Fig. 6]


22a
22b
22c
22

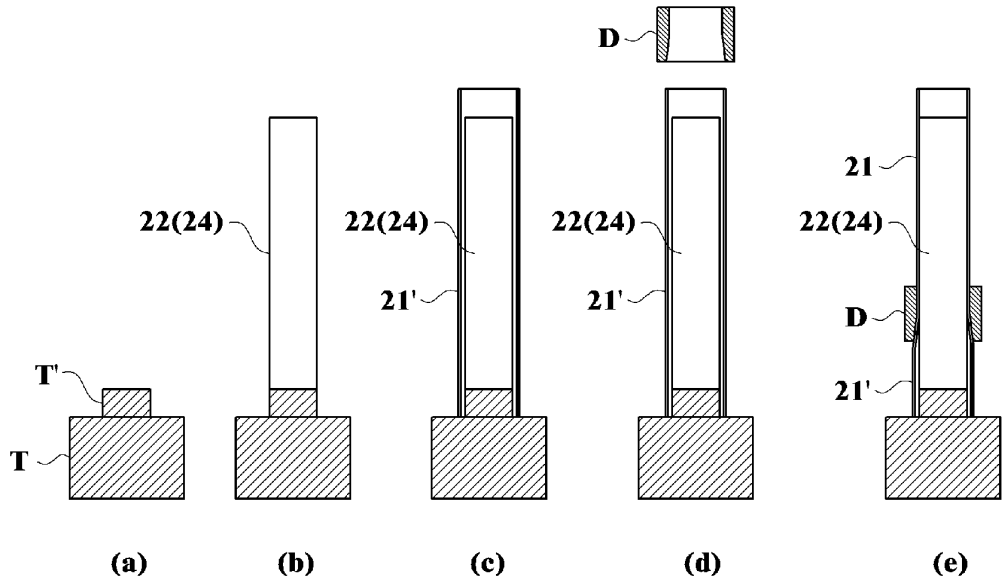
[Fig. 7]



[Fig. 8]



[Fig. 9]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2012/000466

A. CLASSIFICATION OF SUBJECT MATTER

F28F 1/40(2006.01)i, F28F 1/10(2006.01)i, F28D 15/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F28F 1/40; F28D 7/16; B21C 1/22; F15D 1/04; B21C 1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: heat exchanger pipe, S, wave, wave form, inner pin, hemisphere, boiler, rib

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2011-191049 A (TANICO CORP) 29 September 2011 See paragraph [0046] - paragraph [0059]; figures 1 - 6.	1-7
A	US 03870081 A (KLEPPE BYRGE et al.) 11 March 1975 See column 2, line 30 - column 4, line 7; figures 1 - 5.	1-7
A	JP 2001-347310 A (TOSHIBA CORP) 18 December 2001 See paragraph [0022] - paragraph [0074]; figures 1 - 2.	1-7

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 NOVEMBER 2012 (06.11.2012)	**16 NOVEMBER 2012 (16.11.2012)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2012/000466

Patent document cited in search report	Publication date	Patent family member	Publication date
JP 2011-191049 A	29.09.2011	NONE	
US 03870081 A	11.03.1975	US 03870081 A	11.03.1975
JP 2001-347310 A	18.12.2001	NONE	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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