

DESCRIPTION

PIPE COUPLING METHOD, PIPE EXPANSION JIG, AND PIPE EXPANSION METHOD USING PIPE EXPANSION JIG

Technical Field

[0001]

The present invention relates to a method for coupling pipes used for air conditioning and the like, a pipe expansion jig used for this method, and a pipe expansion method using this pipe expansion jig.

Background Art

[0002]

One outdoor unit and a plurality of indoor units provided in a package type air conditioner are coupled by pipes such as copper pipes, and heat is exchanged between an interior and an exterior via the pipes. The copper pipes forming the pipes are brazed at a connection point so as to be extended.

Since the copper pipes are easily oxidized, by heating at the time of brazing, an oxide film is generated on inner and outer peripheries of the pipes. When the oxide film is formed on the inner peripheries of the pipes, the oxide film is exfoliated by a coolant or the like flowing in the pipes. When the exfoliated oxide film reaches a refrigerator, there is a fear that a failure such as breakdown is caused.

[0003]

In consideration with such a situation, various means for not generating the oxide film inside the pipes at the time of brazing are examined and disclosed in Patent Literatures 1 and 2. In the means disclosed in Patent Literature 1, after pipes are temporarily assembled, the air in the pipes is replaced with an inert gas, and then a coupling point is heated and brazed. Specifically, the inert gas which is inactive gas such as nitrogen is preliminarily charged in a coolant circuit of an outdoor unit. After temporary assembling of the outdoor unit, indoor units, and the pipes are completed on site, the inert gas charged in the coolant circuit is discharged into the pipes, the air inside the pipes is replaced with the inert gas, and then the step is shifted to a brazing step.

[0004]

In the means disclosed in Patent Literature 2, as well as the pipe coupling method disclosed in Patent Literature 1, the air in pipes is replaced with an inert gas and brazing is performed. However, a joint is used at the time of coupling. Specifically, the joint having the substantially same diameter as the pipes serving as objects to be coupled is prepared. In the vicinity of a center on an outer periphery of the joint, a convex stopper is formed. Ends of the pipes serving as objects to be coupled are expanded, and the expanded parts are inserted from both ends of the joint. In such a temporarily assembled state, the air inside the pipes is replaced, and the pipes abutted with the

stopper are brazed.

Citation List

Patent Literature

[0005]

Patent Literature 1: JP 7-190575 A (Claims, [0014], [0017], and the like)

Patent Literature 2: JP 7-185804 A ([0002], [0015] - [0019], and the like)

Summary of the Invention

Technical Problem

[0006]

It is thought that by coupling the pipes by the means described above, formation of the oxide film inside the pipes serving as objects to be coupled can be prevented. However, the means disclosed in Patent Literatures 1, 2 respectively hold the following problems.

In the means disclosed in Patent Literature 1, firstly, there is a need for preliminarily charging the inert gas in the coolant circuit. In a case where length of the pipes is long, there is a fear that the charged inert gas becomes insufficient. In the means disclosed in Patent Literature 2, there is a need for preparing a cylinder or the like in which the inert gas is charged for making the inert gas flowing into the pipes. Further, since the joint is used at the time of coupling the pipes, there is a need for providing a joint having a corresponding diameter

for each of the pipes serving as objects to be coupled. There is also a problem that in a case where the pipes and the joints are warped, the joints cannot be used for the pipes serving as objects to be coupled.

[0007]

In a case where both the means are implemented, a worker is required to perform a coupling task of the pipes while coming and going between an inflow port and a discharge port of the inert gas in the pipes and confirming a replacement situation of the inert gas. Although various cases are assumed, the coupled pipes have a height difference of 50 m and pipe length of nearly 100 m even for a general building. Thus, a coming and going task between the inflow port and the discharge port is a big burden upon performing the coupling task.

[0008]

A first object of the present invention is to provide a pipe coupling method capable of solving the above problems and reducing the burden of the coming and going task required at the time of charging the gas without using a separate part for coupling the pipes. A second object of the present invention is to provide a pipe expansion jig used in the pipe coupling method for achieving the object, and to provide a pipe expansion method using this pipe expansion jig.

Solution to Problem

[0009]

In order to achieve the object above, a pipe coupling method according to the present invention includes:

a closing step of closing an open end of one pipe among two pipes each having a coupling end and the open end, and partly closing the open end of the other pipe;

a pipe expansion step of expanding the coupling end of the one pipe and expanding a part of the expanded coupling end toward the outside of other parts so as to form a partial pipe expansion portion;

an assembling step of inserting the coupling end of the other pipe into the expanded coupling end of the one pipe;

a gas replacement step of making a combustion gas flow in from the partial pipe expansion portion toward the open end of the one pipe and discharging the air in the two pipes from the partly closed open end of the other pipe; and

a brazing step of filling a gap in the coupling end of the one pipe and the coupling end of the other pipe after the gas replacement step is completed.

[0010]

In the pipe coupling method having the above characteristics,

it is desirable that the pipe expansion step comprising of:

a first pipe expansion step of equally expanding the coupling end of the one pipe so as to form an equal pipe expansion portion; and

a second pipe expansion step of further expanding a part of the equal pipe expansion portion of the one pipe after the first pipe expansion step is completed so as to form a partial pipe expansion portion.

By performing such stepwise pipe expansion, breakage of the coupling end of the pipe in the pipe expansion step can be suppressed.

[0011]

In the pipe coupling method having the above characteristics, it is desirable that the partial pipe expansion portion be formed on the lower side of the one pipe.

By arranging the partial pipe expansion portion on the lower side of the one pipe, efficiency of gas replacement can be improved and an oxide film generation ratio inside the pipes after the brazing step can be lowered.

Further, in the pipe coupling method having the above characteristics,

at the time of partly closing the open end of the other pipe in the closing step, an opening area of the open end may be narrowed down and an opening part after narrowing may be set to face the ground.

Such a characteristic method also contributes to lowering of the oxide film generation ratio inside the pipes after the brazing step.

[0012]

In order to achieve the object above, a pipe expansion jig includes:

- a conical center member;

- a plurality of pipe expansion blocks arranged on an outer periphery of the center member so as to form a cylindrical outer form, and pushed out in a radial manner toward the outer periphery side by moving the center member in the center axis direction of the conical form so as to expand an end of a pipe and form a pipe expansion portion; and

- a partial pipe expansion block arranged on the outer periphery side of the cylindrical form formed by the pipe expansion blocks detachably from the outer periphery, so as to further expand a part of the pipe expansion portion formed in the pipe toward the outside by moving the center member in the center axis direction in a state that the partial pipe expansion block is in contact with the outer periphery, and form a partial pipe expansion portion, wherein

when the partial pipe expansion block is in a separated state from the outer periphery of the pipe expansion blocks, a gap accounting for at least thickness of the pipe which serves as an object to be expanded is provided.

[0013]

In the pipe expansion jig having the above characteristics, it is desirable that length of the partial pipe expansion block in the insertion direction into the end of the pipe be longer than

length of the pipe expansion blocks in the insertion direction into the end of the pipe.

With such a configuration, depth of the partial pipe expansion portion from the end of the pipe can be formed deeper than depth of the equal pipe expansion portion from the end of the pipe. Therefore, at the time of making the combustion gas flowing in, a gap between the one pipe and the other pipe can be reliably ensured in the partial pipe expansion portion.

[0014]

According to the present invention, a pipe expansion method using the pipe expansion jig having a conical center member, a plurality of pipe expansion blocks arranged on an outer periphery of the center member so as to form a cylindrical outer form, and pushed out in a radial manner toward the outer periphery side by moving the center member in the center axis direction of the conical form so as to expand an end of a pipe and form a pipe expansion portion, and a partial pipe expansion block arranged on the outer periphery side of the cylindrical form formed by the pipe expansion blocks detachably from the outer periphery, so as to further expand a part of the pipe expansion portion formed in the pipe toward the outside by moving the center member in the center axis direction in a state that the partial pipe expansion block is in contact with the outer periphery, and form a partial pipe expansion portion, wherein when the partial pipe expansion block is in a separated state from the outer periphery of the pipe

expansion blocks, a gap accounting for at least thickness of the pipe which serves as an object to be expanded is provided, includes:

- a first insertion step of inserting the pipe expansion blocks into the end of the pipe serving as an object to be expanded;

- a first pipe expansion step of moving the center member and equally expanding the end so as to form an equal pipe expansion portion;

- a second insertion step of inserting the pipe expansion blocks in a state that the partial pipe expansion block is in contact with the outer periphery of the pipe expansion blocks into the equal pipe expansion portion after the first pipe expansion step is completed; and

- a second pipe expansion step of moving the center member and pushing out the pipe expansion blocks so as to further expand a part of the equal pipe expansion portion and form a partial pipe expansion portion.

Effects of the Invention

[0015]

According to the pipe coupling method having the above characteristics, at the time of coupling the pipes, there is no need for using a separate part such as a joint. The burden of the coming and going task required at the time of charging the gas can be reduced.

Brief Description of the Drawings

[0016]

Fig. 1 is a view for illustrating a flow of a pipe coupling method according to an embodiment.

Fig. 2 is a view showing a shape of a coupling end of a partly expanded pipe.

Fig. 3A is a front view of an insertion mode of a pipe expansion jig at the time of forming an equal pipe expansion portion.

Fig. 3B is a right side sectional view of the insertion mode of the pipe expansion jig at the time of forming the equal pipe expansion portion.

Fig. 3C is a front view of a pipe expansion mode of the pipe expansion jig at the time of forming the equal pipe expansion portion.

Fig. 3D is a right side sectional view of the pipe expansion mode of the pipe expansion jig at the time of forming the equal pipe expansion portion.

Fig. 4A is a front view of an insertion mode of the pipe expansion jig at the time of forming a partial pipe expansion portion.

Fig. 4B is a right side sectional view of the insertion mode of the pipe expansion jig at the time of forming the partial pipe expansion portion.

Fig. 4C is a front view of a pipe expansion mode of the pipe expansion jig at the time of forming the partial pipe expansion

portion.

Fig. 4D is a right side sectional view of the pipe expansion mode of the pipe expansion jig at the time of forming the partial pipe expansion portion.

Fig. 5 is a view for illustrating an application example of the pipe coupling method applicable at the time of coupling a plurality of pipes.

Fig. 6 is a view for illustrating an arrangement mode of an outdoor unit and indoor units in a package type air conditioner.

Description of Embodiments

[0017]

Hereinafter, an embodiment according to a pipe coupling method, a pipe expansion jig, and a pipe expansion method using the pipe expansion jig of the present invention will be described in detail with reference to the drawings.

Fig. 6 shows an arrangement mode of an outdoor unit 50 and indoor units 52 in a package type air conditioner. Fig. 6 shows an example that the outdoor unit 50 arranged on a rooftop of a building and the plurality of indoor units 52 arranged on the first floor of the building are coupled by pipes 10.

The pipe coupling method of the present invention is a favorable method to be implemented at the time of coupling the pipes extended in such a way. A first embodiment according to the pipe coupling method of the present invention will be described with reference to Figs. 1 and 2.

[0018]

Firstly, two pipes serving as objects to be coupled (a first pipe 10a and a second pipe 10b) are prepared. Among the two pipes shown in Fig. 1 (the first pipe 10a and the second pipe 10b), the first pipe 10a is a pipe coupled to the side of the outdoor unit 50 (one pipe), and the second pipe 10b is a pipe having fixed length (such as 4 m) to be coupled to the first pipe 10a (the other pipe) (refer to "Step A" in Fig. 1).

[0019]

Next, an open end of the first pipe 10a is closed, and an open end of the second pipe 10b is partly closed. In a case of the present embodiment, since the outdoor unit 50 is coupled to the open end of the first pipe 10a and the open end is in a closed state, this state may be maintained. It should be noted that in a case where both ends of the first pipe 10a are opened, as shown in "Step B" in Fig. 1, a closing member 12 such as a cap may be arranged in the open end of the first pipe 10a. Meanwhile, as a method for partly closing the open end of the second pipe 10b, a partial closing member 14 may be arranged in an opening part of the open end of the second pipe 10b so as to narrow an opening area of the open end. Specifically, a cap corresponding to a caliber of the second pipe 10b and having at least one through hole 16 may be arranged on a surface of the open end of the second pipe 10b, the surface to be partly closed. The through hole 16 is desirably provided in the cap in such a manner that the through

hole is arranged in the vicinity of a center of the surface at the time of arranging the cap on the surface to be partly closed. A diameter of the through hole 16 depends on a diameter of the second pipe 10b serving as an object to be coupled. However, when the diameter of the second pipe 10b is in a range approximately ranging from 15 mm to 32 mm, the diameter may be about 9 mm. A route bending member 18 such as a so-called elbow is arranged in the through hole 16, so that the opening part of the second pipe 10b after narrowing is desirably set to face the ground. This is because by partly closing the open end of the second pipe 10b in such a way, a replacement ratio of a gas inside the pipes and a combustion gas can be increased, so that formation of an oxide film inside the pipes at the time of brazing can be suppressed (closing step: refer to "Step B" in Fig. 1).

[0020]

Next, a pipe expansion jig 30 (refer to Figs. 3A, 3B, 3C, 3D, 4A, 4B, 4C, and 4D) is inserted into a coupling end of the first pipe 10a, so as to expand the coupling end. As shown in Figs. 3A, 3B, 3C, 3D, 4A, 4B, 4C, and 4D, the pipe expansion jig 30 used for pipe expansion is provided with a conical center member 32, a plurality of pipe expansion blocks 34 arranged on an outer periphery of this center member 32, and a partial pipe expansion block 36 arranged on the outer periphery side of the pipe expansion blocks 34. The center member 32, the pipe expansion blocks 34, and the partial pipe expansion block 36 are arranged all together

in a block base 38 forming the pipe expansion jig 30, and movement and the pipe expansion are performed taking this block base 38 as a basis.

[0021]

By operating a handle (not shown), the center member 32 is moved in the center axis direction shown by arrow A of Fig. 3B. The center member 32 is formed into a conical shape, and a contact surface of the center member 32 and the pipe expansion blocks 34 is formed into a taper shape. Therefore, by pushing the center member 32 forward, the pipe expansion blocks 34 arranged on the outer periphery of the center member 32 are pushed out toward the outer periphery side of the center member 32 (in the radial direction).

[0022]

An outer form of the pipe expansion blocks 34 is formed into a cylindrical shape by combining a plurality of (six in the example shown in the present embodiment) blocks. Therefore, by being pushed out toward the outer periphery side in accordance with movement of the center member 32, the pipe expansion blocks 34 can equally expand the coupling end of the first pipe 10a so as to form an equal pipe expansion portion 20.

[0023]

The partial pipe expansion block 36 is provided detachably from the outer periphery of one of the plurality of pipe expansion blocks 34. An attaching and detaching mechanism of the partial

pipe expansion block 36 is not particularly limited but a spring mechanism 40 may be used for example as shown in Figs. 3A, 3B, 3C, 3D, 4A, 4B, 4C, and 4D. In a case where such a spring mechanism 40 is used, as shown in Figs. 3A, 3B, 3C, and 3D, a gap accounting for at least thickness of the first pipe 10a serving as an object to be expanded is provided between the pipe expansion block 34 and the partial pipe expansion block 36 in a normal state (at the time of forming the equal pipe expansion portion 20). Thereby, the pipe expansion can be performed with not inserting the partial pipe expansion block 36 into the first pipe 10a but inserting only the pipe expansion blocks 34. Meanwhile, after the pipe expansion is completed, by bringing the pipe expansion blocks 34 from a pipe expansion mode (opened state) to an insertion mode (closed state), the partial pipe expansion block 36 can also be inserted into the expanded coupling end of the first pipe 10a in addition to the pipe expansion blocks 34. That is, after the pipe expansion of the coupling end of the first pipe 10a, the pipe expansion blocks 34 are drawn out from the coupling end, the pipe expansion blocks 34 are brought from the pipe expansion mode to the insertion mode again, and then the pipe expansion blocks 34 are inserted into the coupling end of the first pipe 10a. At this time, the partial pipe expansion block 36 can be inserted into the expanded coupling end at the same time. By operating the handle (not shown) in such a state and moving the center member 32 of the pipe expansion jig 30, the pipe expansion blocks 34 are pushed out toward the outer

periphery side again. A spring is compressed at the time of abutting the partial pipe expansion block 36 with an inner wall of the coupling end of the first pipe 10a in accordance with push-out of the pipe expansion blocks 34, and the partial pipe expansion block is in contact with the outer periphery of the pipe expansion block 34 as shown in Figs. 4A, 4B, 4C, and 4D and pushed out together with the pipe expansion block 34. In a part where the partial pipe expansion block 36 is arranged (partial pipe expansion block arrangement portion), a radius from the center member 32 is larger than other pipe expansion block arrangement portions. Therefore, only the partial pipe expansion block 36 arrangement portion can push out the coupling end of the first pipe 10a further toward the outside so as to form a partial pipe expansion portion 22.

[0024]

With such a configuration, formation of the equal pipe expansion portion 20 and formation of the partial pipe expansion portion 22 can be easily implemented by one jig. Since the formation of the equal pipe expansion portion 20 and the formation of the partial pipe expansion portion 22 can be performed stepwise, a breakage ratio of the pipe at the time of the pipe expansion can be reduced. It should be noted that the partial pipe expansion portion 22 is desirably formed slightly longer than insertion length L of the pipe expansion blocks 34 shown in Fig. 3B. Therefore, depth of the partial pipe expansion portion 22 can be

deeper than depth of the equal pipe expansion portion 20. Thus, in an assembling step described in detail later, even when a coupling end of the second pipe 10b is assembled to the expanded coupling end of the first pipe 10a, a gap via the partial pipe expansion portion 22 is reliably formed in a coupling part between the first pipe 10a and the second pipe 10b.

[0025]

In a pipe expansion procedure of the coupling end of the first pipe 10a using the pipe expansion jig 30 with such a configuration, firstly, the pipe expansion blocks 34 are brought into the insertion mode and then inserted into the coupling end of the first pipe 10a (first insertion step). After that, the pipe expansion blocks 34 are pushed out so as to equally expand the coupling end of the first pipe 10a and form the equal pipe expansion portion 20 (first pipe expansion step: refer to "Step C" in Fig. 1).

[0026]

Next, the pipe expansion blocks 34 are drawn out from the coupling end and the pipe expansion blocks 34 are brought from the pipe expansion mode to the insertion mode. In a state that the partial pipe expansion block 36 is in contact with the outer periphery of the pipe expansion blocks 34, the pipe expansion blocks 34 are inserted into the coupling end (second insertion step). After that, the pipe expansion blocks 34 are pushed out together with the partial pipe expansion block 36 so as to form

the partial pipe expansion portion 22. It should be noted that a contact timing of the partial pipe expansion block 36 with the pipe expansion blocks 34 may be the same as an expansion timing of the pipe expansion blocks 34, or as in the above embodiment, the pipe expansion blocks 34 may be inserted into the coupling end in a state that the partial pipe expansion block 36 is preliminarily brought into contact with the pipe expansion blocks 34 (second pipe expansion step: refer to "Step D" in Fig. 1).

[0027]

After the second pipe expansion step is completed, the coupling end of the second pipe 10b is fitted into and temporarily assembled to the expanded coupling end of the first pipe 10a (assembling step: refer to "Step E" in Fig. 1).

The combustion gas flows into the first pipe 10a and the second pipe 10b temporarily assembled to each other, and the air in the first pipe 10a and the second pipe 10b is discharged from the opening part of the open end of the partly closed second pipe 10b. As the combustion gas, a combustion gas of a burner used for brazing described in detail later can be used, for example. The combustion gas has a lower oxidation effect than the air. Thus, by replacing the inside air of the first pipe 10a and the second pipe 10b with the combustion gas, the formation of the oxide film inside the first pipe 10a and the second pipe 10b at the time of brazing can be suppressed.

[0028]

The combustion gas flows into the first pipe 10a and the second pipe 10b from a gap produced at the time of assembling the first pipe 10a and the second pipe 10b. Specifically, as shown in "Step F" in Fig. 1, the combustion gas may flow in from the partial pipe expansion portion 22 formed in the second pipe expansion step. An inflow amount of the combustion gas can be controlled by detecting an inflow amount of a gas component from the through hole 16 but also can generally be controlled by an inflow time. Specifically, the inflow amount is changed according to a diameter and length of the pipe, jet pressure of the combustion gas, or the like. However, with a general pipe having a diameter of about $\phi 32$ mm, by making the combustion gas flow in for about 20 to 30 seconds irrespective of length, the replacement with the combustion gas can be completed. It should be noted that this value is an empirical value inversely calculated and derived from the inflow time of the combustion gas and an oxide film formation state inside the pipe after brazing.

[0029]

In order to make the combustion gas flow in from the partial pipe expansion portion 22 of the first pipe 10a, as shown in "Step F" in Fig. 1, the combustion gas flows in toward the open end side of the first pipe 10a. Therefore, the inside air of the first pipe 10a and the second pipe 10b is discharged from the through hole 16 formed in the partial closing member 14 which is arranged in the open end of the second pipe 10b as in arrows shown in "Step

F" in Fig. 1. Thus, the inside air can be effectively replaced with the combustion gas (gas replacement step: refer to "Step F" in Fig. 1).

[0030]

After the gas replacement step is completed, a wax material is inserted into the heated partial pipe expansion portion 22, and by melting this wax material, the partial pipe expansion portion 22 is sealed. In parallel to such a task, the wax material melted in the partial pipe expansion portion 22 is sent into the gap between the first pipe 10a and the second pipe 10b by wettability with wall surfaces of the pipes and wetting spreading due to a capillary action of the gap formed in the coupling end of the first pipe 10a and the coupling end of the second pipe 10b. Thereby, the gap in the coupling end of the first pipe 10a and the coupling end of the second pipe 10b is filled (brazing step: refer to "Step G" in Fig. 1).

[0031]

With the pipe coupling method as described above, first of all, there is no need for a separate part for coupling the pipes such as a joint. Since there is only a need for coming and going over about 4 m of the fixed-length pipe at the longest, a burden of a coming and going task required at the time of charging the gas can be reduced.

Industrial Applicability

[0032]

In the above embodiment, the description is given taking the method at the time of coupling the two pipes as an example. However, at the time of temporarily coupling a plurality of pipes, coupling parts are provided at plural points as shown in Fig. 5. The pipe coupling method of the present application can also be applied to such a case.

[0033]

For example, Fig. 5 is a view showing an example of a case where five pipes including first to fifth pipes 10a to 10e are coupled, and coupling parts (coupling parts a to d) are provided at four points. In a case where such pipes are coupled, firstly, coupling ends of the coupling parts a to d are expanded. Pipe expansion of the coupling ends may be performed in order of the first pipe expansion step and the second pipe expansion step as well as the above embodiment. In a case of a coupling method shown in Fig. 5, the pipe expansion of the first to fifth pipes 10a to 10e may respectively be performed as follows. Firstly, a right end in the figure of the first pipe 10a is expanded. The second pipe 10b and the fourth pipe 10d are not expanded, and both ends of the third pipe 10c are expanded. A left end in the figure of the fifth pipe 10e is expanded. By performing the pipe expansion in such a way, the pipes can be coupled and the following coupling method can be implemented.

[0034]

As described above, after the first to fifth pipes 10a to

10e are expanded, the pipes are temporarily assembled, and open ends of the pipes positioned at both ends are closed by closing members 12a and 12b. Next, the combustion gas flows into the pipes from a partial pipe expansion portion 22 of the coupling part a shown by an arrow. At this time, partial pipe expansion portions 22 of the coupling parts b to d are opened. Thus, the closing member 12a exerts the same effect as a partly closed state in a pseudo manner (gas replacement step).

[0035]

After the gas replacement step is completed, brazing of the coupling part a is performed. Thereby, coupling of the fourth pipe 10d and the fifth pipe 10e is completed (brazing step). Next, the combustion gas flows into the pipes from the partial pipe expansion portion 22 of the coupling part b. In the present step, the air inside the pipes is replaced with the inflow combustion gas from the partial pipe expansion portions 22 of the coupling parts c and d (gas replacement step).

[0036]

After the gas replacement step from the coupling part b is completed, brazing of the coupling part b is performed. Thereby, coupling of the first pipe 10a and the second pipe 10b is completed (brazing step). After the brazing of the coupling part b is completed, the combustion gas is introduced from the partial pipe expansion portion 22 of the coupling part c and gas replacement is performed. In the present step, the inside air is replaced

with the combustion gas via the partial pipe expansion portion 22 of the coupling part d remaining as an open part (gas replacement step).

[0037]

After the gas replacement step is completed, brazing of the coupling part c is performed, so that the second pipe 10b and the third pipe 10c are coupled (brazing step). After the brazing of the coupling part c is completed, it is predicted that the pipes are sufficiently filled with the combustion gas. Therefore, following the brazing of the coupling part c, brazing of the coupling part d is performed, so that the third pipe 10c and the fourth pipe 10d are coupled (brazing step). It should be noted that as a previous step of the brazing of the coupling part d, a step of making the combustion gas flow into the pipes from the partial pipe expansion portion 22 of the coupling part d may be performed.

Even in a case of coupling the plurality of pipes by such a method, when the coupling parts are individually seen, the pipes serving as objects to be coupled are two, so that the same effect as the above embodiment is obtained. Therefore, the coupling method of the plurality of pipes described above is included in the pipe coupling method of the present invention.

Reference Signs List

[0038]

10a: First pipe

10b: Second pipe
12: Closing member
14: Partial closing member
16: Through hole
18: Route bending member
20: Equal pipe expansion portion
22: Partial pipe expansion portion
30: Pipe expansion jig
32: Center member
34: Pipe expansion block
36: Partial pipe expansion block
38: Block base
40: Spring mechanism
50: Outdoor unit
52: Indoor unit

CLAIMS

1. A pipe coupling method comprising:

a closing step of closing an open end of one pipe among two pipes each having a coupling end and the open end, and partly closing the open end of the other pipe;

a pipe expansion step of expanding the coupling end of the one pipe and expanding a part of the expanded coupling end toward the outside of other parts so as to form a partial pipe expansion portion;

an assembling step of inserting the coupling end of the other pipe into the expanded coupling end of the one pipe;

a gas replacement step of making a combustion gas flow in from the partial pipe expansion portion toward the open end of the one pipe and discharging the air in the two pipes from the partly closed open end of the other pipe; and

a brazing step of filling a gap in the coupling end of the one pipe and the coupling end of the other pipe after the gas replacement step is completed.

2. The pipe coupling method according to claim 1, wherein the pipe expansion step comprising:

a first pipe expansion step of equally expanding the coupling end of the one pipe so as to form an equal pipe expansion portion; and

a second pipe expansion step of further expanding a part of the equal pipe expansion portion of the one pipe after the first pipe expansion step is completed so as to form a partial pipe expansion portion.

3. The pipe coupling method according to claim 1, wherein the partial pipe expansion portion is formed on the lower side of the one pipe.

4. The pipe coupling method according to claim 2, wherein the partial pipe expansion portion is formed on the lower side of the one pipe.

5. The pipe coupling method according to claim 1, wherein at the time of partly closing the open end of the other pipe in the closing step, an opening area of the open end is narrowed down and an opening part after narrowing is set to face the ground.

6. The pipe coupling method according to claim 2, wherein at the time of partly closing the open end of the other pipe in the closing step, an opening area of the open end is narrowed down and an opening part after narrowing is set to face the ground.

7. The pipe coupling method according to claim 3, wherein at the time of partly closing the open end of the other pipe in the closing step, an opening area of the open end is narrowed down and an opening part after narrowing is set to face the ground.

8. The pipe coupling method according to claim 4, wherein at the time of partly closing the open end of the other pipe in the closing step, an opening area of the open end is narrowed

down and an opening part after narrowing is set to face the ground.

9. A pipe expansion jig comprising:

a conical center member;

a plurality of pipe expansion blocks arranged on an outer periphery of the center member so as to form a cylindrical outer form, and pushed out in a radial manner toward the outer periphery side by moving the center member in the center axis direction of the conical form so as to expand an end of a pipe and form a pipe expansion portion; and

a partial pipe expansion block arranged on the outer periphery side of the cylindrical form formed by the pipe expansion blocks detachably from the outer periphery, so as to further expand a part of the pipe expansion portion formed in the pipe toward the outside by moving the center member in the center axis direction in a state that the partial pipe expansion block is in contact with the outer periphery, and form a partial pipe expansion portion, wherein

when the partial pipe expansion block is in a separated state from the outer periphery of the pipe expansion blocks, a gap accounting for at least thickness of the pipe which serves as an object to be expanded is provided.

10. The pipe expansion jig according to claim 9, wherein

length of the partial pipe expansion block in the insertion direction into the end of the pipe is longer than length of the pipe expansion blocks in the insertion direction into the end of

the pipe.

11. A pipe expansion method using a pipe expansion jig having a conical center member, a plurality of pipe expansion blocks arranged on an outer periphery of the center member so as to form a cylindrical outer form, and pushed out in a radial manner toward the outer periphery side by moving the center member in the center axis direction of the conical form so as to expand an end of a pipe and form a pipe expansion portion, and a partial pipe expansion block arranged on the outer periphery side of the cylindrical form formed by the pipe expansion blocks detachably from the outer periphery, so as to further expand a part of the pipe expansion portion formed in the pipe toward the outside by moving the center member in the center axis direction in a state that the partial pipe expansion block is in contact with the outer periphery, and form a partial pipe expansion portion, wherein when the partial pipe expansion block is in a separated state from the outer periphery of the pipe expansion blocks, a gap accounting for at least thickness of the pipe which serves as an object to be expanded is provided, comprising:

- a first insertion step of inserting the pipe expansion blocks into the end of the pipe serving as an object to be expanded;

- a first pipe expansion step of moving the center member and equally expanding the end so as to form an equal pipe expansion portion;

- a second insertion step of inserting the pipe expansion

blocks in a state that the partial pipe expansion block is in contact with the outer periphery of the pipe expansion blocks into the equal pipe expansion portion after the first pipe expansion step is completed; and

a second pipe expansion step of moving the center member and pushing out the pipe expansion blocks so as to further expand a part of the equal pipe expansion portion and form a partial pipe expansion portion.