US 20120227935A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2012/0227935 A1
(43) Pub. Date: Sep. 13, 2012
HUANG

(54) **INTERCONNECTED HEAT PIPE ASSEMBLY AND METHOD FOR MANUFACTURING THE SAME**

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(21) Appl. No.: **13/045,737**

(22) Filed: **Mar. 11, 2011**

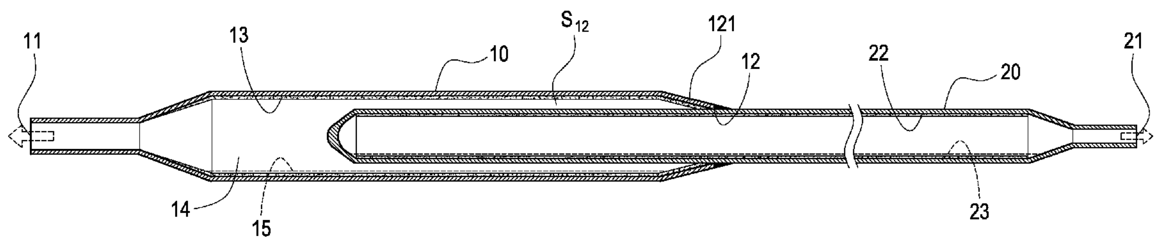
Publication Classification

(51) **Int. Cl.**
F28D 15/04 (2006.01)
B21D 53/02 (2006.01)

(52) **U.S. Cl.** **165/104.26**; 29/890.032

(57) **ABSTRACT**

The present invention relates to an interconnected heat pipe assembly and a method for manufacturing the same. The interconnected heat pipe assembly includes a first heat pipe and a second heat pipe. The first heat pipe comprises a first pipe, a first wick structure and a first working fluid. The first pipe has a hollow chamber and an opening. The first wick structure is arranged on inner walls of the hollow chamber. The first working fluid is filled in the hollow chamber. The second heat pipe is disposed through the opening in the first pipe with a portion of the second heat pipe being received in the hollow chamber. An air channel is formed between outer walls of the second heat pipe and inner walls of the first pipe. The present invention can conduct heat to a long distance and has an increased heat-conducting efficiency.



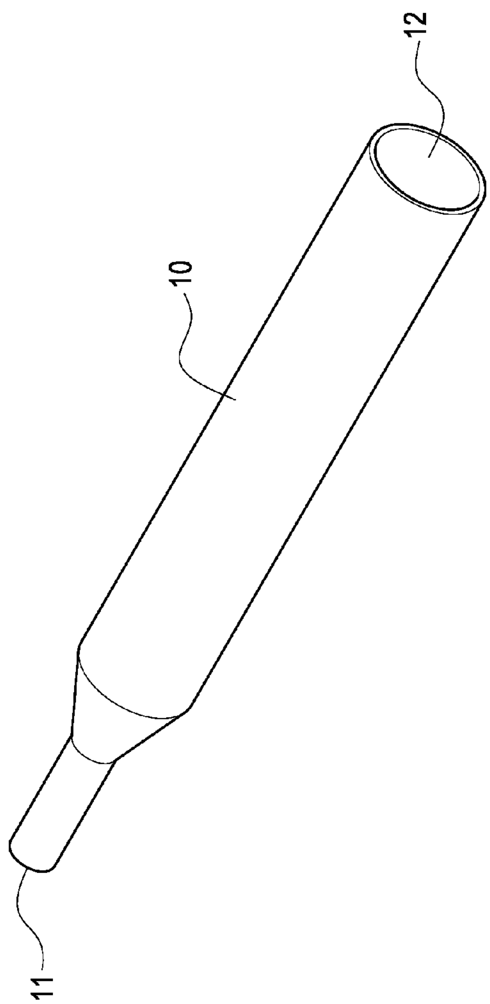


FIG.1

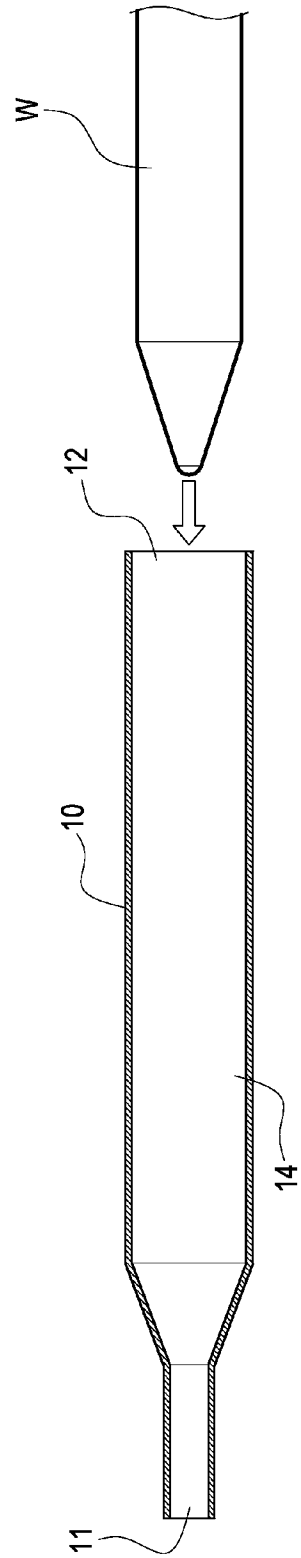


FIG.2

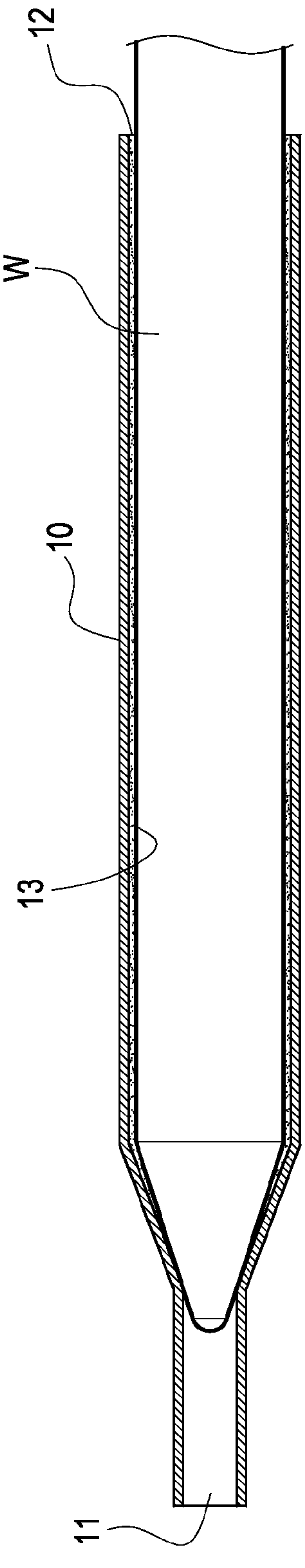


FIG.3

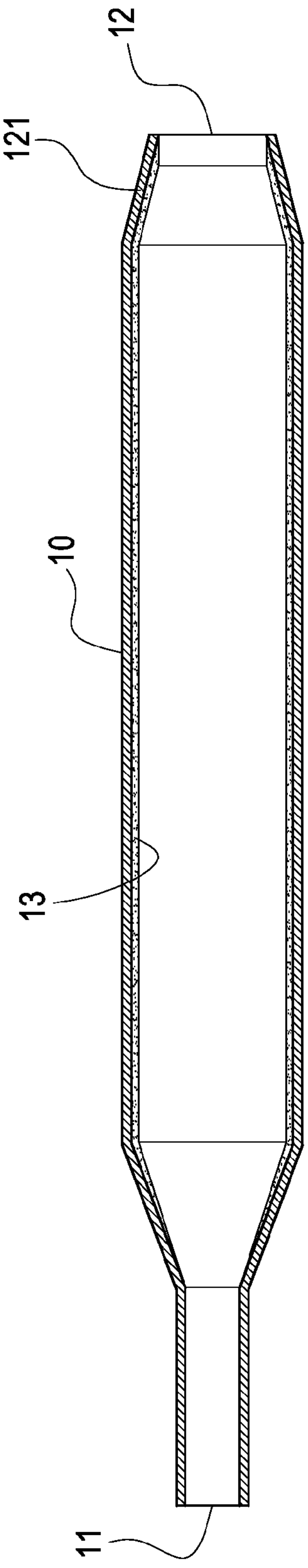


FIG.4

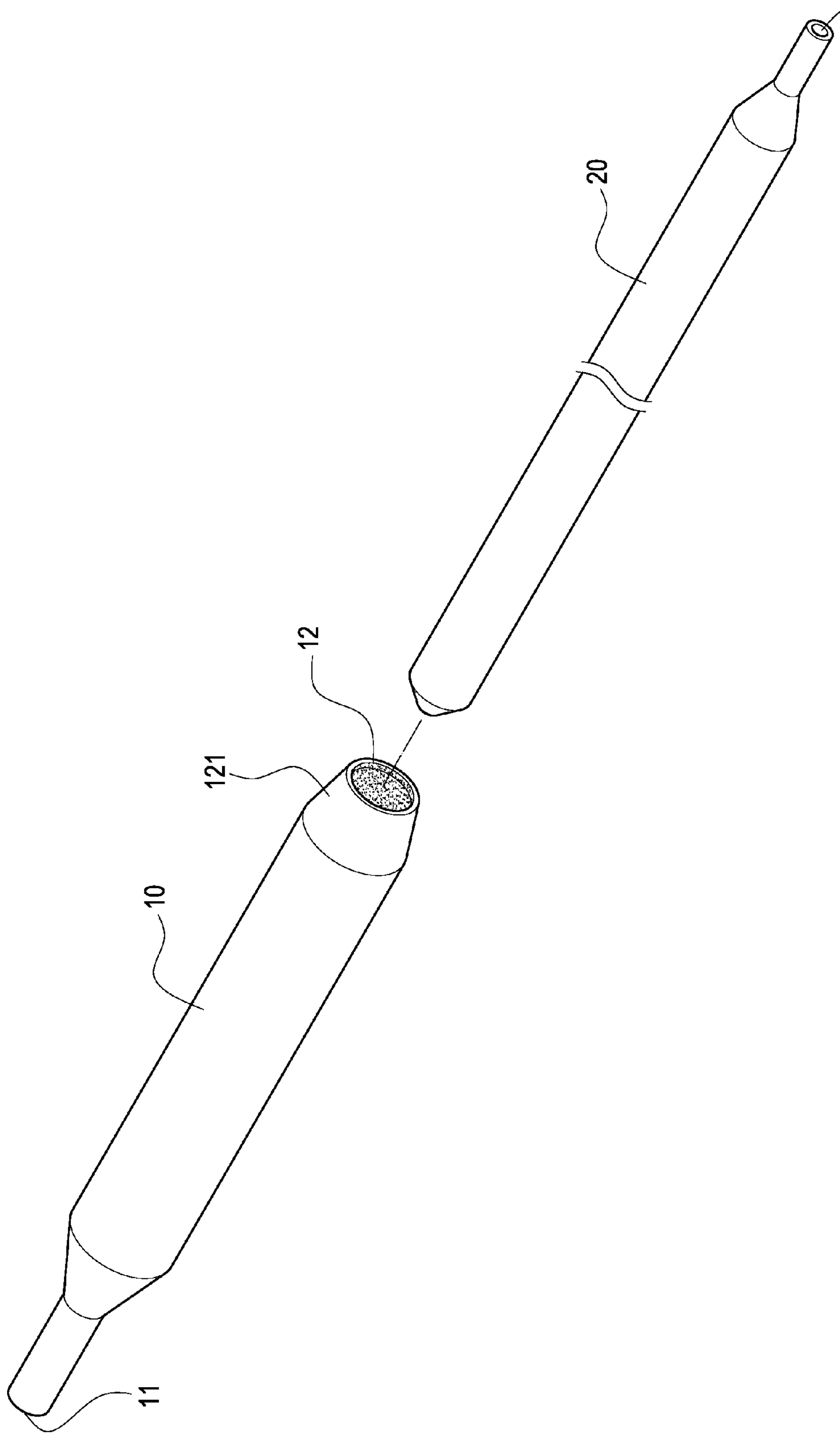


FIG.5

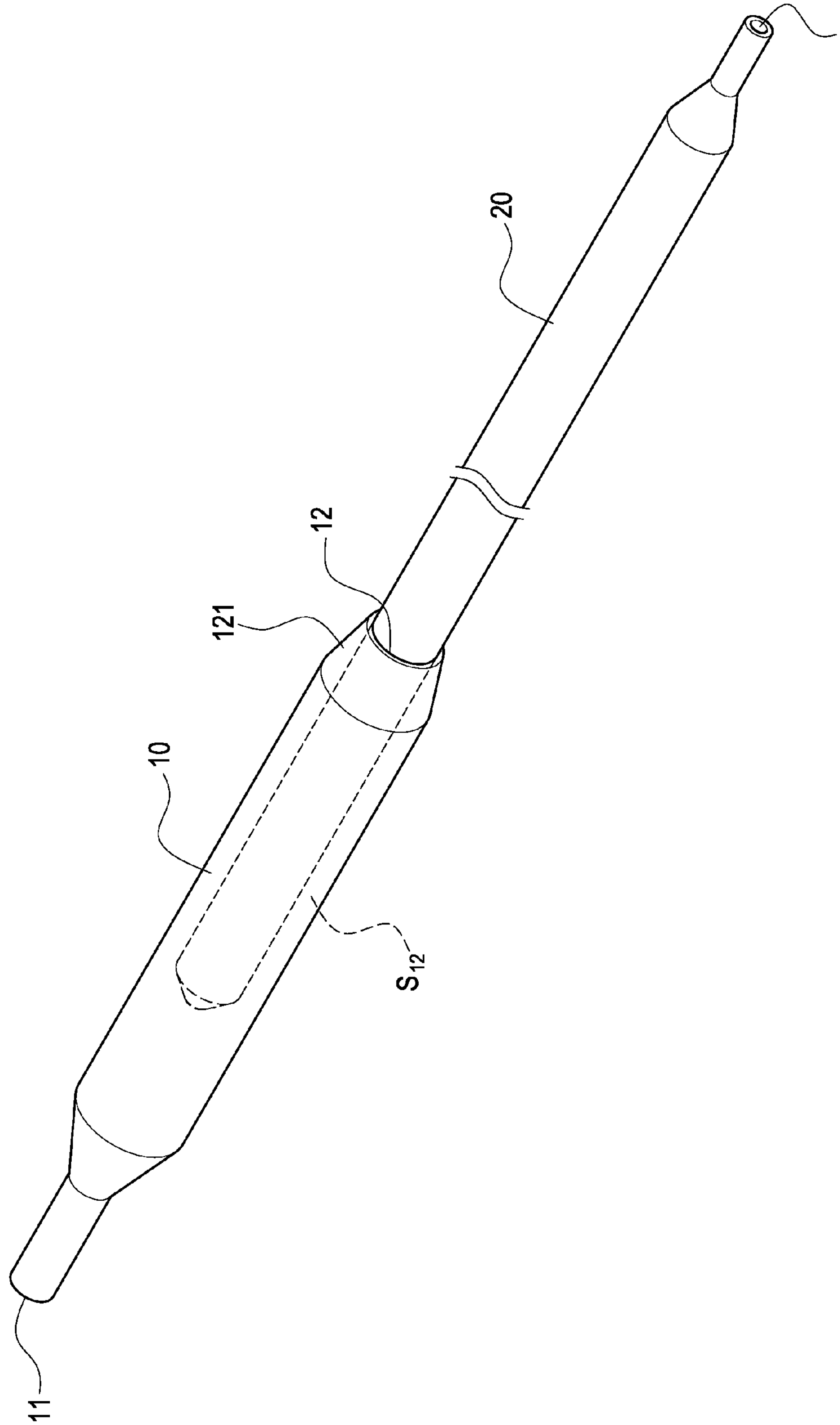


FIG.6

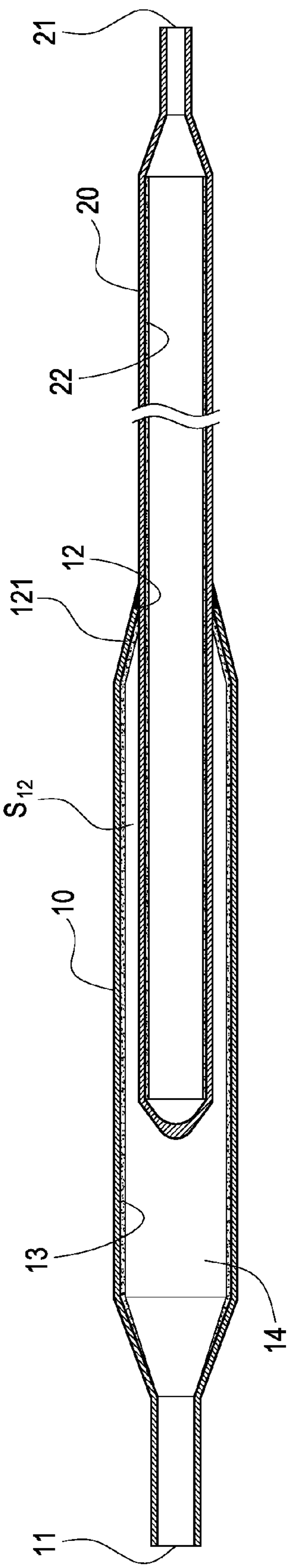


FIG.7

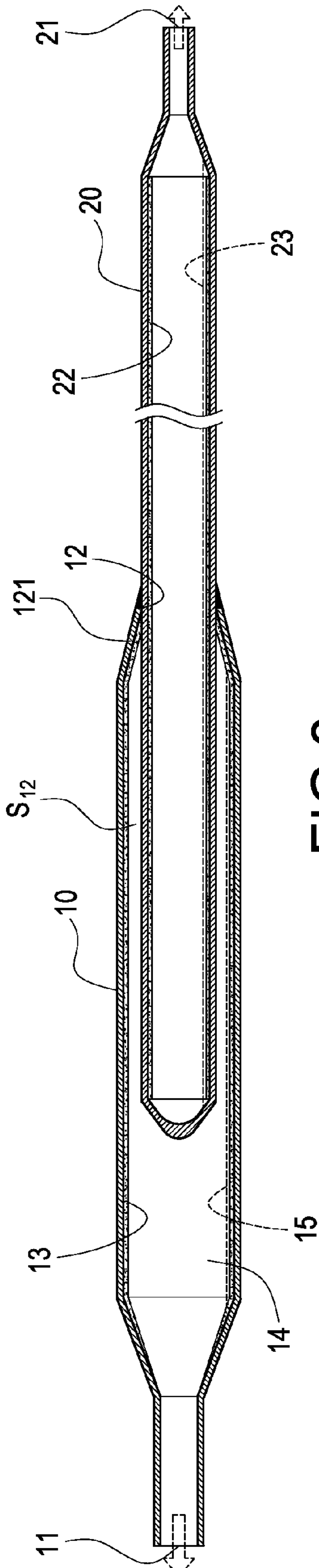


FIG.8

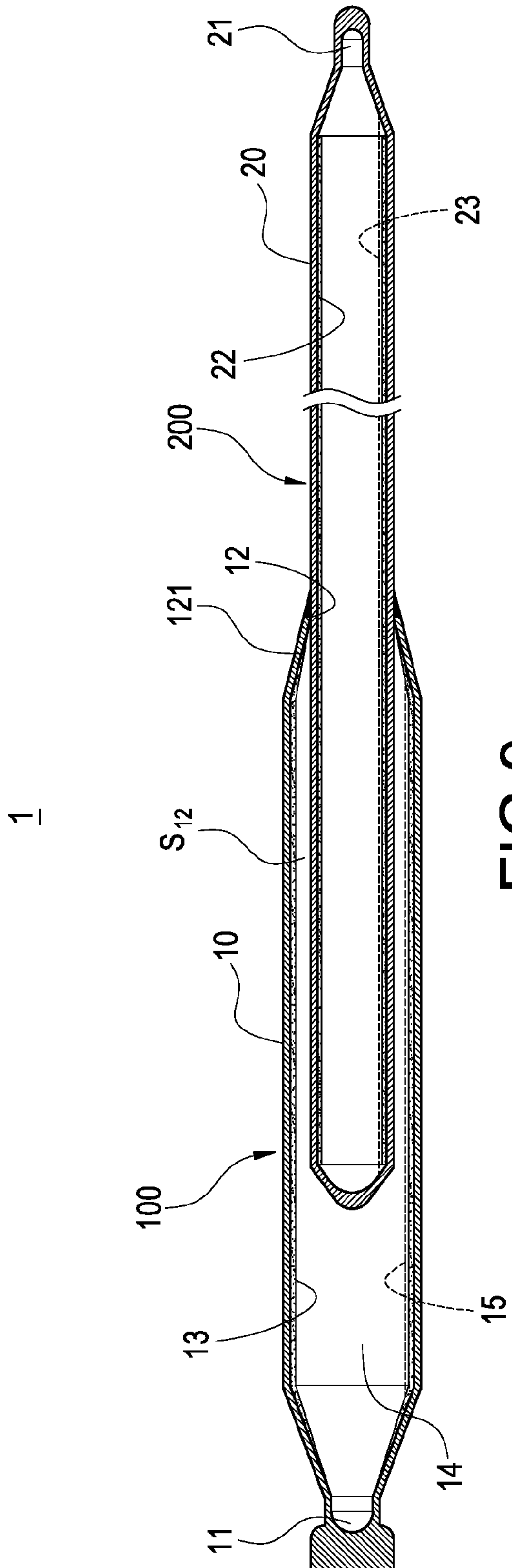


FIG.9

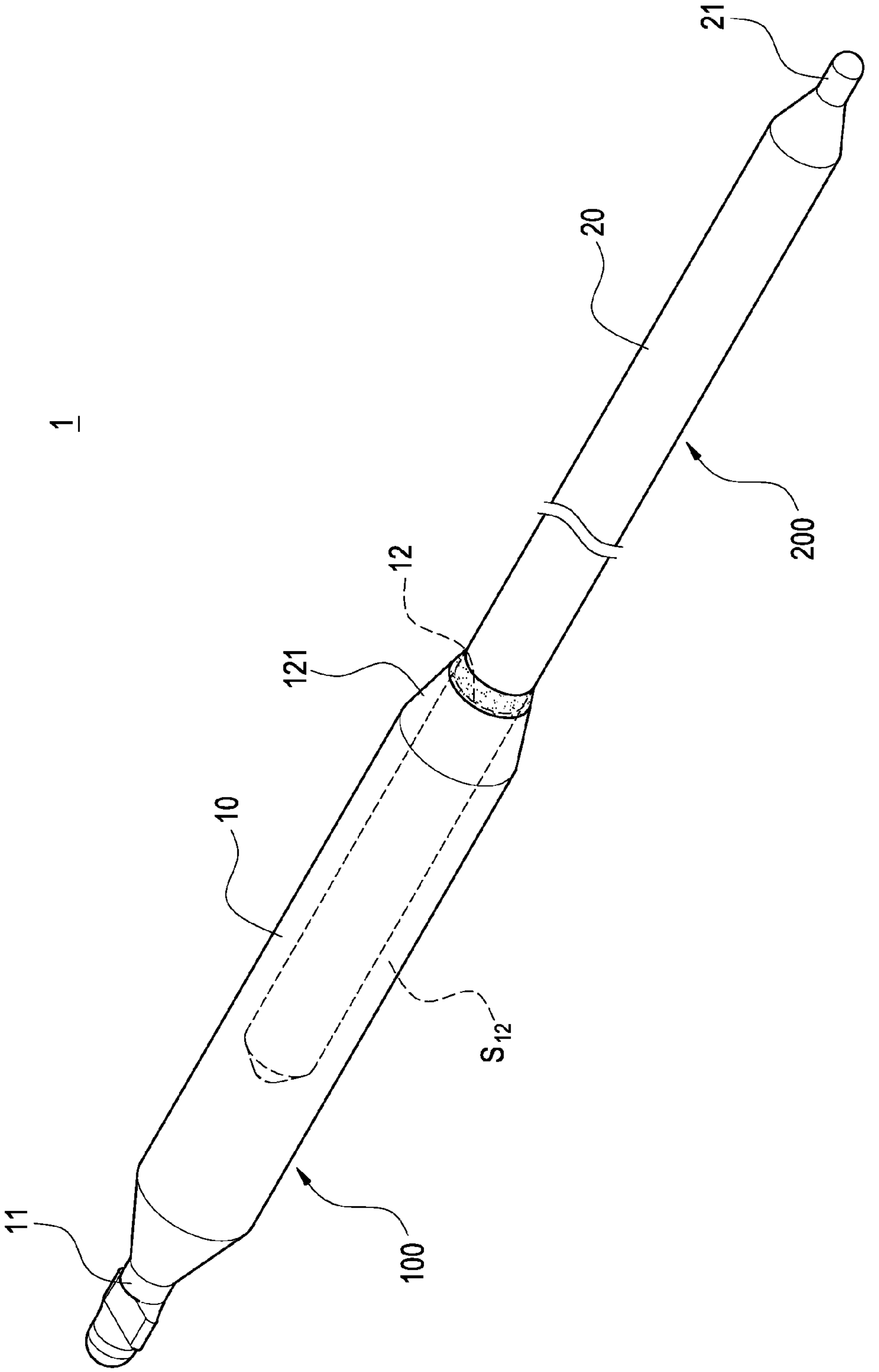


FIG.10

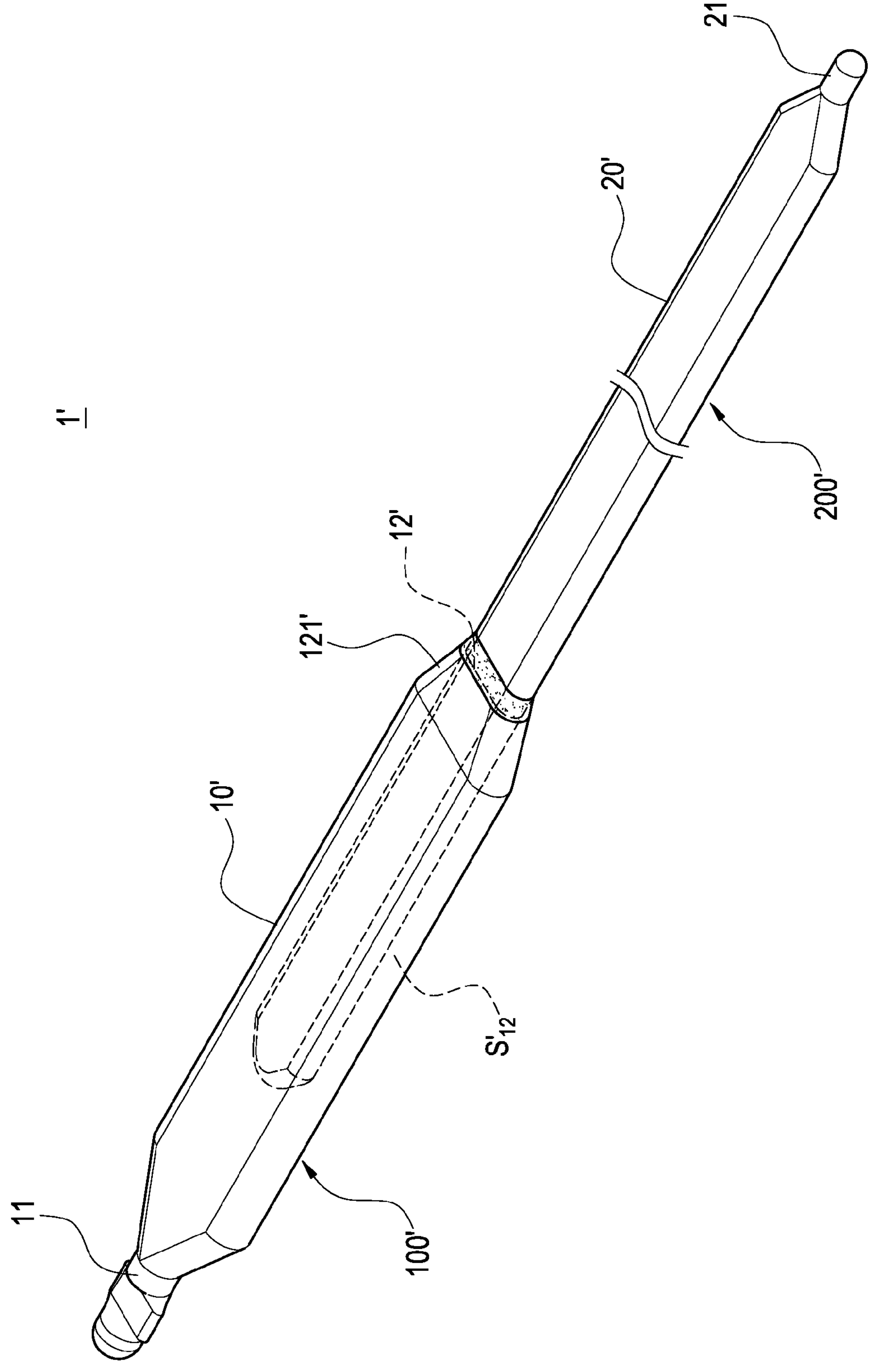


FIG.11

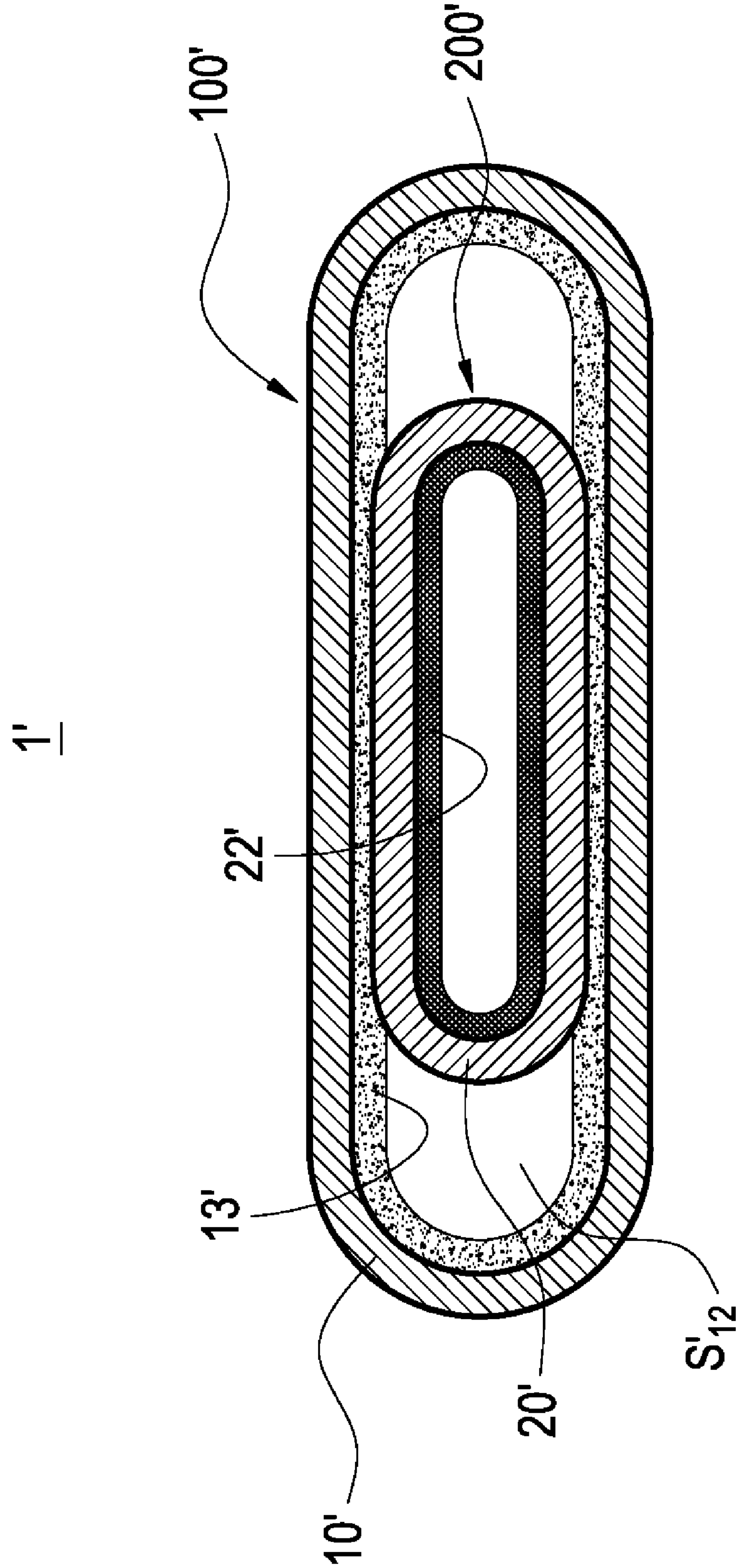


FIG.12

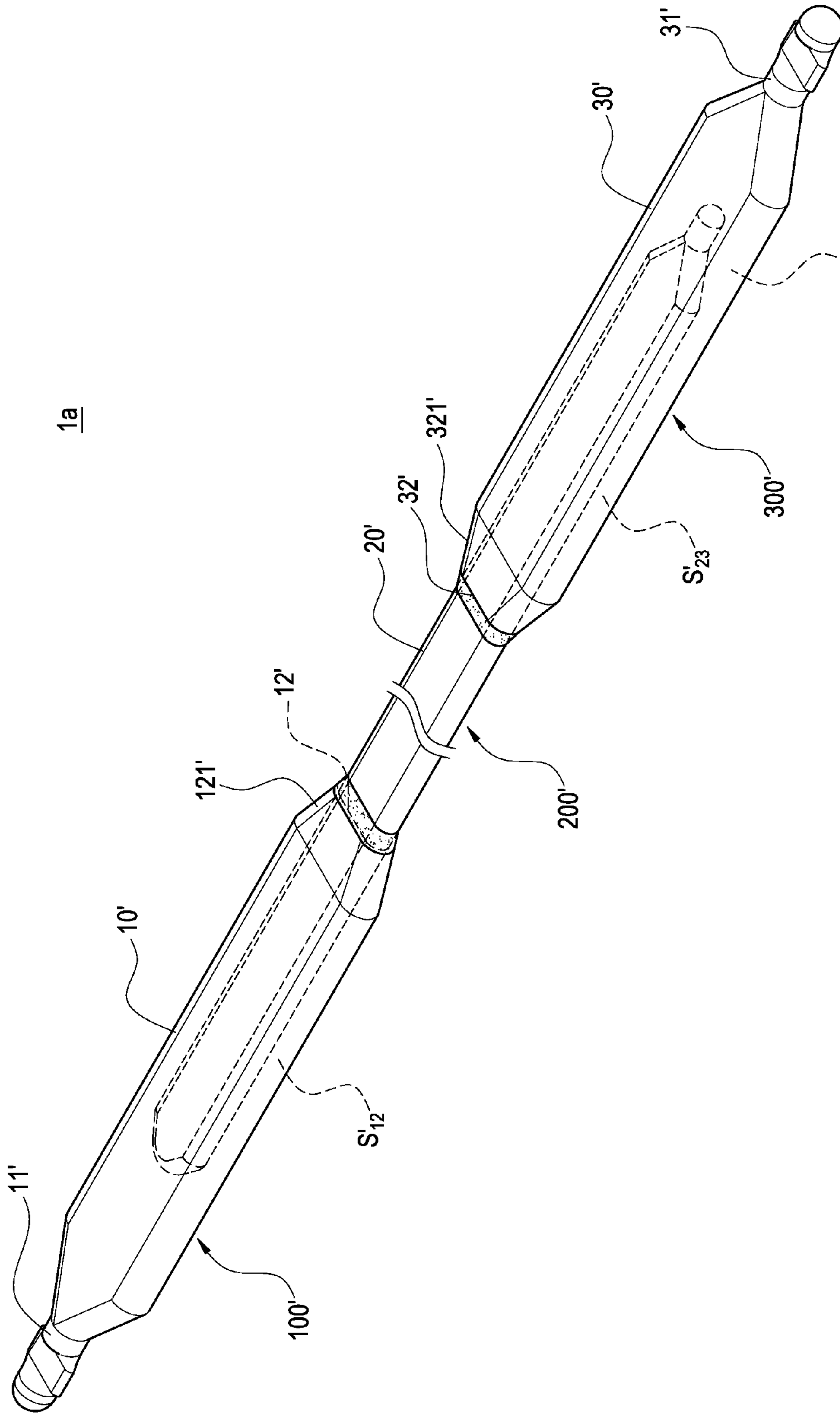


FIG.13

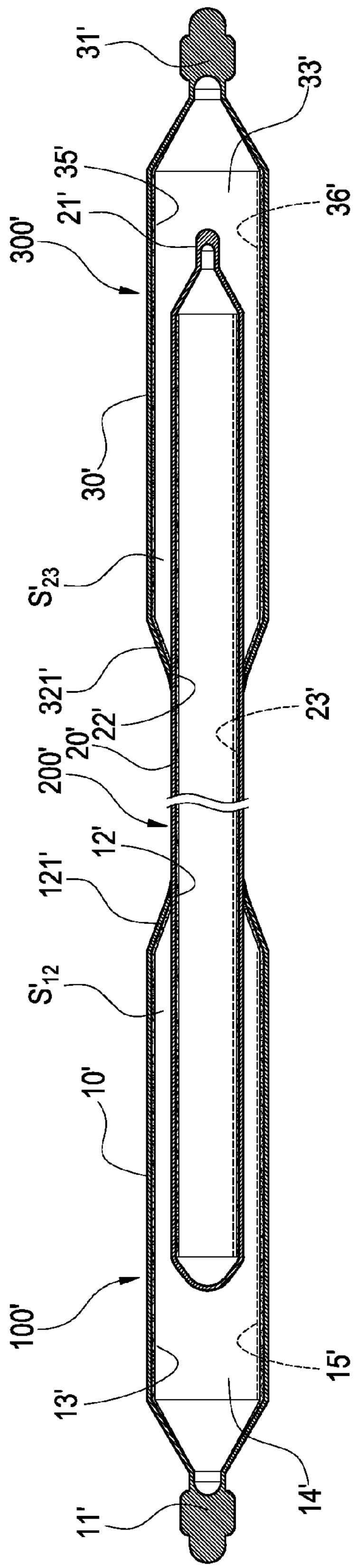

31'
33'
35'
21'
36'
300'
30'
S'_{23}
321'
22'
23'
20'
200'
12'
121'
S'_{12}
10'
100'
13'
15'
14'
11'

FIG.14

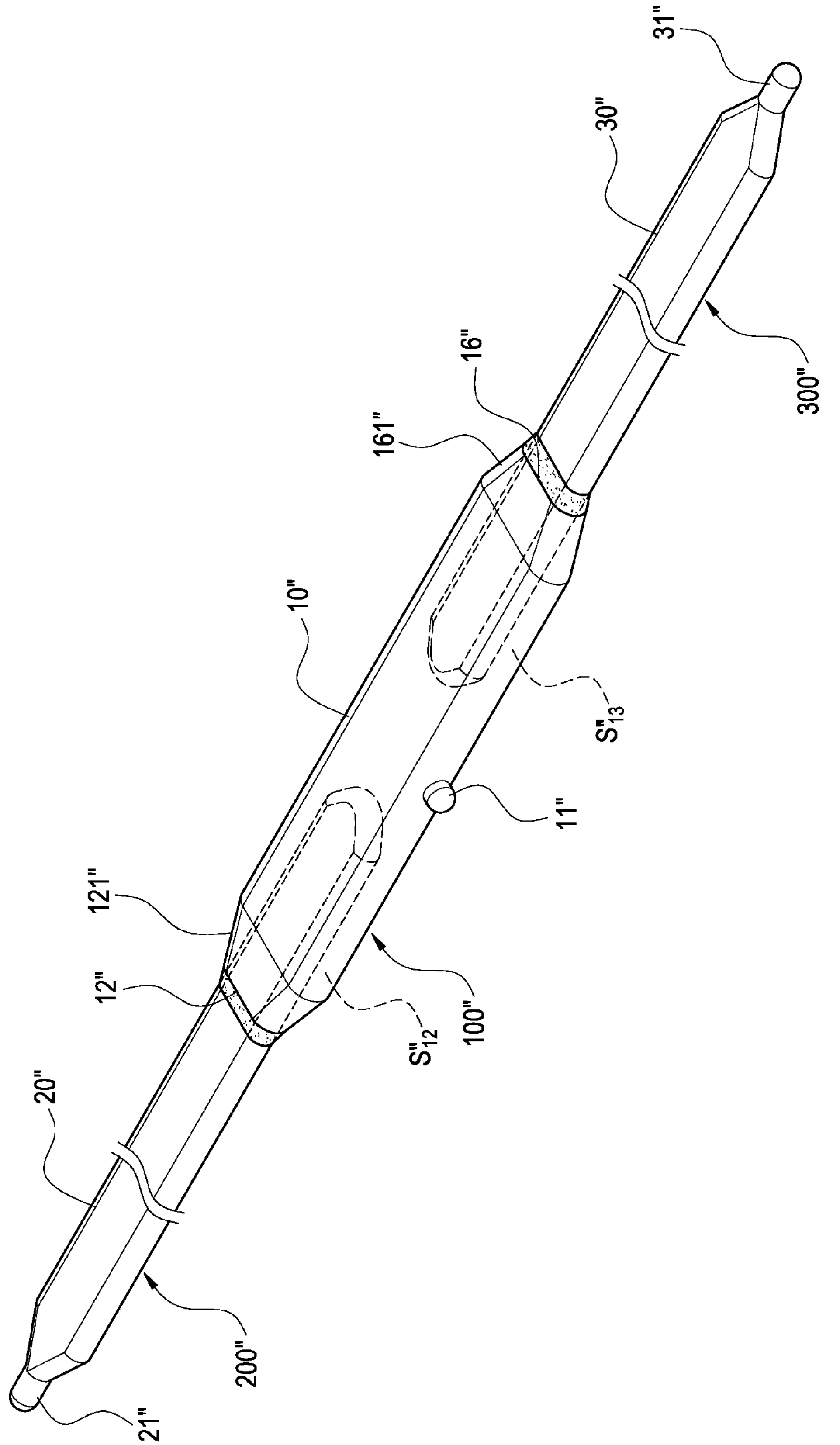


FIG.15

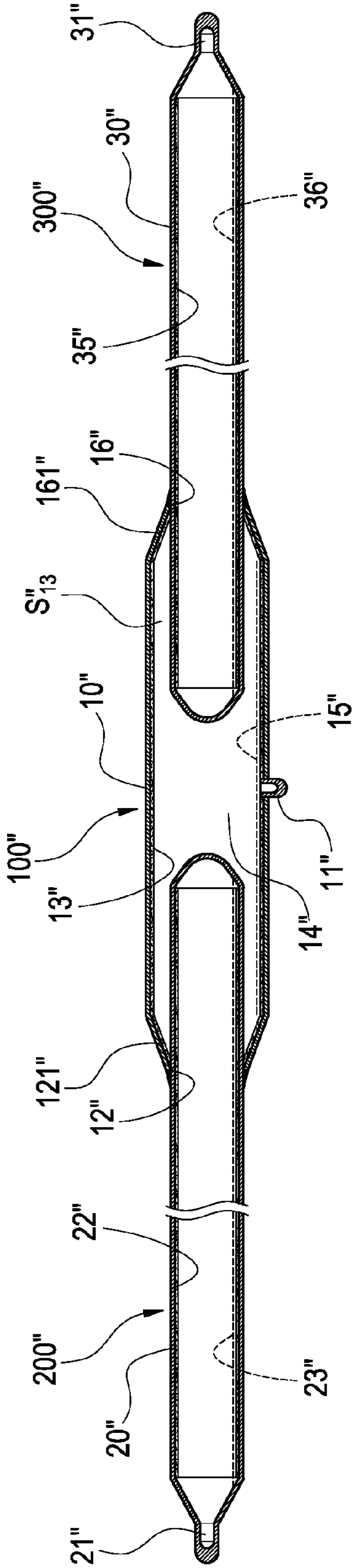


FIG.16

INTERCONNECTED HEAT PIPE ASSEMBLY AND METHOD FOR MANUFACTURING THE SAME

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a heat pipe assembly, in particular to an interconnected heat pipe assembly and a method for manufacturing the same.

[0003] 2. Description of Prior Art

[0004] A heat pipe includes a sealed pipe, a wick structure arranged on an inner wall of the sealed pipe, and a working fluid filled in the sealed pipe. In use, one end of the heat pipe brought into thermal contact with a heat source is called as a heat-absorbing section (evaporating end), and the other end of the heat pipe away from the heat-absorbing end is called a heat-releasing section (condensing end). The heat generated by the heat source is absorbed by the working fluid in the heat-absorbing section of the heat pipe, so that the liquid-phase working fluid in the heat-absorbing section turns into a vapor phase. The vapor-phase working fluid flows toward the heat-releasing section due to a temperature difference in the heat pipe. The vapor-phase working fluid releases its latent heat to return to a liquid phase. The liquid-phase working fluid flows back to the heat-absorbing section along the wick structure inside the heat pipe. With the circulation and liquid-vapor phase change of the working fluid in the heat pipe, the heat generated by the heat source can be conducted from the heat-absorbing section to the heat-releasing section.

[0005] With the advancement of science and technology, the operating performance of electronic elements is increased greatly. As a result, the amount of heat generated by the electronic elements per unit of time is also increased substantially. Thus, when the working fluid in the heat-absorbing section of the heat pipe absorbs such a large amount of heat, the working fluid in the heat-absorbing section evaporates completely. However, the evaporating rate of the working fluid in the heat-absorbing section is much larger than the condensing rate of the working fluid in the heat-releasing section. Thus, the heat-absorbing section of the heat pipe may dry out after working for a period of time. In order to solve this problem, it is necessary to increase the size of the heat pipe so as to increase the volume of the working fluid contained therein. As a result, the electronic elements having such a large-sized heat pipe cannot be made more compact.

[0006] On the other hand, since the vapor-flowing rate in the heat pipe is larger than the liquid-reflowing rate in the wick structure, such a difference in rate becomes significant in a heat pipe of a long distance. As a result, the dry-out problem becomes more serious in a long heat pipe. Thus, it is an important issue for those skilled in this art to design a long heat pipe. On the other hand, the effective region of the heat pipe concentrates on the heat-absorbing section and the heat-releasing section only, and the rest portion of the heat pipe seems to serve as a transferring section. Thus, the heat-conducting efficiency of the whole heat pipe is restricted.

[0007] Therefore, it is an important issue for the present Inventor to solve the above-mentioned problems.

SUMMARY OF THE INVENTION

[0008] The present invention is to provide an interconnected heat pipe assembly, which is capable of conducting heat in a long distance and has an increased heat-conducting efficiency.

[0009] The present invention provides an interconnected heat pipe assembly, including:

[0010] a first heat pipe comprising a first pipe, a first wick structure and a first working fluid, the first pipe having a hollow chamber, the first wick structure being arranged on at least one inner wall of the hollow chamber, the first working fluid being filled in the hollow chamber; and

[0011] a second heat pipe comprising a second pipe, a second wick structure and a second working fluid, a portion of the second heat pipe being received and sealed in the hollow chamber of the first pipe, an air channel being formed between an outer wall of the second heat pipe and an inner wall of the first pipe.

[0012] The present invention is to provide a method for manufacturing an interconnected heat pipe assembly which is capable of conducting heat in a long distance and has an increased heat-conducting efficiency.

[0013] The present invention provides a method for manufacturing an interconnected heat pipe assembly, including steps of:

[0014] a) providing a first pipe, both ends of the first pipe being formed into a first degassing port and an opening;

[0015] b) providing a first wick structure, arranging the first wick structure on an inner wall of the first pipe;

[0016] c) providing a second heat pipe, disposing the second heat pipe through the opening of the first pipe with a portion of the second heat pipe being received in the first pipe;

[0017] d) providing a soldering apparatus, soldering a connecting portion between the opening of the first pipe and the second heat pipe by the soldering apparatus;

[0018] e) providing a first working fluid, filling the first working fluid into the first pipe through the first degassing port; and

[0019] f) providing a degassing and soldering apparatus, degassing the first pipe and then sealing the first degassing port to form a first heat pipe by the degassing and soldering apparatus.

[0020] The present invention provides a method for manufacturing an interconnected heat pipe assembly, including steps of:

[0021] a) providing a first pipe, both ends of the first pipe being formed into an opening and a second opening, the first pipe being provided with a degassing tube;

[0022] b) providing a first wick structure, arranging the first wick structure on an inner wall of the first pipe;

[0023] c) providing a second heat pipe, disposing the second heat pipe through the opening of the first pipe with a portion of the second heat pipe being received in the first pipe and the other portion of the second heat pipe penetrating the opening to form a second degassing port;

[0024] d) providing a third heat pipe, disposing the third heat pipe through the second opening of the first pipe with a portion of the third heat pipe being received in the first pipe and the other portion of the third heat pipe penetrating the second opening to form a third degassing port;

[0025] e) providing a soldering apparatus, soldering a connecting portion between the opening of the first pipe and the second heat pipe as well as a connecting portion between the second opening of the first pipe and the third heat pipe by the soldering apparatus;

[0026] f) providing a working fluid, filling the working fluid into the first pipe through the degassing tube, filling the working fluid into the second pipe through the second degassing port, filling the working fluid into the third pipe through the third degassing port; and

[0027] g) providing a degassing and soldering apparatus, degassing and sealing the first pipe, the second pipe and third pipe to form a first heat pipe, a second heat pipe and a third heat pipe respectively by the degassing and soldering apparatus.

[0028] According to another feature of the present invention, the present invention provides a pressing tool to press the first heat pipe and the second heat pipe to be flat. In this way, the second heat pipe is configured to support the inner walls of the first heat pipe.

[0029] In comparison with prior art, the present invention has the following advantageous features.

[0030] A portion of the second heat pipe is inserted into the first heat pipe in such a manner that an air channel is formed between outer walls of the second heat pipe and inner walls of the first heat pipe. The working fluid is filled in the hollow chamber of the heat pipe and the second heat pipe. The working fluid in the first heat pipe and the working fluid in the second heat pipe are respectively subjected to liquid/vapor phase change. Thus, the dry-out phenomenon occurred in conventional single heat pipe will not happen in the present invention. In other words, the working fluid in the first heat pipe and the working fluid in the second heat pipe can be used for heat exchange sufficiently. Further, the first heat pipe and the second heat pipe are formed with an independent hollow chamber respectively. Therefore, the interconnected heat pipe assembly of the present invention exhibits a larger heat-conducting efficiency than the conventional single heat pipe.

[0031] According to still another feature of the present invention, a pressing tool is used to press the first heat pipe and the second heat pipe to be flat with the second heat pipe being configured to support the inner walls of the first heat pipe. Thus, the flattened first heat pipe has a larger contact area than a conventional tubular heat pipe, thereby increasing the heat-conducting efficiency thereof. Further, the flattened first heat pipe reduces the overall thickness of the interconnected heat pipe assembly, thereby conforming to the requirements for compact design.

BRIEF DESCRIPTION OF DRAWING

[0032] FIG. **1** is a perspective view showing a first pipe of the present invention;

[0033] FIG. **2** is a side cross-sectional view showing that a core rod is disposed in the first pipe of the present invention;

[0034] FIG. **3** is a side cross-sectional view showing that the core rod is disposed in the first pipe of the present invention and a first wick structure is formed;

[0035] FIG. **4** is a side cross-sectional view showing the first heat pipe of the present invention;

[0036] FIG. **5** is a schematic view showing that a second heat pipe is to be disposed in the first pipe of the present invention;

[0037] FIG. **6** is a perspective view showing that the second heat pipe has been inserted into the first heat pipe of the present invention;

[0038] FIG. **7** is a side cross-sectional view showing that the second heat pipe has been inserted into the first heat pipe of the present invention;

[0039] FIG. **8** is a side cross-sectional view showing that a working fluid is filled in the first heat pipe of the present invention, and the first heat pipe and the second heat pipe are degassed;

[0040] FIG. **9** is a side cross-sectional view showing that the first heat pipe and the second heat pipe of the present invention are sealed;

[0041] FIG. **10** is a perspective view of FIG. **9**;

[0042] FIG. **11** is a perspective view showing a second embodiment of the present invention;

[0043] FIG. **12** is an end cross0sectional view showing the second embodiment of the present invention;

[0044] FIG. **13** is a perspective view showing a third embodiment of the present invention;

[0045] FIG. **14** is a cross-sectional view of FIG. **13**;

[0046] FIG. **15** is a perspective view showing a fourth embodiment of the present invention; and

[0047] FIG. **16** is a cross-sectional view of FIG. **15**.

DETAILED DESCRIPTION OF THE INVENTION

[0048] The detailed description and technical contents of the present invention will become apparent with the following detailed description with reference to the accompanying drawings. It is noteworthy to point out that the drawings is provided for illustration only, but not intended to limit the scope of the present invention.

[0049] Please refer to FIGS. **1** to **10**, which show the first embodiment of the present invention. The present invention provides an interconnected heat pipe assembly **1** and a method for manufacturing the same. In order to better understand the construction of the interconnected heat pipe assembly **1**, the method of the present invention is described as follows according to the sequence of steps.

[0050] The method for manufacturing an interconnected heat pipe assembly of the present invention includes steps as follows.

[0051] a) providing a first pipe, both ends of the first pipe being formed into a first degassing port and an opening;

[0052] In the step a), as shown in FIG. **1**, a first pipe **10** is provided, which is a hollow pipe having two open ends. Then, one end (left end in FIG. **1**) of the first pipe **10** is narrowed to form a first degassing port **11**. As shown in FIG. **2**, a core rod W is disposed through the opening **12** into the first pipe **10**. The profile and outer diameter of the core rod **100** are designed to be slightly smaller than the profile and inner diameter of the first pipe **10**, thereby generating a gap between the first pipe **10** and the core rod **100**.

[0053] b) providing a first wick structure, arranging the first wick structure on an inner wall of the first pipe;

[0054] In the step b), as shown in FIG. **3**, the gap between the first pipe **10** and the core rod **100** is filled with a first wick structure **13**. The first wick structure **13** is made by sintering metal powder at high temperature, thereby forming a porous first wick structure **13** on at least one inner wall of the first pipe **10**. Of course, the first wick structure **12** may be made by other materials such as metallic woven meshes to have a spring-like, a groove-like, a post-like and a net-like construction. After the core rod **100** is removed, the first pipe **10** is formed with a hollow chamber **14** and the opening **12** away from the first degassing port **11**. Further, one end of the first pipe **10** adjacent to the opening **12** is formed with a first tapered section **121**.

[0055] c) providing a second heat pipe, disposing the second heat pipe through the opening of the first pipe with a portion of the second heat pipe being received in the first pipe;

[0056] In the step c), as shown in FIGS. **5** and **6**, a second pipe **20** is provided. The outer diameter of the second pipe **20** is smaller than the inner diameter of the opening **12** of the first pipe **10**, so that the second pipe **20** can be disposed through the opening **12** into the first pipe **10** with a portion of the second pipe **20** being received in the first pipe **10**. Before disposing the second pipe **20** into the first pipe **10**, the left end of the second pipe **20** is sealed first, and the right end of the second pipe **20** is narrowed to form a second degassing port **21**. Then, by using a common method for manufacturing a heat pipe, metal powder is filled in the second degassing port **21** and sintered at high temperature, thereby forming a porous second wick structure **22** (FIG. **7**) in the second pipe **20**. Of course, the second wick structure **22** may be made by other materials such as metallic woven meshes having a spring-like, a groove-like, a post-like and a net-like construction.

[0057] d) providing a soldering apparatus, soldering and sealing a connecting portion between the opening of the first pipe and the second heat pipe by the soldering apparatus.

[0058] In the step d), as shown in FIG. **7**, after the second pipe **20** is inserted into the hollow chamber **14** of the first pipe **10**, a soldering apparatus (not shown) is used to solder and seal the opening **12** of the first pipe **10**, thereby sealing the first tapered section **121** of the first pipe **10** and the second pipe **20** together at the opening **12**.

[0059] e) providing a first working fluid, filling the first working fluid in the first pipe via the first degassing port; and f) providing a degassing and soldering apparatus, degassing and sealing the first pipe to form a first heat pipe by the degassing and soldering apparatus.

[0060] In the steps e) and f), as shown in FIG. **8**, a first working fluid **15** and a second working fluid **23** (such as water) are filled in the first pipe **10** via the first degassing port **11** and filled in the second pipe **20** via the second degassing port **21**. Then, a degassing and soldering apparatus (not shown) is used to degas the first pipe **10** and the second pipe **20**. Finally, the first degassing port **11** and the second degassing port **21** are soldered and sealed to form a first heat pipe **100** shown in FIG. **9** and a second heat pipe **200** shown in FIG. **10** respectively. A portion of the second heat pipe **200** is received and sealed in the hollow chamber **14** in such a manner that an air channel S_{12} is formed between an outer wall of the second heat pipe **200** and an inner wall of the first pipe **10**. In addition to water, the first working fluid **15** and the second working fluid **23** may be any one selected from a group including inorganic compounds, alcohols, ketones, liquid metals, coolants, organic compounds and mixtures thereof.

[0061] Of course, it can be contemplated that the second pipe **20** may be made into the second heat pipe **200** first, and then it is disposed into the first pipe **10**. Next, the connecting portion between the second heat pipe **200** and the first pipe **10** is soldered and sealed. Finally, the first pipe **10** is subjected to the filling of the first working fluid **15**, the degassing and soldering to finish the first heat pipe **100**. In this way, the interconnected heat pipe assembly **1** of the present invention can be also achieved.

[0062] Please refer to FIG. **9**. The heat-conducting principle of the interconnected heat pipe assembly **1** of the present invention will be described. When a section of the first heat pipe **100** near the first degassing port **11** is adhered to a heat source (not shown), the heat generated by the heat source is absorbed by the section of the first heat pipe **100**, so that the first working fluid **15** inside the section of the first heat pipe **100** absorbs the heat to evaporate. Then, the vapor-phase first working fluid **15** flows toward the air channel S_{12} and heat-exchanges with a portion of the second heat pipe **200** overlapped with the first heat pipe **100**, so that the vapor-phase first working fluid **15** in the air channel S_{12} releases its latent heat to condense. Then, the condensed working fluid **15** flows back to the section of the first heat pipe **100** near the first degassing port **11**. At the same time, the second working fluid **23** in the portion of the second heat pipe **200** overlapped with the first heat pipe **100** absorbs the heat released from the vapor-phase first working fluid **15** to evaporate. Then, the vapor-phase second working fluid **23** flows toward another portion of the second heat pipe **200** near the second degassing port **21** and releases its latent heat to return to liquid phase. In this way, the heat generated by the heat source can be conducted from the first heat pipe **100** to the second heat pipe **200** and finally dissipated to the outside. Thus, if a plurality of heat-dissipating fins (not shown) is connected to the portion of the second heat pipe **200** near the second degassing port **21**, the heat generated by the heat source can be quickly conducted from the first heat pipe **100** to the second heat pipe **200** and dissipated to the outside via the heat-dissipating fins.

[0063] Please refer to FIG. **11**, which shows the second embodiment of the present invention. The difference between the second embodiment and the first embodiment lies in that: each of the first heat pipe **100** and the second heat pipe **200** in the first embodiment is formed into a tubular shape. In the second embodiment, a pressing tool (not shown) is provided to press the first heat pipe **100** and the second heat pipe **200** to be flat, thereby obtaining a flat first heat pipe **100'** and a flat second heat pipe **200'**. The steps of the method in the second embodiment are substantially the same as those of the method in the first embodiment except for an additional step of pressing the first heat pipe **100** and the second heat pipe **200** into a flat heat pipe **100'** and a flat second heat pipe **200'**. Although FIG. **11** shows that the first heat pipe **100'** and the second heat pipe **200'** are pressed to be flat in their whole length, it can be contemplated that the pressing may be performed on only a portion of the first heat pipe **100'** and the second heat pipe **200'**.

[0064] It can be seen from FIG. **12** that, after pressing, the vertical outer walls of the first pipe **10'** expand laterally, thereby increasing the contact area between the vertical outer walls of the first pipe **10'** and a heat source (not shown) greatly. Thus, the heat generated by the heat source can be conducted from the first heat pipe **100'** to the second heat pipe **200'** more quickly. On the other hand, after pressing, the vertical inner walls of the first pipe **10'** are brought into tight contact with the vertical outer walls of the second heat pipe **200'**, that is, the vertical outer walls of the second heat pipe **200'** are brought into tight contact with the first wick structure **13'** inside the first pipe **10'**, thereby increasing the supporting strength of the interconnected heat pipe assembly V. Since the first pipe **10'** is pressed to be flat, two air channels S_{12}' are formed between the lateral inner walls of the first pipe **10'** and the lateral outer walls of the second heat pipe **200'**.

[0065] Please refer to FIGS. **13** and **14**, which show the interconnected heat pipe assembly **1***a* of the third embodiment of the present invention. The difference between the third embodiment and the second embodiment lies in that: the third embodiment further comprises a third heat pipe **300'** connected to the second heat pipe **200'** and away from the first heat pipe **100'**. The size of the third heat pipe **300'** is larger than that of the second heat pipe **200'**, thereby forming the interconnected heat pipe assembly **1***a* having a “big-small-big” construction.

[0066] In the interconnected heat pipe assembly **1***a*, the steps of the method for manufacturing the first heat pipe **100'** and the second heat pipe **200'** are substantially the same as those in the previous embodiments, and thus the redundant description is omitted for clarity. In the following, only the method for manufacturing the third heat pipe **300'** is described.

[0067] A third pipe **30'** and a third wick structure **35'** are provided. The third wick structure **35'** is arranged on an inner wall of the third pipe **30'**. The third pipe **30'** has a chamber **33'** and a pipe hole **32'**. One end of the second heat pipe **200'** away from the first heat pipe **100'** is disposed through the pipe hole **32'** into the third pipe **30'**, so that the other portion of the second heat pipe **200'** is received and sealed in the chamber **33'**. An air channel S_{23}' is formed between the outer wall of the other portion of the second heat pipe **200'** and the inner wall of the third pipe **30'**. One end of the third pipe **30'** away from the pipe hole **32'** is narrowed to form a third degassing port **31'**. The third pipe **30'** is formed with a third tapered section **321'** near the pipe hole **32'**. The soldering apparatus is used to seal the third pipe **30'** and the second heat pipe **200'**, so that the third tapered section **321'** and the second heat pipe **200'** are soldered together at the pipe hole **32'**. A third working fluid **36'** is provided and filled in the third pipe **30'**. The degassing and soldering apparatus is used to degas the third pipe **30'** and seal the third degassing port **31'**, thereby finishing the third heat pipe **300'**. A pressing tool is provided to press at least one portion of the first heat pipe **100'**, the second heat pipe **200'** and the third heat pipe **300'** to be flat.

[0068] The interconnected heat pipe assembly **1***a* of the second embodiment has a primary advantage of further extending the length of the second heat pipe **200'** for heat conduction to a longer distance. The third heat pipe **300'** is put on a portion of the second heat pipe **200'**. An air channel S_{23}' is also formed between the third heat pipe **300'** and the second heat pipe **200'** like the first embodiment. The portion of the second heat pipe **200'** located in the third heat pipe **300'** serves as a heat-releasing section for heat-exchanging with the third heat pipe **300'**. Thus, the heat is dissipated to the outside via the outer surface of the third heat pipe **300'**. In other words, the third heat pipe **300'** not only increases the heat-conducting length of the second heat pipe **200'**, but also increases the heat-dissipating area of the second heat pipe **200'**. Thus, the heat-dissipating effect is improved greatly.

[0069] Please refer to FIGS. **15** and **16**, which show the interconnected heat pipe assembly **1***b* of the fourth embodiment of the present invention. The difference between the fourth embodiment and the second embodiment lies in that: the fourth embodiment further comprises a third heat pipe **300"** connected to the first heat pipe **100"** and away from the second heat pipe **200"**. The size of the third heat pipe **300"** is smaller than that of the first heat pipe **100"**. In other words, two open ends of the big first heat pipe **100"** are inserted by a small second heat pipe **200"** and a small third heat pipe **300"** respectively, thereby forming an interconnected heat pipe assembly **1***b* having a “small-big-small” construction.

[0070] The method of the third embodiment is described as follows. First, a first pipe **10"** is provided. The middle section of the first pipe **10"** is provided with a degassing tube **11"**. Both ends of the first pipe **10"** are formed with an opening **12"** and a second opening **16"**. The first pipe **10"** is formed with a tapered section **161"** near the second opening **16"**. Then, a first wick structure **13"** is filled into the first pipe **10"** and sintered to be adhered onto inner walls of the first pipe **10"**. Then, a second pipe **20"** and a third pipe **30"** are provided. A second wick structure **22"** is arranged on inner walls of the second pipe **20"**, and a third wick structure **35"** is arranged on inner walls of the third pipe **30"**. The second pipe **20"** is narrowed to form a second degassing port **21"**, and the third pipe **30"** is narrowed to form a third degassing port **31"**. The second pipe **20"** is disposed through the opening **12"** into the first heat pipe **10"**, and the third pipe **30"** is disposed through the second opening **16"** into the first heat pipe **10"**. The second pipe **20"** and the first tapered section **121"** are soldered together at the opening **12"**. The third pipe **30"** and the tapered section **161"** are soldered together at the second opening **16"**. The first working fluid **15"** is filled in the first pipe **10"** via the degassing tube **11"**. The second working fluid **23"** is filled in the second pipe **20** “ via the second degassing port **21**”. The third working fluid **36"** is filled in the third pipe **30"** via the third degassing port **31"**. The first pipe **10"**, the second pipe **20"** and the third pipe **30"** are respectively degassed via the first degassing port **11"**, the second degassing port **21"** and the third degassing port **31"**, thereby finishing the first heat pipe **100"**, the second heat pipe **200"** and the third heat pipe **300"**. Finally, a pressing tool is provided to press at least one portion of the first heat pipe **100"**, the second heat pipe **200"** and the third heat pipe **300"**. After pressing, air channels S_{12}" are formed between the lateral inner walls of a portion of the first pipe **10"** and the lateral outer walls of the second heat pipe **200"**. Air channels S_{13}" are formed between the lateral inner walls of the other portion of the first pipe **10"** and the lateral outer walls of the third heat pipe **300"**.

[0071] It can be seen from FIG. **16** that, when the first heat pipe **100"** is brought into thermal contact with a heat source, the heat pipe **100"** absorbs the heat of the heat source to evaporate the first working fluid within the first pipe **100"**, thereby heating a portion of the second heat pipe **200"** and a portion of the third heat pipe **300"** within the first heat pipe **100"**. As a result, a section of the second heat pipe **200"** near the second degassing port **21"** and a section of the third heat pipe **300"** near the third degassing port **31"** serve as a heat-releasing section respectively. In other words, the interconnected heat pipe assembly **1***b* can conduct the heat of a heat source located in the center of the assembly **1***b* to its both ends.

[0072] Of course, those skilled in this art can easily contemplate to connect at least one heat pipe **100"** to the interconnected heat pipe assembly **1***b* shown in FIG. **15** to form a four-piece or five-piece interconnected heat pipe assembly.

[0073] Although the present invention has been described with reference to the foregoing preferred embodiments, it will be understood that the invention is not limited to the details thereof. Various equivalent variations and modifications can still occur to those skilled in this art in view of the teachings of the present invention. Thus, all such variations and equivalent modifications are also embraced within the scope of the invention as defined in the appended claims.

What is claimed is:

1. An interconnected heat pipe assembly, including:

a first heat pipe comprising a first pipe, a first wick structure and a first working fluid, the first pipe having a hollow chamber, the first wick structure being arranged on at least one inner wall of the hollow chamber, the first working fluid being filled in the hollow chamber; and

a second heat pipe comprising a second pipe, a second wick structure and a second working fluid, a portion of the second heat pipe being received and sealed in the hollow chamber of the first pipe, an air channel being formed between an outer wall of the second heat pipe and an inner wall of the first pipe.

2. The interconnected heat pipe assembly according to claim **1**, wherein the first pipe is provided with an opening, one end of the first pipe near the opening is formed with a first tapered section, the other end of the first pipe away from the opening is formed with a first degassing port, the first tapered section and a portion of the second heat pipe are soldered together at the opening.

3. The interconnected heat pipe assembly according to claim **2**, wherein the other portion of the second heat pipe penetrates the opening to form a second degassing port.

4. The interconnected heat pipe assembly according to claim **3**, wherein the first heat pipe and the second heat pipe are pressed to be flat in such a manner that vertical inner walls of the first pipe are brought into tight contact with vertical outer walls of the second heat pipe, the air channel is formed between lateral inner walls of the first pipe and lateral outer walls of the second heat pipe.

5. The interconnected heat pipe assembly according to claim **4**, further comprising a third heat pipe connected to the second heat pipe and away from the first heat pipe.

6. The interconnected heat pipe assembly according to claim **5**, wherein the third heat pipe comprises a third pipe and a third wick structure arranged on an inner wall of the third pipe, the third pipe has a chamber and a pipe hole, one end of the second heat pipe away from the first heat pipe is disposed through the pipe hole into the third pipe with the other portion of the second heat pipe being received and sealed in the chamber, an air channel is formed between outer walls of the other portion of the second heat pipe and inner walls of the third pipe.

7. The interconnected heat pipe assembly according to claim **6**, wherein one end of the third pipe near the pipe hole is formed with a third tapered section, the other end of the third pipe away from the pipe hole is formed with a third degassing port, the third tapered section and the second heat pipe are soldered together at the pipe hole.

8. The interconnected heat pipe assembly according to claim **4**, further comprising a third heat pipe connected to the first heat pipe and away from the second heat pipe.

9. The interconnected heat pipe assembly according to claim **8**, wherein one end of the first pipe away from the opening is formed with a second opening, the third heat pipe comprises a third pipe and a third wick structure arranged on an inner wall of the third pipe, the third heat pipe is disposed through the second opening into the first pipe with a portion of the third heat pipe being received and sealed in the hollow chamber, another air channel is formed between outer walls of the third heat pipe and inner walls of the first pipe.

10. The interconnected heat pipe assembly according to claim **9**, wherein one end of the first pipe near the second opening is formed with a tapered section, a middle portion of the first pipe is provided with a degassing tube, the tapered section and the third heat pipe are soldered together at the second opening, the other portion of the third heat pipe penetrates the second opening to form a third degassing port.

11. A method for manufacturing an interconnected heat pipe assembly, including steps of:

a) providing a first pipe, both ends of the first pipe being formed into a first degassing port and an opening;

b) providing a first wick structure, arranging the first wick structure on an inner wall of the first pipe;

c) providing a second heat pipe, disposing the second heat pipe through the opening of the first pipe with a portion of the second heat pipe being received in the first pipe;

d) providing a soldering apparatus, soldering a connecting portion between the opening of the first pipe and the second heat pipe by the soldering apparatus;

e) providing a first working fluid, filling the first working fluid into the first pipe through the first degassing port; and

f) providing a degassing and soldering apparatus, degassing the first pipe and then sealing the first degassing port to form a first heat pipe by the degassing and soldering apparatus.

12. The method according to claim **11**, further including a step of providing a pressing tool, and pressing at least one portion of the first heat pipe and the second heat pipe to be flat by the pressing tool.

13. The method according to claim **11**, further including steps of:

g) providing a third pipe, both ends of the third pipe being formed with a third degassing port and a pipe hole;

h) providing a third wick structure, arranging the third wick structure on an inner wall of the third pipe;

j) narrowing the third degassing port, disposing a portion of the second heat pipe away from the first pipe through the pipe hole into the third pipe;

j) soldering a connecting portion between the third pipe and the second heat pipe by the soldering apparatus;

k) providing a third working fluid, filling the third working fluid into the third pipe; and

1) degassing the third pipe via the third degassing port by the degassing and soldering apparatus, sealing the third pipe by the soldering apparatus to form a third heat pipe.

14. The method according to claim **13**, further including a step of providing a pressing tool, and pressing at least one portion of the first heat pipe, the second heat pipe and the third heat pipe to be flat by the pressing tool.

15. A method for manufacturing an interconnected heat pipe assembly, including steps of:

a) providing a first pipe, both ends of the first pipe being formed into an opening and a second opening, the first pipe being provided with a degassing tube;

b) providing a first wick structure, arranging the first wick structure on an inner wall of the first pipe;

c) providing a second heat pipe, disposing the second heat pipe through the opening of the first pipe with a portion of the second heat pipe being received in the first pipe and the other portion of the second heat pipe penetrating the opening to form a second degassing port;

d) providing a third heat pipe, disposing the third heat pipe through the second opening into the first pipe with a portion of the third heat pipe being received in the first pipe and the other portion of the third heat pipe penetrating the second opening to form a third degassing port;

e) providing a soldering apparatus, soldering a connecting portion between the opening of the first pipe and the second heat pipe as well as a connecting portion between the second opening of the first pipe and the third heat pipe by the soldering apparatus;

f) providing a working fluid, filling the working fluid into the first pipe through the degassing tube, filling the working fluid in the second pipe through the second degassing port, filling the working fluid in the third pipe through the third degassing port; and

g) providing a degassing and soldering apparatus, degassing and sealing the first pipe, the second pipe and third pipe to form a first heat pipe, a second heat pipe and a third heat pipe respectively by the degassing and soldering apparatus.

16. The method according to claim **15**, further including a step of: providing a pressing tool, and pressing at least one the first heat pipe, the second heat pipe and the third heat pipe to be flat by the pressing tool.

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