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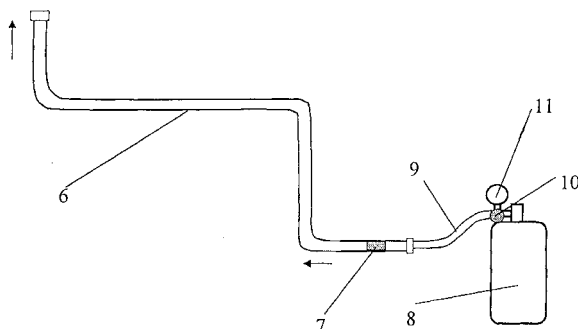
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(54) **Piping cleaning method of air conditioner, compounds used therein, and piping cleaning apparatus**

(57) When changing from an air conditioner having an existing piping (6) to a new air conditioner, the existing piping (6) can be used as it is. In this method, an air conditioner having an excellent long-term reliability can be installed. A piping cleaning method of air conditioner for removing foreign matter existing in the piping installed between an indoor unit and an outdoor unit in-

cludes (a) a step of inserting a compound (7) from an opening of the piping, (b) a step of leading a compressed gas from the opening into the piping, and conveying the compound (7) through the piping while keeping the compound (7) in contact with the inner wall of the piping, and (c) a step of removing the foreign matter existing in the piping, together with the compound (7), from the piping.

Fig. 2



Description

Field of the Invention

[0001] The present invention relates to a cleaning method of piping in installation work of an air conditioner, compounds used therein, and a piping cleaning apparatus.

Background of the Invention

[0002] Hitherto, a refrigerating apparatus such as air conditioner has a compression type heat pump using hydrochlorofluorocarbon (HCFC) refrigerant such as R22. This kind of refrigerating apparatus has a refrigerant circuit mainly connecting the compressor, outdoor heat exchanger, expansion valve, and indoor heat exchanger by means of refrigerant piping.

[0003] Recently, as the heating and cooling demand increases, a large-scale air conditioner such as building air conditioner is widely used. Usually, a building air conditioner comprises an outdoor unit installed at one position, and indoor units installed in a plurality of rooms. The outdoor unit and indoor units are connected through a refrigerant piping. Therefore, the refrigerant piping is extended to every room, and connected to every corner of the building.

[0004] In the light of the global environmental problem, lately, it is being demanded to change the refrigerant used in the refrigerating apparatus from the HCFC refrigerant such as R22 to a substitute refrigerant such as hydrofluorocarbon (HFC) refrigerant. Henceforth, in the building air conditioner, it is required to use the substitute refrigerant.

[0005] In the HFC refrigerant, as the refrigerating machine oil, ester oil, ether oil, or other synthetic oil is used. The ester oil or ether oil is inferior in stability to the conventional mineral oil used in the HCFC refrigerant. It is hence likely to form foreign precipitates such as sludge solid matter called contamination. It therefore requires stricter moisture control or contamination control than in the prior art.

[0006] Moreover, the refrigerant piping of a building air conditioner must be connected to every room, and its installation takes much time and cost. Therefore, when changing from the HCFC to the substitute refrigerant, it is preferred to use the existing piping. If the existing piping can be used, the installation cost is saved and the installation time is shortened, as compared with a completely new installation of building air conditioner.

[0007] However, using the existing refrigerating apparatus, when the refrigerant in the refrigerant circuit is changed from the HCFC refrigerant to the HFC refrigerant, the following problems occur. Firstly, since the refrigerant piping of the building air conditioner extends a long distance, strict moisture control and contamination control must be effect in a large scale, and its management is very difficult. Secondly, the existing piping must

be cleaned thoroughly, and this cleaning takes enormous time and cost. That is, in the refrigerant piping, lubricating oil and other refrigerating machine oil of the compressor in the refrigerating apparatus may be adhered in a heavily deteriorated state. Accordingly, when replacing the refrigerant in the refrigerant circuit with a different refrigerant, it is most important to remove the existing refrigerating machine oil.

[0008] As mentioned above, in the refrigerating apparatus using the conventional HCFC refrigerant, mineral oil is used as the refrigerating machine oil. On the other hand, in the refrigerating apparatus using the HFC refrigerant, ester oil, ether oil or other synthetic oil is used as the refrigerating machine oil. The stability of the ester oil or ether oil is inferior to the stability of the mineral oil. Accordingly, if the ester oil or ether oil is mixed with the mineral oil, contamination precipitates. If the mineral oil is left over in the refrigerant piping, therefore, when using the HFC refrigerant, contamination is formed in the refrigerant circuit, and this contamination exerts adverse effects on the operation of the refrigerating apparatus. When changing from the HCFC refrigerant to the HFC refrigerant, it is hence required to remove the remaining refrigerating machine oil completely from the refrigerant piping. It, however, takes much time and cost to remove and clean the mineral oil in the refrigerant piping.

[0009] It is hence an object of the invention to present a piping cleaning method of air conditioner capable of obtaining a long-term reliability, if the existing piping is used, when installing a new air conditioner by dismantling the existing air conditioner.

Summary of the Invention

[0010] A piping cleaning method of air conditioner of the invention for removing foreign matter existing inside the piping installed between the indoor units and outdoor unit comprises:

- (a) a step of inserting a compound from an opening of the piping,
- (b) a step of leading compressed gas from the opening into the piping, and conveying the compound through the piping while keeping the compound in contact with the inner wall of the piping, and
- (c) a step of removing the foreign matter existing in the piping, together with the compound, from the piping.

[0011] Preferably, the piping cleaning method of air conditioner further comprises a step of repeating the step (a), step (b), and step (c) a plurality of times.

[0012] Preferably, the compound has a plurality of compounds, and the foreign matter in the piping is removed by the use of the plurality of compounds.

[0013] A compound used for cleaning the inside of the piping installed between the outdoor unit and indoor

units of the invention comprises an outer circumference nearly coinciding with the outer circumference of the section of the inner wall of the piping, and a front surface nearly coinciding with the sectional shape of the piping. The compound passes through the piping while contacting with the inner wall of the piping, so that the foreign matter in the piping is removed.

[0014] A cleaning apparatus of the invention for cleaning the inside of the piping installed between the outdoor unit and indoor units of the air conditioner comprises:

- a compound inserted into the piping from one open end of the piping and discharged from other open end, and
- a compressed gas generator for generating a compressed gas for pressing the compound in the piping,
- in which the compound is conveyed in the piping, contacting with the inner wall of the piping, while being pushed by the compressed gas, and
- the compound is discharged from the piping together with the foreign matter existing in the piping.

[0015] In this constitution, when changing from the air conditioner having the existing piping to a new air conditioner, the existing piping can be used as it is. By this method, the air conditioner having an excellent reliability for a long period can be installed.

Brief Description of the Drawings

[0016] Fig. 1 is a schematic diagram showing an example of installation work of air conditioner of in-residence buried piping system in a field of application of the invention.

[0017] Fig. 2 is a schematic block diagram of copper piping cleaning method in an embodiment of the invention.

[0018] Fig. 3 is a drawing of a cleaning compound conveyed in copper piping in embodiments 4, 5 of the invention.

[0019] Fig. 4 is a drawing of a cleaning compound conveyed in copper piping in embodiment 6 of the invention.

[0020] Fig. 5 is a drawing of a cleaning compound conveyed in copper piping in embodiment 7 of the invention.

[0021] Fig. 6 is a drawing of a cleaning compound conveyed in copper piping in embodiment 8 of the invention.

[0022] Fig. 7 is a drawing of a cleaning compound conveyed in copper piping in embodiments 9 to 11 of the invention.

[0023] Fig. 8 is a drawing of a cleaning compound conveyed in copper piping in embodiments 12 to 15, and 32 of the invention.

[0024] Fig. 9 is a characteristic diagram showing the relation of temperature and viscosity of mineral oil.

[0025] Fig. 10 is a drawing of a cleaning compound conveyed in copper piping in embodiment 22 of the invention.

[0026] Fig. 11 is a drawing of a cleaning compound conveyed in copper piping in embodiment 23 of the invention.

[0027] Fig. 12 is a drawing of a cleaning compound conveyed in copper piping in embodiment 24 of the invention.

[0028] Fig. 13 is a drawing of a cleaning compound conveyed in copper piping in embodiments 25 to 27, 31, and 33 of the invention.

[0029] Fig. 14 is a drawing of a cleaning hydrophilic compound conveyed in copper piping in embodiment 27 of the invention.

[0030] Fig. 15 is a characteristic diagram showing the relation of temperature and viscosity of HAB oil used in the invention.

[0031] Fig. 16 is a sectional structural view of split type ultrafine fiber used in an embodiment of the invention.

[0032] Fig. 17 is a sectional structural view of peeling type ultrafine fiber used in an embodiment of the invention.

[0033] Fig. 18 is a structural diagram of a cleaning compound conveyed in piping in embodiment 35 of the invention.

[0034] Fig. 19 is a structural diagram of a cleaning compound conveyed in piping in embodiment 36 of the invention.

[0035] Fig. 20 is a structural diagram of a cleaning compound conveyed in piping in embodiment 37 of the invention.

[0036] Fig. 21 is a structural diagram of a cleaning compound conveyed in piping in embodiment 38 of the invention.

[0037] Fig. 22 is a structural diagram of a cleaning compound conveyed in piping in embodiment 39 of the invention.

[0038] Fig. 23 is a characteristic diagram showing the relation between temperature and viscosity of hard alkyl benzene oil used in the invention.

[0039] Fig. 24 is a structural diagram of a cleaning compound conveyed in piping in embodiment 40 of the invention.

[0040] Fig. 25 is a structural diagram showing a piping cleaning method in embodiment 41 of the invention.

[0041] Fig. 26 (a) is a graph showing oil viscosity and temperature changes, and Fig. 26 (b) is a graph showing a pressurizing method in piping.

[0042] Fig. 27 (a) is a sectional structural diagram showing compound and inserting jig used in embodiment 42 of the invention, and Fig. 27 (b) is a perspective view of the inserting jig.

[0043] Fig. 28 (a) is a sectional structural diagram showing compound and inserting jig used in embodiment 43 of the invention, and Fig. 28 (b) is a perspective view thereof.

[0044] Fig. 29 (a) is a sectional structural diagram showing compound and inserting jig used in embodiment 44 of the invention, and Fig. 29 (b) is a perspective view thereof.

[0045] Fig. 30(a) is a sectional structural diagram showing compound and inserting jig used in embodiment 45 of the invention, and Fig. 30(b) is a perspective view thereof.

Reference Numerals

[0046]

- 1 Outdoor unit
- 2 Indoor unit A
- 3 Indoor unit B
- 4 Indoor unit C
- 5 Branch unit
- 6 Copper pipe
- 7 PP resin
- 8 Nitrogen cylinder
- 9 Pressure-proof hose
- 10 Regulator valve
- 11 Gauge
- 12 Thread ABS resin
- 13 ABS resin
- 14 O-ring
- 15 Soft vinyl chloride cap
- 16 NBR bellows cap
- 17 ABS resin
- 18 Nylon hair fiber
- 19 ABS resin
- 20 PP long filament nonwoven cloth
- 21 PP film
- 22 HAB oil
- 23 PP long filament nonwoven cloth
- 24 PP film
- 25 HAB oil
- 26 Polyester ultrafine fiber
- 27 PP film
- 28 HAB oil
- 29 PP long filament molded element
- 30 Polyester ultrafine fiber
- 31 Polyacrylic acid partially neutralized crosslinked molded element
- 32 Polyester ultrafine fiber

Detailed Description of the Invention

[0047] A first piping cleaning method of air conditioner of the invention is characterized by removing foreign matter existing inside by conveying a compound from a piping opening by a compressed gas, in a piping connecting between indoor units and outdoor unit of air conditioner.

[0048] A second piping cleaning method of air conditioner of the invention is characterized by removing foreign matter existing inside by conveying a compound

from a piping opening by a compressed gas a plurality of times, in a piping connecting between indoor units and outdoor unit of air conditioner.

[0049] A third piping cleaning method of air conditioner of the invention is characterized by removing foreign matter existing inside by conveying two or more compounds from a piping opening by a compressed gas, in a piping connecting between indoor units and outdoor unit of air conditioner.

[0050] Preferably, in the third piping cleaning method of air conditioner, at least one of the two or more compounds is an lipophilic (or oleophilic) compound, and at least one is a hydrophilic compound.

[0051] Preferably, in any one of the piping cleaning methods of air conditioner, after operating the air conditioner for a specific time in heating mode, the compound is conveyed from the piping opening by the compressed gas.

[0052] Preferably, in any one of the piping cleaning methods of air conditioner, the compound is nearly in a form of circular cylinder, having flexibility and elasticity for retaining the degree of freedom of shape in the piping.

[0053] Preferably, in any one of the piping cleaning methods of air conditioner, a groove is processed on the side surface of the compound.

[0054] Preferably, the groove processing is threading, spiral groove processing, or parallel groove processing.

[0055] Preferably, in any one of the piping cleaning methods of air conditioner, the shape of the compound is concave in the conveying direction.

[0056] Preferably, in any one of the piping cleaning methods of air conditioner, the compound is nearly in a form of circular cylinder, and the outside diameter of the compound is larger than the inside diameter of the piping.

[0057] Preferably, in any one of the piping cleaning methods of air conditioner, an O-ring elastomer is disposed at the side surface of the compound.

[0058] Preferably, in any one of the piping cleaning methods of air conditioner, flocky processing is applied at the side surface of the compound.

[0059] Preferably, in any one of the piping cleaning methods of air conditioner, the side surface of the compound is covered with a nonwoven cloth.

[0060] Preferably, in any one of the piping cleaning methods of air conditioner, at least the side surface of the compound has lipophilic (oleophilic) property.

[0061] Preferably, the bulk density of the compound is in a range of 0.1 to 0.6 g/ml.

[0062] Preferably, in any one of the piping cleaning methods of air conditioner, the compound is an elastomer, of which hardness is 60 or less in spring type A.

[0063] Preferably, in any one of the piping cleaning methods of air conditioner, the compound is an elastomer, and more specifically a foamed molded element with a bulk density of 0.1 to 0.6 g/ml.

[0064] Preferably, in any one of the piping cleaning

methods of air conditioner, the side surface of the compound is composed of a plastic film material or elastomer film material, containing liquid in its inside.

[0065] Preferably, the side surface of the compound is composed of a plastic film material or elastomer film material covered with a nonwoven cloth.

[0066] Preferably, the side surface of the compound is composed of a plastic film material or elastomer film material covered with a woven cloth of ultrafine fibers.

[0067] Preferably, in any one of the piping cleaning methods of air conditioner, the compound is filled with oleophilic fibers at a bulk density of 0.1 to 0.6 g/ml.

[0068] Preferably, in any one of the piping cleaning methods of air conditioner, the compound is a lipophilic (oleophilic) material with a bulk density of 0.05 to 0.6 g/ml, and oil is contained in the compound when conveying the compound from the piping opening by a compressed gas. In this constitution, more preferably, the oil is hard alkyl benzene. Further preferably, the oil should be properly selected so as to have a dynamic viscosity of 9.0 to 74.8 mm²/s at 40°C, and a low viscosity at low temperature and a high viscosity at high temperature depending on the environmental conditions.

[0069] Preferably, in the third piping cleaning method of air conditioner, at least one of the two or more compounds is a lipophilic (oleophilic) compound, and at least one is a hydrophilic compound, the compound includes at least one of the following features:

- (i) at least the side surface of the lipophilic compound has lipophilic property;
- (ii) the bulk density of the compound is 0.1 to 0.6 g/ml; or
- (iii) the compound is filled with lipophilic (oleophilic) fibers at a bulk density of 0.1 to 0.6 g/ml.

[0070] Preferably, in the third piping cleaning method of air conditioner, at least one of the two or more compounds is a lipophilic (oleophilic) compound, and at least one is a hydrophilic compound, and the bulk density of the hydrophilic compound is 0.1 to 0.6 g/ml. In this constitution, more preferably, the hydrophilic compound is a woven cloth of ultrafine fibers at the side surface, in the existing piping cleaning method of air conditioner.

[0071] Preferably, the ultrafine fibers are 0.3 denier or less. Preferably, the ultrafine fibers are of split type or of peeling type.

[0072] Preferably, in any one of the piping cleaning methods of air conditioner, the conveying pressure of the compressed gas is 0.5 to 5 kgf/cm².

[0073] Preferably, in any one of the piping cleaning methods of air conditioner, the compressed gas is a dry gas of which dew point is -30°C or less.

[0074] Preferably, in any one of the piping cleaning methods of air conditioner, the compressed gas is air or nitrogen.

[0075] The "lipophilic" and "oleophilic" are the same meaning each other.

[0076] Embodiments of the invention are described below.

[0077] A piping cleaning method of air conditioner in a first embodiment of the invention comprises a step of conveying a compound from a piping opening by a compressed gas. In this constitution, the remaining oil sticking to the piping inner wall is discharged out of the piping by the excluding volume effect caused when the compound is conveyed by the compressed gas. Therefore, when the existing piping is used continuously as the piping for the new air conditioner, the reliability is obtained for a long period.

[0078] A piping cleaning method of air conditioner in a second embodiment of the invention comprises a step of repeating a plurality of times a step of conveying a compound from a piping opening by a compressed gas. In this constitution, by repeating a plurality of times the step of discharging out of the piping by the excluding volume effect of compound, the remaining oil sticking to the piping inner wall is further cleaned. Therefore, when the existing piping is used continuously as the piping for the new air conditioner, a secure reliability is obtained for a long period.

[0079] A piping cleaning method of air conditioner in third and fourth embodiments of the invention comprises a step of conveying two or more compounds from a piping opening by a compressed gas. In this constitution, by conveying two or more compounds having mutually contradictory properties such as oleophilic and hydrophilic characteristics, not only the oily matter but also the moisture left over in the piping can be excluded sufficiently. As a result, when the existing piping is used continuously as the piping for the new air conditioner, a more secure reliability is obtained for a long period.

[0080] A piping cleaning method of air conditioner in a fifth embodiment of the invention comprises a step of cleaning the piping after operating for a specific time in heating mode. In this constitution, even in winter when the viscosity of the remaining oil is very high, by heating operation, the copper piping can be warmed sufficiently. As a result, the oil removing effect is enhanced.

[0081] A piping cleaning method of air conditioner in a sixth embodiment of the invention is characterized by the compound which is nearly in a form of circular cylinder and has a high degree of freedom. In this constitution, since the compound being conveyed is flexible and elastic, if the piping has bent parts, it can be cleaned sufficiently, and if the compound to be conveyed is relatively long, clogging in the midst of conveying can be prevented. As a result, the oil removing effect is enhanced.

[0082] A piping cleaning method of air conditioner in seventh and eighth embodiments of the invention comprises a step of processing a groove on the side surface of the compound. In this constitution, by threading, spiral groove processing, or parallel groove processing on the side surface of the resin, when the resin is conveyed, the threads are advanced while colliding against the in-

ner wall of the copper piping. As a result, the deposit scraping effect is great. Besides, since the threads advance while colliding against the inner wall by point contact, the frictional resistance is small.

[0083] A piping cleaning method of air conditioner in a ninth embodiment of the invention is characterized by the shape of the compound which is concave in the conveying direction. In this constitution, since the compound to be conveyed has a concave shape, the deposit excluded from the copper piping inner wall can be discharged outside while depositing in the concave shape. The compound is made of a soft material, and its concave shape is a slightly trapezoidal shape or bellows shape in the advancing direction of the concave shape. Therefore, the sliding portion of the compound and the copper piping is reduced in area.

[0084] A piping cleaning method of air conditioner in a tenth embodiment of the invention is characterized by the compound of which outside diameter is larger than the inside diameter of the piping. In this constitution, since the compound advances while rubbing against the copper pipe inner wall, the deposit scraping effect is enhanced.

[0085] A piping cleaning method of air conditioner in an eleventh embodiment of the invention is characterized by that an O-ring elastomer is disposed at the side surface of the compound. In this constitution, by disposing the elastic O-ring at the outer side of the resin, undulations are formed on the outer side of the compound to be conveyed. As a result, the sliding resistance occurring when the resin is conveyed is reduced. Moreover, by decreasing the hardness of the O-ring, the maximum diameter of the compound to be conveyed can be set slightly larger than the inside of the copper piping. Therefore, when the resin is conveyed, the O-ring advances while rubbing against the copper piping inner wall, so that the deposit scraping effect is enhanced.

[0086] A piping cleaning method of air conditioner in a twelfth embodiment of the invention is characterized by that the compound has a side surface treated by flocky processing. Preferably, the outside diameter of the molded element treated by flocky processing has a larger outside diameter than the copper piping. Therefore, the flocky portion advances while rubbing against the copper piping inner wall, so that the deposit scraping effect is enhanced.

[0087] A piping cleaning method of air conditioner in a thirteenth embodiment of the invention is characterized by that the side surface of the compound is covered with a nonwoven cloth. The nonwoven cloth is, for example, an oleophilic material such as polypropylene (PP) nonwoven cloth, or an oleophilic processed material such as polyester nonwoven fabric. In this constitution, the oil retaining power of the compound is increased, and the residual oil removing effect is enhanced.

[0088] A piping cleaning method of air conditioner in a fourteenth embodiment of the invention is character-

ized by that at least the side surface of the compound has lipophilic property or oleophilic property. In this constitution, since the side surface of the compound or the compound itself is oleophilic, the sliding resistance is reduced when the compound is conveyed in the copper piping. Moreover, since the compound itself is oleophilic, the compound sufficiently absorbs the residual oil. The compound itself is swollen, and the scraping effect of the deposit in the copper piping is secure and enhanced.

[0089] A piping cleaning method of air conditioner in a fifteenth embodiment of the invention is characterized by that the bulk density of the compound is in a range of 0.1 to 0.6 g/ml. In this constitution, the molded element of lipophilic (or oleophilic) polypropylene long filament adsorbs mineral oil, and the molded element is gradually swollen, and the density of the molded element increases. In this state, when the molded element is conveyed by compressed nitrogen, the amount of nitrogen slipping the conveyed molded element is decreased. As a result, the effect of removing the residual oil in the copper piping is extremely enhanced.

[0090] A piping cleaning method of air conditioner in a sixteenth embodiment of the invention is characterized by that the compound is an elastomer, of which hardness is 60 or less in spring type A. In this constitution, the flexible and elastic rubber can be lowered in hardness so as to be applicable in the bent parts of the piping. Thus, the feature of the elastomer can be sufficiently utilized. Besides, since the rubber is flexible and elastic, if the compound to be conveyed is somewhat extended in length, clogging of the compound in the midst of conveying can be prevented. As a result, the oil excluding rate is enhanced.

[0091] A piping cleaning method of air conditioner in a seventeenth embodiment of the invention is characterized by that the compound is an elastomer, and more specifically a foamed molded element with a bulk density of 0.1 to 0.6 g/ml. In this constitution, since the elastomer has a foamed molded element, the flexibility and elasticity are further enhanced. Hence, even in the extended length state of the compound to be conveyed, clogging of the compound in the midst of conveying can be prevented. As a result, the oil excluding rate is enhanced.

[0092] A piping cleaning method of air conditioner in an eighteenth embodiment of the invention is characterized by that the side surface of the compound is composed of a plastic film material or elastomer film material, containing liquid in its inside. In this constitution, by conveying the compound retaining elasticity by containing liquid inside, the compound having an extremely excellent flexibility and elasticity is obtained. As a result, if the compound to be conveyed is considerably long, clogging of the compound in the copper piping is prevented.

[0093] A piping cleaning method of air conditioner in a nineteenth embodiment of the invention is character-

ized by that the side surface of the compound is composed of a plastic film material or elastomer film material covered with a nonwoven cloth. In this constitution, by adhering the nonwoven cloth to the plastic film, the effect of scraping the deposit in the copper piping is enhanced. Moreover, since it has a sufficient flexibility and elasticity, if the compound to be conveyed is considerably long, clogging of the compound in the copper piping is prevented.

[0094] A piping cleaning method of air conditioner in a twentieth embodiment of the invention is characterized by that the side surface of the compound is composed of a plastic film material or elastomer film material covered with a woven cloth of ultrafine fibers. In this constitution, by using the compound formed by adhering ultrafine fibers to the plastic film, the wiping effect of the deposit in the piping inner wall is enhanced. In particular, when the compound scrapes copper powder or iron powder, the scraped copper powder or iron powder is discharged outside of the piping without dropping out.

[0095] A piping cleaning method of air conditioner in a twenty-first embodiment of the invention is characterized by that the compound is filled with lipophilic (oleophilic) fibers at a bulk density of 0.1 to 0.6 g/ml. In this constitution, the wiping effect of the deposit in the copper piping inner wall is enhanced. In particular, when copper powder or iron powder is scraped, the scraped copper powder or iron powder is discharged outside of the piping without dropping out. Moreover, the lipophilic (oleophilic) PP fiber molded element adsorbs mineral oil, and is gradually swollen, and the density of the molded element increases. In this state, the molded element as the compound is conveyed by compressed nitrogen. Hence, the effect of eliminating the residual oil in the copper piping is extremely enhanced.

[0096] A piping cleaning method of air conditioner in a twenty-second embodiment of the invention further comprises a step of containing oil in the compound before cleaning. When the lipophilic (oleophilic) PP long filament molded element adsorbs mineral oil, if the remaining oil is less, the effect of removing copper powder or iron powder is small. However, in order not to have effects on the reliability if left over as contamination oil, the compound is conveyed in the piping in a state of containing oil, and therefore if the remaining oil is less, the remaining oil, copper powder and iron powder are sufficiently eliminated.

[0097] A piping cleaning method of air conditioner in a twenty-fourth embodiment of the invention is characterized by that the bulk density of the hydrophilic compound is in a range of 0.1 g/ml to 0.6 g/ml. The hydrophilic compound with bulk density of 0.1 to 0.6 g/ml has a sufficient flexibility, and by adsorbing water, it is gradually swollen, and the density of the molded element increases. In this state, the compound is conveyed by compressed nitrogen. Hence, the effect of removing the residual moisture in the copper piping is extremely enhanced.

[0098] A piping cleaning method of air conditioner in a twenty-fifth embodiment of the invention is characterized by that the side surface of the hydrophilic compound is has a woven cloth of ultrafine fibers. In this constitution, since the side surface of the compound is covered with ultrafine fibers, the deposit wiping effect of the copper piping inner wall is enhanced. In particular, when copper powder or iron powder is scraped, the scraped copper powder or iron powder is discharged outside of the piping without dropping out. Moreover, since the compound is hydrophilic, by adsorbing moisture, the compound is gradually swollen, and the density of the molded element increases. In this state, the compound is conveyed by compressed nitrogen. Hence, the effect of removing the residual oil in the copper piping is extremely enhanced.

[0099] A piping cleaning method of air conditioner in a twenty-sixth embodiment of the invention is characterized by that the oil contains hard alkyl benzene (HAB oil). In this constitution, the hard alkyl benzene is replaced with the oil deteriorated oil remaining in the piping. Accordingly, if fresh hard alkyl benzene oil is left over in the piping, it has little effect on the reliability of the air conditioner.

[0100] A piping cleaning method of air conditioner in a twenty-seventh embodiment of the invention is characterized by that the oil to be used includes various types of oil depending on the environmental conditions of the installation work. That is, oil of low viscosity is used when the environment is low in temperature, and oil of high viscosity is used when the temperature is high. In this constitution, since the had alkyl benzene oil contained in the compound to be conveyed is selected adequately depending on the environmental condition of the installation work, the effect of eliminating the deteriorated oil left over in the piping is enhanced.

[0101] A piping cleaning method of air conditioner in a twenty-eighth embodiment of the invention is characterized by that the ultrafine fibers are 0.3 denier or smaller in diameter. In this constitution, the cleanliness in the piping is further enhanced after wiping off copper powder and iron powder

[0102] A piping cleaning method of air conditioner in a twenty-ninth embodiment of the invention is characterized by that the ultrafine fibers have either the split type spinning shape or of peeling type spinning shape. Thus, by spinning the ultrafine fibers in split type or peeling type, the ultrafine fibers have a triangular or flat section with a sharp edge. Accordingly, once scraped off, the contamination is entrapped in the entangled fibers. As a result, the scraped contamination is hardly desorbed again, and the cleanliness of the piping is further improved.

[0103] A piping cleaning method of air conditioner in a thirtieth embodiment of the invention is characterized by that the conveying pressure of the compressed gas is 0.5 to 5 kgf/cm². By thus optimizing the conveying pressure of the compressed gas, useless slip on the

compound to be conveyed is prevented, and lowering of deposit scraping or wiping effect is avoided. As a result, the residual oil in the piping can be securely removed.

[0104] A piping cleaning method of air conditioner in a thirty-first embodiment of the invention is characterized by that the compressed gas is a dry gas of which dew point is -30°C or less. By passing the compressed gas through a hollow filter of polyimide or the like, dry gas with dew point of -40°C or less is obtained. By controlling the moisture content in the gas to be supplied, the moisture left over at the time of completion of piping cleaning work can be lowered. By feeding dry gas, the moisture existing inside is discharged while accompanying the conveyed gas.

[0105] A piping cleaning method of air conditioner in a thirty-second embodiment of the invention is characterized by that the compressed gas is air or nitrogen. In this constitution, the compressed air can be obtained easily, and the working efficiency of installation is further enhanced.

Exemplary Embodiments

[0106] Referring now to the drawings, exemplary embodiments of the invention are described in detail below.

[0107] Fig. 1 is a schematic diagram showing an installation work of air conditioner of in-residence buried system in an exemplary embodiment of the invention. In the case of a single dwelling as shown in Fig. 1, the air conditioner comprises one outdoor unit 1, a branch unit 5, and three indoor units A2, B3, C4. At this time, the copper piping is buried in the dwelling wall and installed in zigzag state in consideration of the appearance of the dwelling. When the indoor units are remote from the outdoor unit, the copper piping may extend a distance of as long as 30 m. In such a case, when burying the copper piping newly, it takes enormous time and cost. Fig. 2 is a schematic block diagram of copper piping cleaning method in an embodiment of the invention. By the method shown in Fig. 2, the oil remaining in the existing piping is removed as much as possible, and the outdoor unit and indoor units are newly installed, while the existing piping is used. One piping is explained. In Fig. 2, first, a compound 7 to be conveyed is inserted into one copper piping 6. At this time, depending on the type of the compound 7, the compound 7 is pushed into the copper piping 6 by force. The flared copper piping is connected to a pressure-proof hose 9 linked to a nitrogen cylinder 8 through a nipple (not shown). With a regulator valve 10 disposed in the nitrogen cylinder 8 in closed state, the primary pressure is released. While observing a gauge 11, the regulator valve 10 is opened gradually. As a result, nitrogen gas is sent into the copper piping under pressure. By this nitrogen gas, the compound 7 is moved while eliminating oil and other foreign matter remaining inside, and is discharged from other exit. At this time, the oil and foreign matter remain-

ing inside are discharged simultaneously with the compound 7. The nitrogen cylinder 8, pressure-proof hose 9, regulator valve 10, and gauge 11 compose a compressed gas generator.

[0108] This is a system of inserting the compound in the copper piping, and conveying the compound by compressed gas. The compound used in this system has various forms as explained in the following specific embodiments.

[0109] In this case, the conventional air conditioner using the R22 refrigerant of HCFC is replaced with a new air conditioner using the R410A refrigerant of HFC. In other case, the air conditioner using the R410A refrigerant of HFC is replaced with other air conditioner using the same R410A refrigerant. On the other hand, the air conditioner using the R410A refrigerant contains refrigerating machine oil of ester oil or refrigerating machine oil of ether oil. In the exemplary embodiment, the piping cleaning method when changing from the R22 refrigerant to the R410A refrigerant is explained.

Exemplary Embodiment 1

[0110] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0111] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, a polypropylene molded element of 7.82 mm in outside diameter and 7.0 mm in length with end face curvature of R2 was prepared. This compound was inserted into the copper piping in the atmosphere of 25°C . A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm^2 , the compound (polypropylene molded element) was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 60% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 2

[0112] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0113] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, a polypropylene molded element of 7.82 mm in outside diameter and 7.0 mm in

length with end face curvature of R2 was prepared. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve.

[0114] At a pressure of about 4 kgf/cm², the compound (polypropylene molded element) was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 50% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 3

[0115] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0116] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, a polypropylene molded element of 7.82 mm in outside diameter and 7.0 mm in length with end face curvature of R2 was prepared. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve.

[0117] At a pressure of about 4 kgf/cm², the compound (polypropylene molded element) was conveyed in the piping. Successively, the oil sticking to the polypropylene molded element was wiped by a cloth. Then the wiped polypropylene molded element was conveyed again in the piping in the same manner as above. As a result, about 70% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 4

[0118] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0119] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, an acrylonitrile-butadiene-styrene (ABS) resin molded element as shown in Fig. 3 was prepared. The ABS resin molded element 12 has a groove 12a. That is, the ABS resin molded element 12 has an outside diameter of 7.82 mm, a length of 7.0 mm, and a thread pitch of 1 mm. This compound was inserted into the copper piping in the atmosphere

of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve.

[0120] At a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 70% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 5

[0121] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0122] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, an acrylonitrile-butadiene-styrene (ABS) resin molded element as shown in Fig. 3 was prepared. The ABS resin molded element 12 has an outside diameter of 7.82 mm, a length of 7.0 mm, and a thread pitch of 1 mm. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve.

[0123] At a pressure of about 2 kgf/cm², the compound (ABS resin molded element) was conveyed in the piping. Successively, the oil sticking to the ABS molded element was wiped by a cloth. Then the wiped ABS molded element was conveyed again in the piping in the same manner as above. As a result, about 85% of the remaining mineral oil in the piping was removed.

[0124] In exemplary embodiments 4 and 5, threads are formed on the side surface of the compound. In this constitution, when the compound is conveyed in the piping, the threads advance while colliding against the inner wall of the copper piping. As a result, the deposit scraping effect of the compound in the piping is improved. Moreover, the compound advances while colliding against the inner wall of the piping in point contact. Hence, the friction resistance of piping is decreased.

[0125] In the exemplary embodiments, threads are formed in the compound, but not limited to this constitution, the side surface of the compound may also have spiral groove or parallel groove. In such constitution, too, the same effects as above were obtained.

Exemplary Embodiment 6

[0126] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings

can be cleaned in the same method as this cleaning method of one piping.

[0127] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, an acrylonitrile-butadiene-styrene (ABS) resin molded element 13 and an O-ring elastomer 14 installed on the outer circumference of the ABS molded element as shown in Fig. 4 were prepared. The ABS resin molded element 13 has an outside diameter of 6.0 mm and a length of 7.0 mm, and a groove is formed in the outer circumference of the ABS resin molded element 13. The O-ring elastomer 14 is put in this groove. The O-ring elastomer 14 is made of chloroprene rubber (CR), and the wire diameter of the O-ring is about 1.5 mm, and the hardness is 30 in spring type A. Two O-rings are placed as the O-ring 14 placed on the outer circumference of the ABS resin molded element 13. The O-ring 14 is elastic. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve.

[0128] At a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 80% of the remaining mineral oil in the piping was removed.

[0129] In this exemplary embodiment, by disposing the elastic O-rings 14 on the outer circumference of the molded element 13, undulations are shaped on the outer surface of the compound (to be conveyed). As a result, the sliding resistance when the compound is conveyed can be decreased. Moreover, by lowering the hardness of the O-ring, the maximum diameter of the compound (to be conveyed) may be set slightly larger than the inside diameter of the copper piping. Accordingly, when the compound is conveyed in the piping, the O-ring 14 advances while rubbing against the inner wall of the copper piping. As a result, the deposit scraping effect of the compound in the piping is enhanced.

[0130] The number of O-rings 14 placed on the outer circumference of the ABS resin molded element 13 is not particularly limited, but, for example, one O-ring, or a plurality of O-rings such as three or four may be used. As the O-ring 14, the chloroprene rubber is used, but other elastic material may be also used. Usable elastic materials include, for example, butadiene-acrylonitrile copolymer (NBR), ethylene-propylene copolymer (EPDM), isobutene-isoprene copolymer (IIR), and silicone rubber.

Exemplary Embodiment 7

[0131] In this exemplary embodiment, a cleaning

method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0132] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, a soft vinyl chloride resin molded element 15 as shown in Fig. 5 was prepared. The resin molded element 15 has a cap shape with a recess 15a, having a bottom surface of 7.50 mm in diameter, a top surface of 7.92 mm in diameter × 15 mm, and a thickness of 1.5 mm. This compound was inserted into the copper piping in the atmosphere of 25°C. In this case, the compound was inserted into the piping so that the opening side of the recess 15a may be at the insertion leading end, that is, the opening side of the recess may be in the advancing direction. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve.

[0133] At a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 90% of the remaining mineral oil in the piping was removed.

[0134] In this exemplary embodiment, the resin molded element 15 as the compound has a slightly trapezoidal shape in the advancing direction. Therefore, while the opening periphery of the recess 15a is sliding on the inner wall of the piping, the compound moves in the piping. The cap-shaped soft vinyl chloride resin molded element 15 has an elastic property. Accordingly, the sliding portion of the compound and the piping is decreased. Since the recess of the molded element 15 is inserted in the conveying direction the deposit removed from the inner wall of the piping is discharged outside while depositing in the recess.

[0135] As such cap-shaped molded element 15, for example, CR, EPDM rubber, or styrene elastomer may be also used.

Exemplary Embodiment 8

[0136] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0137] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, an acrylonitrile-butadiene-rubber (NBR) molded element 16 as shown in Fig. 6 was prepared. The molded element 16 has a bellows type cap shape with inside diameter of 4.92 mm, length of 15 mm, and thickness of 1.5 mm. The hardness of the NBR is 50 in spring type A. This compound was in-

serted into the copper piping in the atmosphere of 25°C. In this case, the compound was inserted into the piping so that the bellows opening side may be at the insertion leading end, that is, the bellows opening side may be in the advancing direction. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve.

[0138] At a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 90% of the remaining mineral oil in the piping was removed.

[0139] In this exemplary embodiment, since the side surface of the compound is in the bellows profile, the sliding portion area of the compound and piping is small, and the sliding resistance is small. Hence, the compound moves smoothly in the piping. As a result, the working efficiency is enhanced.

[0140] As such bellows type molded element 16, for example, CR, EPDM rubber, or styrene elastomer may be also used.

Exemplary Embodiment 9

[0141] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0142] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. The compound has a flocky shape as shown in Fig. 7. That is, the compound has a molded element 17, and hair fibers 18 disposed around the molded element 17. The molded element 17 is made of acrylonitrile-butadiene-styrene (ABS) resin, and has a columnar shape of 6.5 mm in diameter and 7 mm in length. The hair fibers 18 are made of polyamide (trade-name: Nylon), and have flocky portions of 1.0 mm in height. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve.

[0143] At a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the hair fibers 18 of the compound, and is discharged from other exit of the piping. As a result, about 90% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 10

[0144] The compound comprising the ABS molded element 17 and hair fibers 18, the piping and mineral oil same as in exemplary embodiment 9 were used. At a pressure of about 4 kgf/cm², the compound was conveyed in the piping. The other cleaning conditions are same as in exemplary embodiment 9. As a result, about 85% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 11

[0145] The compound comprising the ABS molded element 17 and hair fibers 18, the piping and mineral oil same as in exemplary embodiment 9 were used. This compound was inserted into the copper piping in the atmosphere of 5°C. At a pressure of about 4 kgf/cm², the compound was conveyed in the piping. The other cleaning conditions are same as in exemplary embodiment 9. As a result, about 80% of the remaining mineral oil in the piping was removed.

[0146] In exemplary embodiments 9, 10, and 11, the flocky compound of hair fibers 18 is directly used as the side surface of the molded element 17, but not limited to this, a tape having flocky hair fibers may be adhered to the side surface of the molded element 17. The outside diameter of the molded element 17 must be smaller than the inside diameter of the piping, but the outside diameter of the compound having the hair fibers 18 is preferred to be larger than the inside diameter of the piping. In this constitution, the hair fibers 18 advance while rubbing against the inner wall of the piping, and the deposit scraping effect of the compound in the piping is enhanced.

[0147] In these exemplary embodiments, polyamide hair fibers 18 are used, but not limited to this example, hair fibers 18 may be also made of polypropylene fibers, polyester fibers, acrylic fibers, cotton fibers, wool fibers, and others. Preferably, the hair fibers 18 are lipophilic (oleophilic). The lipophilic (oleophilic) hair fibers 18 are improved in the effect of removing the oil in the piping. Polypropylene hair fibers are most oleophilic. Preferably, hair fibers are made of polypropylene, and excellent effects are expected.

[0148] More preferably, the surface of the hair fibers 18 is processed by hard alkyl benzene (HAB) having a high viscosity. If the hair fibers 18 are not oleophilic, the hair fibers 18 are provided with oleophilic property by HAB surface treatment. As a result, the effect of removing the oil in the piping is further enhanced.

Exemplary Embodiment 12

[0149] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0150] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. The compound has a nonwoven cloth 20 as shown in Fig. 8. That is, the compound has a molded element 19, and the nonwoven cloth 20 disposed around the molded element 19. The molded element 19 is made of acrylonitrile-butadiene-styrene (ABS) resin, and has a columnar shape of 5.0 mm in diameter and 8 mm in length. The nonwoven cloth 20 is made of long filaments of polypropylene, and is wound around the molded element 19 in a thickness of 2.0 mm. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve.

[0151] At a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the nonwoven cloth 20 of the compound, and is discharged from other exit of the piping. In about 90 seconds after inserting the compound, the mineral oil was discharged from the piping. As a result, about 91% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 13

[0152] The compound comprising the ABS molded element 19 and nonwoven cloth 20, the piping and mineral oil same as in exemplary embodiment 12 were used. At a pressure of about 4 kgf/cm², the compound was conveyed in the piping. The other cleaning conditions are same as in exemplary embodiment 9. In about 30 seconds after inserting the compound, the mineral oil was discharged from the piping. As a result, about 91% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 14

[0153] The compound comprising the ABS molded element 19 and nonwoven cloth 20, the piping and mineral oil same as in exemplary embodiment 12 were used. The nonwoven cloth 20 is wound around the molded element 19 at a thickness of 2.0 mm. This compound was inserted into the copper piping in the atmosphere of 40°C. At a pressure of about 4 kgf/cm², the compound was conveyed in the piping. The other cleaning conditions are same as in exemplary embodiment 9. In about 15 seconds after inserting the compound, the mineral oil was discharged from the piping. As a result, about 92% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 15

[0154] The compound comprising the ABS molded element 19 and nonwoven cloth 20, the piping and mineral oil same as in exemplary embodiment 12 were used. The nonwoven cloth 20 is wound around the molded element 19 at a thickness of 2.0 mm. This compound was inserted into the copper piping in the atmosphere of 5°C. At a pressure of about 4 kgf/cm², the compound was conveyed in the piping. The other cleaning conditions are same as in exemplary embodiment 9. In about 150 seconds after inserting the compound, the mineral oil was discharged from the piping. As a result, about 85% of the remaining mineral oil in the piping was removed.

[0155] In these exemplary embodiments 12 to 15, the nonwoven cloth 20 is made of long filaments of polypropylene, and is oleophilic. Accordingly, the nonwoven cloth 20 adsorbs mineral oil, and is gradually swollen, and the density becomes higher in the swollen portion. When the compound is conveyed by compressed nitrogen in this state, the amount of nitrogen slipping on the outer circumference and inside of the compound to be conveyed is reduced. Therefore, the effect of eliminating the remaining oil in the piping is extremely enhanced. Moreover, since the molded element 19 is present inside the compound, the compound has a strong strength as a structure. Accordingly, if only a small amount of oil is left over in the piping, clogging or breakage of the compound in the course of conveying can be prevented.

[0156] By comparing exemplary embodiment 10 to exemplary embodiment 15, it is known that the remaining oil eliminating effect varies with the environmental temperature in the piping cleaning work. The oil viscosity varies with the temperature. The relation between temperature and viscosity of mineral oil is shown in Fig. 9. As the temperature declines, the viscosity of the mineral oil elevates. As the viscosity of the mineral oil becomes higher, it tends to be more difficult to remove the mineral oil sticking to the inner wall of the piping. In other words, by raising the environmental temperature, the mineral oil removing effect is enhanced. Therefore, in cold climate in winter, before dismounting the outdoor unit and indoor units, by heating operation for about 15 minutes, the piping can be warmed to about 30°C. After raising the piping temperature, by inserting the compound into the piping and conveying, the mineral oil removal efficiency is enhanced.

Exemplary Embodiment 16

[0157] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0158] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, a nitrile-butadiene-rub-

ber (NBR) molded element with outside diameter of 7.92 mm, length of 7.0 mm, and end face curvature of R2 was prepared. The hardness of this NBR is about 50 in spring type A. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm², the compound (polypropylene molded element) was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 85% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 17

[0159] As the compound, a nitrile-butadiene-rubber (NBR) molded element with outside diameter of 7.92 mm, length of 14.0 mm, and end face curvature of R2 was prepared. The hardness of this NBR is about 30 in spring type A. The piping cleaning experiment was conducted in the same manner as in the foregoing exemplary embodiment.

[0160] As a result, about 91% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 18

[0161] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0162] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, an ethylene propylene rubber (EPDM) foamed molded element with outside diameter of 7.93 mm, length of 21.0 mm, and end face curvature of R2 was prepared. The bulk density of this foamed molded element is about 0.2 g/ml. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm², the compound (polypropylene molded element) was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 94% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 19

[0163] As the compound, an EPDM foamed molded element with outside diameter of 7.93 mm, length of 28.0 mm, and end face curvature of R2 was prepared. The bulk density of this foamed molded element is about 0.1 g/ml. The piping cleaning experiment was conducted in the same manner as in exemplary embodiment 18.

[0164] As a result, about 95% of the remaining mineral oil in the piping was removed.

[0165] In these exemplary embodiments 16 to 19, the compound is a flexible and elastic rubber, or a foamed element of rubber. The rubber can pass through bent parts in the existing piping. By using such rubber controlled in the hardness, the features as the elastomer can be sufficiently utilized. Besides, since the rubber is flexible and elastic, if the compound is long in length, its clogging in the piping is prevented. As the length of the compound is extended, the oil eliminating efficiency is enhanced.

[0166] The rubber foamed molded element having foams has a further excellent elasticity. As the foamed element, a foamed element having independent foams is preferred. In this constitution, the oil eliminating efficiency is further enhanced.

[0167] The hardness of the rubber used in the exemplary embodiments is 60 or less in spring type A. It is not inconvenient when the hardness of the compound is too small. However, as the compound of solid, not porous, type, the compound of which hardness is less than 20 in spring type A is hardly available. Hence, it is realistic to use rubber in a hardness range of 20 to 60.

[0168] It is difficult to limit the range of hardness of the foamed molded element by spring type A, and hence the practical range is measured by the bulk density. As a result, a preferred bulk density was in a range of about 0.1 g/ml to about 0.6 g/ml in insertion state. At the bulk density of less than 0.1 g/ml, the mechanical strength of the compound is brittle, and there is a problem in actual use.

[0169] In these exemplary embodiments, as the elastomer of the compound, the NBR rubber and EPDM rubber foamed molded elements are used, but not limited to them, for example, CR, SBR, IIR, silicone, other rubber, and also PP elastomer, styrene elastomer, PP, PE resin, and other foamed molded elements can be used.

Exemplary Embodiment 20

[0170] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0171] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily. As the compound, a fiber molded element with outside diameter of 7.96 mm and length of 14.0 mm

was prepared. This fiber molded element is made of long filaments of polypropylene (PP), and has a bulk density of about 0.2g/ml. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 95% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 21

[0172] As the compound, a PP fiber molded element with outside diameter of 7.94 mm and length of 14.0 mm was prepared. The bulk density of this fiber molded element is about 0.4 g/ml. The piping cleaning experiment was conducted in the same manner as in exemplary embodiment 20. As a result, about 91% of the remaining mineral oil in the piping was removed.

[0173] In these exemplary embodiments, the PP long fiber molded element and PP foamed molded element are oleophilic. Accordingly, when the compound is discharged from the piping, the PP long fiber molded element has sufficiently adsorbed mineral oil. As the PP long fiber molded element adsorbs mineral oil, the molded element is gradually swollen, and the density of the molded element becomes higher. When the compound is conveyed in the piping by compressed nitrogen in this state, the amount of nitrogen slipping on the compound can be reduced. Therefore, the effect of eliminating the remaining oil in the piping is extremely enhanced. However, if only a small amount of oil is left over in the piping, when the bulk density of the PP long fiber molded element is small, it may be broken in the course of conveying depending on the pressure of the compressed nitrogen. Therefore, the bulk density of the fiber molded element is preferred to be 0.1 g/ml or more in insertion state. Further, to make sure of the properties (elasticity, flexibility) of the PP long fiber molded element or foamed molded element, the bulk density of the molded element is preferred to be 0.6 g/ml or less. Therefore, the bulk density of the PP molded element is preferred to be in a range of 0.1 to 0.6 g/ml.

Exemplary Embodiment 22

[0174] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0175] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50

g of mineral oil (tradename: SUNISO 4GS), and 100 mg of copper powder with mean particle size of 2 μm were left over preliminarily. As the compound, a film 21 filled with hard alkyl benzene (HAB) 22 as shown in Fig. 10 was prepared. This film 21 is a PP film with outside diameter of 8 mm, length of 20 mm, and thickness of 50 μm. The inside of this film 21 is filled with HAB oil at density of 0.9 g/ml. This compound was pushed in and inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil and copper powder existing in the piping are cleaned by the compound, and are discharged from other exit of the piping. As a result, about 93% of the remaining mineral oil in the piping was removed. At the same time, about 50% of the copper powder was removed.

[0176] In this exemplary embodiment, the inside of the compound is filled with liquid, and the compound has an elasticity. Accordingly, the compound has an excellent flexibility and elasticity. As a result, if the compound is considerably long, clogging of the compound in the piping is prevented. The HAB oil has no effect on the air conditioner. Since the HAB oil is used in the embodiment, if the compound is broken in the midst of conveying, and the HAB oil is left over in the piping, no problem occurs. The film containing the HAB oil is not limited to the PP film alone, but other film having an excellent oil-proof property may be used. For example, as the film 21, a PP elastomer film may be used.

Exemplary Embodiment 23

[0177] The compound comprises, as shown in Fig. 11, a PP film 24 filled with HAB oil 25, and a nonwoven cloth 23 disposed around the PP film 24. The nonwoven cloth 23 is made of long filaments of PP, and has a thickness of about 1 mm. The piping cleaning experiment was conducted in the same manner as in exemplary embodiment 22. As a result, about 95% of the remaining mineral oil in the piping was removed. At the same time, about 70% of the copper powder was removed.

[0178] By using the compound having the nonwoven cloth adhered to the surface of the PP film, when the compound advances in the piping, it moves while rubbing against the inner wall of the compound, and the deposit scraping effect is further enhanced.

Exemplary Embodiment 24

[0179] The compound comprises, as shown in Fig. 12, a PP film 27 filled with HAB oil 28, and ultrafine fibers 26 disposed around the PP film 27. The ultrafine fibers 26 are made of polyester, and have a fiber diameter of

about 0.1 denier. The piping cleaning experiment was conducted in the same manner as in exemplary embodiment 22. As a result, about 95% of the remaining mineral oil in the piping was removed. At the same time, about 80% of the copper powder was removed.

[0180] By using the compound having the ultrafine fibers adhered to the surface of the PP film, when the compound advances in the piping, it moves while rubbing against the inner wall of the compound, and the deposit wiping effect of the compound is further enhanced. It further improves the effect of the ultrafine fibers for eliminating metal powder such as copper powder and iron powder.

Exemplary Embodiment 25

[0181] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0182] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS), 100 mg of copper powder with mean particle size of 2 μ m, and 1000 mg of water were left over preliminarily. The compound comprises, as shown in Fig. 13, a fiber molded element 29, and ultrafine fibers 30 disposed around the fiber molded element 29. The ultrafine fibers 30 are woven in a cloth form. The fiber molded element 29 is made of PP long filaments with outside diameter of 7.96 mm and length of 14 mm. The fiber molded element 29 has a bulk density of 0.2 g/ml. The ultrafine fibers 30 are made of polyester, having a fiber diameter of about 0.1 denier. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil and copper powder existing in the piping are cleaned by the compound, and are discharged from other exit of the piping. As a result, about 97% of the remaining mineral oil in the piping was removed. At the same time, about 90% of the copper powder was removed. The moisture removal rate was about 70%.

Exemplary Embodiment 26

[0183] In the foregoing exemplary embodiment 25, after passing the compound comprising the fiber molded element 29 and ultrafine fibers 30 through the piping, further, a second compound was conveyed in the piping at a pressure of about 3 kgf/cm². The second compound is a circular columnar foamed molded element with outside diameter of 7.96 mm and length of 14 mm, and the

foamed molded element has a bulk density of about 0.3 g/ml, being made of refined cellulose. The foamed molded element made of refined cellulose has a water absorbing function. The other conditions are same as in the foregoing exemplary embodiment 25. As a result, about 98% of the remaining mineral oil in the piping was removed. At the same time, about 95% of the copper powder was removed. The moisture removal rate was about 98%.

Exemplary Embodiment 27

[0184] In the foregoing exemplary embodiment 25, after passing the compound comprising the fiber molded element 29 and ultrafine fibers 30 through the piping, further, a second compound was conveyed in the piping at a pressure of about 3 kgf/cm². The second compound comprises, as shown in Fig. 14, a molded element 31, and ultrafine fibers 32 disposed around the molded element 31. The molded element 31 is a crosslinked molded element of partially neutralized compound of polyacrylic acid with outside diameter of 7.96 mm and length of 14 mm, having a bulk density of 0.3 g/ml. The ultrafine fibers 32 are made of polyester, having a fiber diameter of about 0.1 denier. The crosslinked molded element of partially neutralized component of polyacrylic acid has a water absorbing function. As a result, about 98% of the remaining mineral oil in the piping was removed. At the same time, about 98% of the copper powder was removed. The moisture removal rate was about 98%.

[0185] In the foregoing exemplary embodiments 26 and 27, as the compound having water absorbing property, the refined cellulose foamed molded element and polyacrylic acid partially neutralized crosslinked compound are used, but the compounds having water absorbing property applicable in the invention are not particularly limited, and others may be used, for example, saponified compound of copolymer of ester acrylate and vinyl acetate, crosslinked polyvinyl alcohol denatured matter, hydrolyte of starch-acrylonitrile graft polymer, starch-acrylate graft polymer, and partially crosslinked compound of polyethylene oxide. As the water-absorbing compounds, the molded elements filled with pulp fiber, cotton, refined cellulose fiber, acrylate fiber and others may be also used.

Exemplary Embodiment 28

[0186] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0187] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS), and 100 mg of copper powder with mean particle size of 2 μ m were left over preliminarily. The compound comprises a fiber molded element, and fresh hard alkyl benzene (HAB)

immersed in the fiber molded element. The fiber molded element is made of PP long filaments with outside diameter of 7.94 mm and length of 14 mm. The fiber molded element has a bulk density of 0.2 g/ml. The HAB oil has a dynamic viscosity of about 32.4 mm²/s when measured at 40°C. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil existing in the piping is cleaned by the compound, and is discharged from other exit of the piping. As a result, about 98% of the remaining mineral oil in the piping was removed. At the same time, about 95% of the copper powder was removed.

Exemplary Embodiment 29

[0188] In the foregoing exemplary embodiment 28, the HAB oil has a dynamic viscosity of about 9.6 mm²/s when measured at 40°C. The other conditions are same as in exemplary embodiment 28.

[0189] As a result, about 98% of the remaining mineral oil in the piping was removed. At the same time, about 93% of the copper powder was removed.

Exemplary Embodiment 30

[0190] In the foregoing exemplary embodiment 28, the HAB oil has a dynamic viscosity of about 65.7 mm²/s when measured at 40°C. The other conditions are same as in exemplary embodiment 28.

[0191] As a result, about 98% of the remaining mineral oil in the piping was removed. At the same time, about 95% of the copper powder was removed.

[0192] In the foregoing exemplary embodiments 28 to 30, only the dynamic viscosity of the HAB oil are different, and the other conditions are same. As the HAB oil immersed in the PP long fiber molded element, it is preferred to use the HAB oil low in viscosity when the ambient temperature is low, and to use the HAB oil high in viscosity when the ambient temperature is high. In particular, if the HAB oil of low viscosity is used while the ambient temperature is high, the effect of immersing the fresh HAB oil into the PP long fiber molded element is extremely lowered. In other words, the compound (conveyed material) moving in the piping, and the pipe wall oil present excellent effects against decrease of sliding resistance, but the effects are too strong, and the effect of scraping the oil of the inner wall of the piping is lowered. Or, when the HAB oil is immersed in the PP long fiber molded element, with the viscosity lowered by warming the HAB oil, preferably, the HAB oil is impregnated in the fiber molded element, and the molded element containing the HAB is cooled, and the compound

is introduced and conveyed in the piping. Therefore, it is preferred to select an appropriate HAB oil depending on the environmental conditions of the work of installing the air conditioner. The viscosity grade of the commercial products of HAB oil are specified in JIS K 2001. The viscosity grade suited to the embodiment is VG10 to VG68, which corresponds to the dynamic viscosity of 9.0 to 74.8 mm²/s as measured at 40°C. For reference, the relation between the temperature and viscosity of the HAB oil is given in Fig. 15.

[0193] When conveying the compound in the piping with the HAB oil immersed in the PP long fiber molded element, the PP long fiber molded element is swollen by the HAB oil. Accordingly, a wall of HAB oil is formed against the nitrogen gas being sent under pressure. Further, the effect of decreasing the sliding resistance on the inner wall of the piping is significant. Therefore, the bulk density of the PP long fiber molded element is preferred to be in a range of 0.05 to 0.6 g/ml.

Exemplary Embodiment 31

[0194] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0195] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS), and 100 mg of copper powder with mean particle size of 2 μm were left over preliminarily. The compound comprises, as shown in Fig. 13, a fiber molded element 29, and ultrafine fibers disposed around the fiber molded element 29. The compound further comprises a fresh hard alkyl benzene (HAB) oil immersed in at least one of the fiber molded element and ultrafine fibers. The HAB oil has a dynamic viscosity of about 32.4 mm²/s when measured at 40°C. The fiber molded element 29 is made of PP long filaments with outside diameter of 7.96 mm and length of 14 mm. The fiber molded element 29 has a bulk density of 0.2 g/ml. The ultrafine fibers 30 are made of polyester, having a fiber diameter of about 0.1 denier. This compound was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm², the compound was conveyed in the piping. While the compound is moving in the piping, the mineral oil and copper powder existing in the piping are cleaned by the compound, and are discharged from other exit of the piping. As a result, about 99% of the remaining mineral oil in the piping was removed. At the same time, about 98% of the copper powder was removed.

Exemplary Embodiment 32

[0196] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0197] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS), and 100 mg of copper powder with mean particle size of 2 μ m were left over preliminarily. The compound comprises, as shown in Fig. 8, a molded element, and a nonwoven cloth disposed around the molded element. Two compounds of the same composition were prepared. The molded element is made of ABS resin with outside diameter of 5.0 mm and length of 8.0 mm. The nonwoven cloth is made of polypropylene fibers, and is 2 mm in thickness. To begin with, a first one of the compounds was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm², the compound was conveyed in the piping. Next, a second compound was inserted into the copper piping, and the piping was cleaned in the same manner. While these compounds are moving in the piping, the mineral oil and copper powder existing in the piping are cleaned by the compounds, and are discharged from other exit of the piping. As a result, about 95% of the remaining mineral oil in the piping was removed. At the same time, about 91% of the copper powder was removed.

[0198] In this exemplary embodiment, alternatively, it is also possible to insert the first compound and second compound into the piping, and then move the first compound and second compound in the piping by compressed nitrogen.

Exemplary Embodiment 33

[0199] In this exemplary embodiment, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0200] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS), and 100 mg of copper powder with mean particle size of 2 μ m were left over preliminarily. Two compounds were prepared. A first compound comprises, as shown in Fig. 13, a fiber molded element, and ultrafine fibers disposed around the fiber molded element. A second compound further comprises fresh hard alkyl benzene (HAB) immersed at least in the fiber molded element and ultrafine fibers. The HAB oil has a dynamic viscosity of about 32.4 mm²/s when measured at 40°C. To begin with, a second com-

pound of the compounds was inserted into the copper piping in the atmosphere of 25°C. A nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled by a regulator valve. That is, at a pressure of about 2 kgf/cm², the compound was conveyed in the piping. Next, a first compound was inserted into the copper piping, and the piping was cleaned in the same manner. While these compounds are moving in the piping, the mineral oil and copper powder existing in the piping are cleaned by the compounds, and are discharged from other exit of the piping. As a result, about 99.5% of the remaining mineral oil in the piping was removed. At the same time, about 99% of the copper powder was removed.

[0201] In this exemplary embodiment, alternatively, it is also possible to insert the first compound and second compound into the piping, and then move the first compound and second compound in the piping by compressed nitrogen.

Comparative Example 1

[0202] In this comparative example, a cleaning method of one piping is explained. A plurality of pipings can be cleaned in the same method as this cleaning method of one piping.

[0203] A copper piping of 3/8 inch (inside diameter 7.92 mm) was prepared by 30 m. Inside the piping, 50 g of mineral oil (tradename: SUNISO 4GS) was left over preliminarily.

[0204] In the atmosphere of 25°C, a nitrogen cylinder was connected to the copper piping by means of a pressure-proof hose. While observing the gauge of the nitrogen cylinder, the nitrogen flow rate flowing into the copper piping was controlled at a pressure of about 5 kgf/cm² by a regulator valve. In this state, the nitrogen stream flowed in the piping for 5 minutes. That is, in this comparative example, without using the compound, only the nitrogen stream flows in the piping. By this nitrogen stream, the mineral oil existing in the piping is discharged from other exit of the piping. As a result, about less than 20% of the remaining mineral oil in the piping was removed.

Exemplary Embodiment 34

[0205] Using deteriorated mineral oil (SUNISO 4GS) (total acid value 0.04), the reliability of the air conditioner was tested. That is, 10g of deteriorated mineral oil is mixed in 260g of ester oil. The refrigerating machine oil composed of 10g of deteriorated mineral oil and 260g of ester oil is mixed into 850g of R410A refrigerant of HFC. The air conditioner containing such R410A refrigerant, deteriorated mineral oil and ester oil was operated for 2000 hours in reliability test in the cooling overload condition of discharge temperature of 115°C at outdoor

unit temperature of 40°C and indoor unit temperature of 40°C. As a result, after operation for 2000 hours, no problem was found in the sliding parts of the compressor of the air conditioner.

[0206] Using ether oil instead of the ester oil, the same long-term reliability test of air conditioner was conducted. As a result, no problem was found in the sliding parts of the compressor.

[0207] In other words, although variable depending on the state of the residual deteriorated old oil state and the residual absolute amount, by cleaning the existing piping according to the exemplary embodiments, it is estimated that the reliability of the newly installed air conditioner is guaranteed in almost all cases.

Exemplary Embodiment 35

[0208] As shown in Fig. 2, herein, one piping is explained representatively. A copper pipe of 3/8 inch (inside diameter 7.92mm) of 30m in length was prepared, and 2000 mg of water and 100mg of copper powder of mean particle size of 10 μ m were preliminarily left over in the piping. In the atmosphere at 20°C, the inside of the piping was filled with about 10g of hard alkyl benzene (HAB, dynamic viscosity 15.1 mm²/s at 40°C) oil. As shown in Fig. 18, the compound was soaked with HAB oil. The compound soaked with HAB oil was inserted into the piping. The nitrogen cylinder and the piping were connected by a pressure-proof hose. The nitrogen flow rate was controlled by a regulator valve while observing the gauge. At a pressure of about 1.0kgf/cm², the compound was conveyed in the piping. The compound has a sandwich structure consisting of PP foamed body 63 (bulk density 0.15g/ml) of 7.96 ϕ $\times$ 10 at the upstream side of the moving direction, PP foamed body 64 (bulk density 0.15 g/ml) of 8.00 ϕ $\times$ 10 at the downstream side, and PP resin film 65 (7.91 ϕ , thickness 100 μ m) in the central part. As a result, about 98% of water and about 95% of copper powder could be removed.

Exemplary Embodiment 36

[0209] A pipe of 3/8 inch (inside diameter 7.92mm) of 30m in length was prepared, and 2000mg of water and 100mg of copper powder of mean particle size of 10 μ m were preliminarily left over in the piping. In the atmosphere at 20°C, the inside was filled with about 10g of HAB oil (dynamic viscosity 15.1 mm²/s at 40°C). As shown in Fig. 19, the compound was soaked with HAB oil. The compound soaked with HAB oil was inserted into the piping. The nitrogen cylinder and the piping were connected by a pressure-proof hose, and the nitrogen flow rate was controlled by a regulator valve while observing the gauge, then the compound was conveyed at a pressure of about 1.0kgf/cm². The compound has a sandwich structure consisting of foamed molded body 66 of ethylene-propylene copolymer (EPDM) (bulk den-

sity 0.2 g/ml) of 7.96 ϕ $\times$ 10 at the upstream side, EPDM foamed body 67 (bulk density 0.2 g/ml) of 8.00 ϕ $\times$ 10 at the downstream side, and PP resin film 68 (7.91 ϕ , thickness 100 μ m) in the central part. As a result, about 98% of water and about 95% of copper powder could be removed.

Exemplary Embodiment 37

[0210] A copper pipe of 3/8 inch (inside diameter 7.92 mm) of 30 m in length was prepared. Inside the piping, 2000mg of water and 100 mg of copper powder of mean particle size of 10 μ m were preliminarily left over. In the atmosphere at 20°C, the inside of the piping was filled with about 10g of HAB oil (dynamic viscosity 15.1 mm²/s at 40°C). As shown in Fig. 20, the compound was soaked with HAB oil. This compound was inserted into the piping. The nitrogen cylinder and the piping were connected by a pressure-proof hose, and the nitrogen flow rate was controlled by a regulator valve while observing the gauge, then at a pressure of about 1.2 kgf/cm², the compound was conveyed. The compound has a sandwich structure consisting of PP foamed body 79 (bulk density 0.15 g/ml) of 7.96 ϕ $\times$ 10 at the upstream side of the moving direction, molded body 70 wound with PP long filament nonwoven cloth (bulk density 0.15 g/ml) of 8.00 ϕ $\times$ 10 at the downstream side, and PP resin film 71 (7.91 ϕ , thickness 100 μ m) in the central part. As a result, about 99% of water and about 95% of copper powder could be removed.

Exemplary Embodiment 38

[0211] A copper pipe of 3/8 inch (inside diameter 7.92mm) of 30 m in length was prepared. Inside the piping, 2000mg of water and 100 mg of copper powder of mean particle size of 10 μ m were preliminarily left over. In the atmosphere at 20°C, the inside of the piping was filled with about 10 g of HAB oil (dynamic viscosity 15.1 mm²/s at 40°C). As shown in Fig. 21, the compound was soaked with HAB oil. This compound was inserted into the piping. The nitrogen cylinder and the piping were connected by a pressure-proof hose, and the nitrogen flow rate was controlled by a regulator valve while observing the gauge, then at a pressure of about 1.2 kgf/cm², the compound was conveyed. The compound has a sandwich structure consisting of EPDM foamed body 72 (bulk density 0.2 g/ml) of 7.96 ϕ $\times$ 10 at the upstream side of the moving direction, molded body 73 wound with PP long filament nonwoven cloth (bulk density 0.15 g/ml) of 8.00 ϕ $\times$ 10 at the downstream side, and PP resin film 74 (7.91 ϕ , thickness 100 μ m) in the central part. As a result, about 99% of water and about 95% of copper powder could be removed.

Exemplary Embodiment 39

[0212] A pipe of 3/8 inch (inside diameter 7.92 mm)

of 30 m in length was prepared. Inside the piping, 2000mg of water and 100mg of copper powder of mean particle size of 10 μ m were preliminarily left over. In the atmosphere at 20°C, the inside of the piping was filled with about 10 g of HAB oil (dynamic viscosity 15.1 mm²/s at 40°C). As shown in Fig. 22, the compound was inserted into the piping. The nitrogen cylinder and the piping were connected by a pressure-proof hose, and the nitrogen flow rate was controlled by a regulator valve while observing the gauge, then at a pressure of about 1.2 kgf/cm², the compound was conveyed. The compound has a sandwich structure consisting of PP foamed body 75 (bulk density 0.15 g/ml) of 7.96 ϕ $\times$ 10 at the upstream side of the moving direction, molded body 77 adhered with polyester ultrafine textile cloth 76 (0.1 denier, 50 μ m) and wound with PP long filament nonwoven cloth (bulk density 0.15 g/ml) of 8.00 ϕ $\times$ 10 at the downstream side, and PP resin film 78 (7.91 ϕ $\times$, thickness 100 μ m) in the central part. As a result, about 99% of water and about 98% of copper powder could be removed.

[0213] That is, in the foregoing exemplary embodiments 35 to 39, the compound is oleophilic; the step of conveying the compound in the piping comprises:

- a step of putting oil into the piping from one opening of the piping, and
- a step of conveying the oil, together with the compound, in the piping; and
- the step of soaking the compound with oil comprises:
- a step of conveying the compound soaked with oil in the piping.

[0214] In exemplary embodiments 35 to 39,

- the compound has a first molded body positioned at the upstream side of the piping, and a second molded body positioned at the downstream side; and
- at least one of the first molded body and second molded body is soaked with the oil.

[0215] The compound has a first molded body positioned at the upstream side of the piping, and a second molded body positioned at the downstream side; and at least one of the first molded body and second molded body has a foamed body.

[0216] The compound has a first molded body positioned at the upstream side of the piping, and a second molded body positioned at the downstream side; and at least one of the first molded body and second molded body has a nonwoven cloth.

[0217] The compound has a first molded body positioned at the upstream side of the piping, and a second molded body positioned at the downstream side; and

- at least one of the first molded body and second molded body has a foamed body, and
- the other one of the first molded body and second molded body has a nonwoven cloth.

[0218] In exemplary embodiments 35 to 39, as the oil impregnated in the PP long filament molded body, it was preferred to use low viscosity type at lower temperature, and high viscosity type at higher temperature. That is, the compound and the oil on the pipe wall of the piping are effective for reducing the sliding resistance, but if the oil of too low viscosity is used, the compound conveying speed is faster and the effect of discharging moisture while growing the oil film is insufficient. Further, the pipe wall wiping effect is also lowered. To improve affinity of compound and oil, when impregnating intentionally, it was effective to heat to lower the viscosity, permeate sufficiently, and feed and convey in the copper piping after cooling. Therefore, depending on the environmental conditions of installation work, the optimum dynamic viscosity of HAB oil varied. In the case of commercial HAB oil, the viscosity grade is specified in JIS K 2001, and the viscosity grade used in the embodiments was VG5 to VG32, which corresponded to dynamic viscosity of 4.14 to 35.2 mm²/s at 40°C. For reference, the relation between the temperature and viscosity in HAB oil is shown in Fig. 23.

[0219] In exemplary embodiments 35 to 39, after filling the piping with fresh oil, by conveying the compound, a thin oil film is formed inside the piping. Accordingly, the residual sticking water and foreign matter are discharged efficiently. Besides, as the oil sticks to the compound, the sliding resistance when the compound is conveyed is reduced, so that the pressure of the compressed gas can be lowered. The fresh oil to be used should be selected in consideration of the compatibility with the oil contained in the compressor of the air conditioner to be installed, and an excellent effect was obtained if the oil used in cleaning of the piping was left over.

Exemplary Embodiment 40

[0220] The compound of the air conditioner in exemplary embodiment 40 further comprises a rope disposed on at least one side of the rear side and front side.

[0221] The rope is wound around the peripheral end of at least one side.

[0222] At least one side has a curved surface formed by winding of the rope.

[0223] That is, at least one end of the compound is wound with a rope-like matter. Thus, when the both ends of the compound are wound with rope-like matter or string-like matter, the leading end of the compound becomes a curved surface. As a result, even in a flat portion of the piping, clogging of the compound is prevented, and the compound smoothly passes through the flat portion. The remaining oil and water sticking in the pip-

ing are discharged out of the piping by the excluding volume effect produced when the compound is conveyed by compressed gas. Therefore, as the piping of the air conditioner, a long-term reliability is obtained.

[0224] Fig. 24 is a structural diagram of the compound in embodiment 40 of the invention. A compound 80 consists of nearly columnar foamed polyethylene 81 of 10 mm in outside diameter and 20 mm in length, a polypropylene sheet 82, and a rope 83. The polypropylene sheet 82 is wound around the foamed polyethylene 81 by one turn. The rope 83 is tied to both ends of the foamed polyethylene 81.

[0225] A piping forming a bend portion of flatness of 70% in the central part of the piping of 9.525 mm in outside diameter (inside diameter 7.925 mm) of 5m was prepared. The inside of the pipe was preliminarily sealed with 50g of mineral oil and 16g of water. In the atmosphere of 25°C, the compound 80 was pressed and inserted into the piping. Further, the nitrogen cylinder and piping were connected to the piping by using a pressure-proof hose. By applying a pressure of 0.35 MPa, the compound was conveyed in the pipe, and this operation was repeated three times. The compound 80 passed without staying at the flat portion of the piping. As a result, 85% of mineral oil and 99% of water were removed.

[0226] In this structure, the compound passes smoothly the flat portion without staying still, and together with the excluding volume effect caused when conveyed by compressed gas, the oil and moisture remaining and sticking in the piping are effectively discharged out of the piping together with the compound.

Exemplary Embodiment 41

[0227] The piping cleaning method of the embodiment comprises:

a step of inserting a compound into a piping,
a step of feeding compressed gas into the piping, and
a step of discharging foreign matter staying in the piping together with the compound from the piping,

in which the step of feeding the compressed gas into the piping includes a step of controlling the compressed gas to a desired pressure.

[0228] The step of feeding the compressed gas into the piping includes a step of detecting when the compound is discharged from the piping.

[0229] The step of feeding the compressed gas into the piping includes a step of controlling the compressed gas while changing to a desired pressure.

[0230] The step of detecting when the compound is discharged from the piping includes a step of detecting the pressure of the compressed gas in the pipe at the compound inserting side of the piping.

[0231] The step of controlling the compressed gas to a desired pressure includes a step of detecting the flow

rate of the compressed gas in the piping at the compound inserting side of the piping.

[0232] The step of feeding the compressed gas into the piping includes a step of detecting the pressure of the compressed gas by a pressure gauge installed in the connection piping for connecting the piping and the compressed gas generating device.

[0233] The cleaning apparatus of the embodiment comprises:

a compound to be inserted into a piping,
a compressed gas generating device, and
a pressure regulator for controlling the pressure of the compressed gas.

[0234] The cleaning apparatus further comprises:
a detector for detecting when the compound is discharged from the piping.

[0235] The cleaning apparatus further comprises:

a pressure regulator for controlling the pressure of the compressed gas, and
a detector for detecting when the compound is discharged from the piping.

[0236] The detector is installed near the opening of the piping positioned at the insertion side of the compound.

[0237] The pressure generating device comprises:
a flow rate detector for detecting the flow rate of the compressed gas,
in which the flow rate detector is installed near the opening of the piping positioned at the insertion side of the compound.

[0238] The pressure generating device includes a pressure generating source (8), a connection piping (9), and a pressure gauge connected to the connection piping, and

the pressure gauge detects the pressure of the compressed gas in the piping.

[0239] The cleaning method and cleaning apparatus in the embodiment are explained by referring to Fig. 25. First, the compound 7 is inserted into the piping 6 from one end of the piping 6. Herein, the opening end of the piping for inserting the compound 7 may be either at outdoor side or at indoor side. When the inserted compound comes out from the other end of the piping, oil, moisture and other foreign matter contained inside the piping are discharged. Accordingly, to prevent contamination of the indoor air by such discharge, it is preferred to feed the compound 7 from the indoor side opening end of the piping. The compound 7 to be inserted is preferably foamed body having independent foams, or such foamed body with nonwoven cloth disposed on the surface thereof. As the foamed body having independent foams, various known materials may be used, such as polyethylene foam, polypropylene foam, and polystyrene foam. On the surface of such foamed body, a non-

woven cloth is disposed, and as such nonwoven cloth, polypropylene, polyester, rayon and other known materials may be used. In particular, as the nonwoven cloth, it is preferred to use a material having a high moisture absorbing property, and such material can sufficiently wipe off the moisture from the surface of the piping. When the entire surface of the foamed body is covered with the nonwoven cloth, separation of nonwoven cloth in the piping is prevented. The foamed body is nearly a circular column, and the nonwoven cloth is disposed along the side surface of the circular column, and the ends of the nonwoven cloth are bonded at least at the top or bottom side of the circular column. The section of the compound to be inserted is a circular column conforming to the piping profile. As a result, the compound contacts tightly with the piping, so that the oil and moisture removing capacity is enhanced. The foamed body and the nonwoven cloth may be adhered by any known method such as adhesive agent and double-sided adhesive tape. Preferably, the end of the nonwoven cloth should be joined, and separation of foamed body and nonwoven cloth in the piping is prevented. The joining method may be any known method such as tying with string or fusing by heat.

[0240] After inserting the compound 7 into the piping 6, a connection pipe 58 with pressure gauge is connected. Then, a compressed gas cylinder 59 is connected. The compressed gas cylinder 59 includes a regulator 10 capable of setting the pressure arbitrarily, and the secondary pressure can be set freely while observing the primary pressure gauge. Thus, the compound can be moved while changing the pressure of the compressed gas to various pressures. The regulator 50 includes a valve 56 for passing compressed gas. As the compressed gas, nitrogen, carbon dioxide, hydrocarbon or the like may be selected, and nitrogen is particularly preferred because the conveying pressure can be raised easily. Air may be also used as compressed gas. In this case, a compressor is used as the compressed gas generating device.

[0241] When cleaning in thus connected state, generally, the viscosity of the oil used in the air conditioner varies extremely depending on the temperature. Fig. 26 (a) shows temperature effects of representative oil viscosity. Therefore, if the same piping and same compound are used, the starting pressure for stating move of the compound differs significantly depending on the ambient temperature.

[0242] In the present evaluation, a copper pipe of 9.525 mm in diameter was prepared (inside diameter 7.925 mm, length 30 m, corresponding to existing piping), and its inside was preliminarily sealed with 50 g of mineral oil and 16 g of moisture. The compounds to be inserted into the piping are columnar polyethylene with outside diameter of about 10 mm and length of about 20 mm, and embossed polypropylene nonwoven cloth wound around its side by one turn, and the both ends of the nonwoven cloth are fused by heat. In the atmos-

phere at 40°C, the compound 7 was inserted into the piping 6 while compressing. The connection pipe with pressure gauge 58, pressure-proof hose 51, regulator 50, and nitrogen cylinder 59 are connected sequentially. As shown in Fig. 26 (b), by opening the valve 56, the regulator 50 was adjusted while observing the secondary pressure gauge 52, and the pressure was gradually raised. Nitrogen somewhat escapes from the clearance between the compound 7 and the piping, but a similar pressure is applied between the regulator 50 and compound 7. Accordingly, the reading of the pressure gauge 58a of the connection piping with pressure gauge 58 also elevates in coincidence. When the pressure is further raised, the compound 7 begins to move at 0.15 MPa, and the compound moves while discharging oil, moisture and other foreign matter in the piping, and is finally discharged from the other end of the piping. When the compound 7 is discharged, the reading of the pressure gauge 8a drops nearly to the atmospheric pressure. As a result, it is evidently known that the compound 7 passes through the piping 6 and is discharged. When this operation is repeated once or twice, 95% of the mineral oil in the piping and 99% of moisture were removed.

[0243] In succession, the same evaluation was carried out in the atmosphere at 5°C. The compound 7 began to move at 0.3 MPa. A similar foreign matter removing performance was recognized. Thus, since the regulator for freely changing the nitrogen pressure is installed, it is possible to start move of the compound if the ambient temperature changes. Moreover, since the pressure gauge is used, it is known from the indoor or outdoor side when the compound passes through the piping and is discharged. Therefore, the foreign matter removing work can be operated by one worker.

[0244] If the piping 6 is extremely flat, the compound 7 may not pass completely through the connection piping 6 if the pressure of the compressed gas is raised. In such a case, a compressed gas cylinder 88 is connected to the other end of the connection piping 6, and the compressed air is blown in, so that the compound 7 may be conveyed by pressure. As a result, the compound 57 may be easily removed from the connection piping.

[0245] In this method, if the compound 7 is clogged in the connection piping 6, the compound 7 can be taken out easily.

Exemplary Embodiment 42

[0246] The compound inserting jig of the embodiment and the cleaning apparatus using the same are explained.

[0247] In the inserting jig for inserting the compound used for cleaning the inside of the piping installed between the indoor unit and outdoor unit of an air conditioner, the compound passes through the piping, and removes the foreign matter in the piping, and the piping has an inner section of a circular section, and the compound has a nearly circular outer section.

[0248] The inserting jig comprises:

a first opening to be inserted into the piping, and
a second opening capable of inserting the compound therein.

[0249] The inserting jig has a nearly circular shape.

[0250] Fig. 27 (a) is a sectional structural diagram of the compound and inserting jig used in exemplary embodiment 35, and Fig. 27 (b) is a perspective view of the inserting jig. The inner section of the piping 6 has a circular shape. The inserting jig 40 has a cylindrical shape. The compound 7 is columnar cylinder. First of all, the compound 7 is set in the inserting jig 40. The leading end of the inserting jig 40 containing the compound is inserted into the inlet of the piping 6. While maintaining this state, only the compound is pushed out into the piping by finger or pushing bar or other means until the compound 7 is completely inserted into the piping 6. After the compound 47 is inserted into the piping 6, the inserting jig 40 is removed from the piping 6.

[0251] Consequently, a pressure-proof hose 9 is connected to the piping. Nitrogen pressure generated from a nitrogen cylinder 8 is passed into the pressure-proof hose 9. By this pressure, the compound 7 moves in the piping 6. The compound moves while removing the foreign matter in the piping, and the foreign matter in the piping is discharged together with the compound. Thus, the foreign matter in the piping is cleaned.

[0252] Thus, by using the inserting jig, the compound can be securely inserted into the piping without deforming the shape of the compound.

Exemplary Embodiment 43

[0253] In embodiment 43, the first opening has a smaller aperture than the second opening.

[0254] Fig. 28 (a) is a sectional structural diagram of the compound and inserting jig used in exemplary embodiment 36, and Fig. 28 (b) is a perspective view of the inserting jig. The inner section of the piping 6 has a circular shape. The inserting jig 42 has a hollow conical shape, and its both ends have openings. A first opening 41a at one end of the inserting jig 42 has a smaller outside diameter than the inside diameter of the piping 6, and a second opening 42b at other end has a larger outside diameter than the inside diameter of the piping 6. That is, the inserting jig 42 has a tapered cylindrical shape. In the first place, the compound 7 is set in the inserting jig 42 through the second opening 42b. Next, the leading end of the first opening 42a of the inserting jig 42 containing the compound 7 is inserted into the inlet of the piping 6. While maintaining this state, only the compound is pushed out into the piping by finger or pushing bar or other means until the compound 7 is completely inserted into the piping 6. After the compound 7 is inserted into the piping 6, the inserting jig 42 is removed from the piping 6. Or, in the first place, the

first opening 42a of the inserting jig 42 is inserted into the piping 6. Then, the compound 7 is set into the inserting jig 42 from the second opening 42b. Further, the compound 7 is pushed completely into the piping 6. Next, only the inserting jig 42 is removed from the piping. Finally, the foreign matter in the piping is removed in the same manner as in embodiment 35.

[0255] Thus, since the diameter of the leading end (first opening) of the cylindrical inserting jig is smaller than the diameter of the rear end (second opening) for inserting the compound, the compound can be easily inserted into the piping.

Exemplary Embodiment 44

[0256] In embodiment 43, the piping has a flare nut, the first opening has a joint to be connected to the flare nut, and the second opening has a cylindrical shape.

[0257] Fig. 29 (a) is a sectional structural diagram of the compound and inserting jig used in exemplary embodiment 37, and Fig. 29 (b) is a perspective view of the inserting jig. The inner section of the piping 6 has a circular shape. A flare nut 44 is connected to the opening of the piping 6. An inserting jig 43 is a cylindrical structure having a flare joint 43a. The flare joint 43a can be engaged with the flare nut 44. Preferably, the leading end of the inserting jig 43 can be engaged with the opening of the piping 6.

[0258] (a) First of all, the compound 7 is set in the inserting jig 43. The flare joint 43a of the inserting jig 43 containing the compound is engaged with the flare nut 44. The flare nut 44 coupled with the inserting jig 43 is connected to the piping 6. Or, (b), first the flare nut 44 is connected to the piping 6. Then the flare joint 43a of the inserting jig 43 is engaged with the flare nut 44. The compound 7 is then inserted into the inserting jig 43. Or, (c), the compound 7 is set in the inserting jig 43. On the other hand, the flare nut 44 is connected to the piping 6. Then the flare joint 43a of the inserting jig 43 containing the compound 7 is engaged with the flare nut 44. In any method of (a), (b), or (c), after inserting the compound 7 into the inserting jig 43, while maintaining this state, only the compound is pushed out into the piping by finger or pushing bar or other means until the compound 7 is completely inserted into the piping 6. After the compound 7 is inserted into the piping 6, the inserting jig 43 and flare nut 44 are removed from the piping 6. Finally, the foreign matter in the piping is removed in the same manner as in embodiment 35. In this method, since the compound is inserted into the piping with the compound held in the inserting jig 43, flare nut 44 or piping, the compound can be inserted into the piping safely and securely.

Exemplary Embodiment 45

[0259] In embodiment 43, the piping has a flare nut, the first opening has a joint to be connected to the flare

nut, the second opening has a conical shape, and the joint and the conical portion are formed integrally.

[0260] Fig. 30 (a) is a sectional structural diagram of the compound and inserting jig used in exemplary embodiment 37, and Fig. 30 (b) is a perspective view of the inserting jig. The inner section of the piping 6 has a circular shape. A flare nut 44 is connected to the opening of the piping 6. An inserting jig 45 is a hollow structure having a flare joint 45a and a conical portion 45b. The conical portion 45b and flare joint 45a are integrally joined, and the conical portion 45b has a larger aperture from the flare joint 45a toward the opening. That is, the inserting jig has a first opening positioned at the flare joint 45a, and a conical second opening. The flare joint 45a can be engaged with the flare nut 44. The flare joint 45a of the inserting jig 45 can be engaged with the flare nut 44. The second opening 42b has a larger outside diameter than the inside diameter of the piping 6. That is, the conical portion 45b of the inserting jig 45 has a tapered cylindrical shape. Preferably, the flare joint 45a of the inserting jig 45 can be engaged with the opening of the piping 6.

[0261] Using such compound 7, inserting jig 45 and flare nut 44, after inserting the compound 7 into the inserting jig 45 in any method of (a), (b), or (c) of the foregoing embodiment 36, while maintaining this state, only the compound is pushed out into the piping by finger or pushing bar or other means until the compound 7 is completely inserted into the piping 6. After the compound 7 is inserted into the piping 6, the inserting jig 45 and flare nut 44 are removed from the piping 6. Finally, the foreign matter in the piping is removed in the same manner as in embodiment 35. In this method, since the compound is inserted into the piping with the compound held in the inserting jig 45, flare nut 44 or piping, the compound can be inserted into the piping safely and securely. In particular, the compound inserting job is extremely easy and the effects are further enhanced.

[0262] In the individual exemplary embodiments, if the compound to be conveyed has a stiff property, it is preferred that its outside diameter is about 10% smaller than the inside diameter of the piping. As a result, the piping is hardly damaged. It is therefore preferred to compose the compound of resin or the like. The compound is preferred to have a hardness at least smaller than that of the copper. When the compound is elastic, the compound is preferred to have an outer diameter larger than by about 5% or less than the inside diameter of the piping. It has hence extremely enhanced the effect of scraping the oil sticking to the inner wall of the piping.

[0263] In the exemplary embodiments, the ultrafine fibers are fibers having the fiber diameter of 1 denier or less, according to the definition that 1 denier is the length of 1 g weight of fiber being 9000 meters. The denier method fiber diameter is the unit applied to the filament and yarn of cloth, and it is the constant length system expressing the thickness of the yarn by the weight per unit length. The ultrafine fibers have their features in the

fineness and shape of fibers. The fiber material is nylon or polyester. Usually, fibers of 1 denier or less are woven in dense state. In this fiber manufacturing method, the fiber are spun in assembled state, and the spun matter is separated later.

[0264] The manufacturing method of ultrafine fibers applied to the exemplary embodiments is either split type or peeling type. By using ultrafine fibers of 0.3 denier or less, copper powder, iron powder and other contaminations collected in the refrigeration cycle used for a long period were eliminated efficiently. The split type manufacturing method is shown in Fig. 16. In Fig. 16, one fiber is separated into two components. Each fiber of ultrafine fibers manufactured according to Fig. 16 has a triangular section with a sharp edge. Accordingly, the ultrafine fibers have an excellent wiping (scraping) effect of oil stain, copper powder, iron powder, and other contamination sticking to the inner wall of the piping. The peeling type manufacturing method is shown in Fig. 17. In Fig. 17, one fiber is peeled into a plurality of components. Each fiber of ultrafine fibers manufactured according to the method of Fig. 17 has a flat shape. The fibers having such a flat shape are twisted, and the wiping (scraping) effect of oil stain, copper powder, iron powder and other contamination is outstanding. Once scraped off, the contamination is entrapped in the entangled fibers, and is hardly desorbed again. Therefore, in these exemplary embodiments, the ultrafine fibers have an extremely excellent effect in the application of eliminating the contamination sticking to the inside of the copper piping.

[0265] The conveying pressure of the compressed gas applied in the exemplary embodiments is preferably about 0.55 kgf/cm² to 5 kgf/cm². In the exemplary embodiments, the conveying pressure of the compressed gas of 2 kgf/cm² and 4 kgf/cm² is presented. If the pressure was higher than 5 kgf/cm², in exemplary embodiment 1, slipping of the gas on the component to be conveyed tended to be too large. In exemplary embodiments 6 to 8, or 9 to 12, the conveying speed is too fast for deposit scraping or wiping operation by the hair fibers or nonwoven cloth. Accordingly, the oil removal rate tended to decline. In the cold climate in winter, for example, at ambient temperature of 5°C, this tendency was more obvious. Therefore, the conveying pressure of the compressed gas must be controlled in consideration of the meteorological condition and the properties of the compound to be conveyed. At the conveying pressure of about 0.5 kgf/cm² or less, if the piping diameter is 1/4 inch and the piping length is long, the pressure loss is large, and the compound cannot be conveyed sufficiently, and clogging of compound in the midst of the piping may take place. As the efficient conveying method, the conveying pressure should be preferably controlled so as to be low when introducing the compound, and higher as the compound is remote from the inlet while advancing through the copper piping.

[0266] The compressed gas applied in the exemplary

embodiments is generally air or nitrogen. These gases are easily available, and by using air or nitrogen, the working efficiency of installation is improved. When air or nitrogen passes through a hollow filter of polyamide or the like, a dry air with dew point of -30°C or less can be obtained. By limiting the moisture content of the feed gas, the residual moisture at the end of cleaning work of the existing piping can be lowered. That is, by feeding dry gas, the moisture existing inside can be discharged together with the feed gas.

[0267] The existing piping cleaning method of the exemplary embodiments can be applied when changing from the air conditioner using R410A refrigerant to other air conditioner using the same R410A refrigerant. Moreover, the exemplary embodiments are also applicable to the air conditioner using ester oil or ether oil as the refrigerating machine oil.

[0268] In the exemplary embodiments, the word of "lipophilic" has the same meaning as the word of "oleophilic".

[0269] Thus, according to the invention, the oil remaining and sticking in the existing piping can be discharged outside of the piping by the excluding volume effect taking place when the compound is conveyed by a compressed gas. Therefore, the existing piping can be used continuously as the piping for a new air conditioner to be installed. Moreover, the new air conditioner using the existing piping has an excellent long-term reliability.

Claims

1. A piping cleaning method of air conditioner for removing foreign matter existing inside a piping (6) installed between an indoor unit (2, 3, 4, 5) and an outdoor unit (1) comprising the steps of:
 - (a) inserting a compound (7) from an opening of said piping,
 - (b) leading a compressed gas from said opening into said piping, and conveying said compound through said piping while keeping said compound in contact with the inner wall of said piping, and
 - (c) removing the foreign matter existing in said piping, together with said compound, from said piping.
2. The piping cleaning method of air conditioner of claim 1, further comprising a step of repeating said step (a), step (b), and step (c) a plurality of times.
3. The piping cleaning method of air conditioner of claim 1, wherein said compound has a plurality of compounds, and the foreign matter in the piping is removed by the use of said plurality of compounds.
4. The piping cleaning method of air conditioner of claim 3, wherein at least one of said plurality of compounds is a lipophilic compound, and at least one of said plurality of compounds is a hydrophilic compound.
5. The piping cleaning method of air conditioner of any one of claims 1 to 4, further comprising:
 - (d) a step of operating the air conditioner for a specific time in heating mode to raise the temperature in the piping,
 - wherein the compound is inserted from one opening after the step of operating the air conditioner for a specific time in heating mode.
6. The piping cleaning method of air conditioner of any one of claims 1 to 5, wherein said compound is nearly in a form of circular cylinder, and the compound has flexibility and elasticity for retaining the degree of freedom of shape in the piping.
7. The piping cleaning method of air conditioner of any one of claims 1 to 6, wherein said compound has a groove (12a) processed in the side thereof.
8. The piping cleaning method of air conditioner of claim 7, wherein said groove is processed by any one of threading, spiral groove processing, or parallel groove processing.
9. The piping cleaning method of air conditioner of any one of claims 1 to 8, wherein said compound has a recess (15a) disposed in the conveying direction, and this compound is conveyed in the piping while collecting foreign matter in the piping in this recess.
10. The piping cleaning method of air conditioner of any one of claims 1 to 9,
 - wherein said compound is nearly in a form of circular cylinder,
 - the outside diameter of the compound is larger than the inside diameter of the piping, and
 - the compound is moved while rubbing against the inner wall of the piping.
11. The piping cleaning method of air conditioner of any one of claims 1 to 9, wherein said compound has an O-ring elastomer (14) disposed at the side surface thereof, and the compound moves while said O-ring elastomer is contacting with the inner wall of the piping.
12. The piping cleaning method of air conditioner of any one of claims 1 to 11, wherein said compound has a flocky side surface (18), and the compound is conveyed in the piping while the flocky side surface is contacting with the inner wall of the piping.

13. The piping cleaning method of air conditioner of any one of claims 1 to 11, wherein the side surface of said compound is covered with a nonwoven cloth (20). 5
14. The piping cleaning method of air conditioner of any one of claims 1, 2, and 5 to 13, wherein said compound has an lipophilic side surface.
15. The piping cleaning method of air conditioner of any one of claims 1 to 14, wherein said compound has a bulk density in a range of 0.1 to 0.6 g/ml. 10
16. The piping cleaning method of air conditioner of any one of claims 1 to 15, wherein said compound has an elastomer with a hardness of 60 or less as measured in spring type A. 15
17. The piping cleaning method of air conditioner of any one of claims 1 to 15, wherein said compound is an elastomer, and more specifically said elastomer is a foamed molded element with a bulk density of 0.1 to 0.6 g/ml. 20
18. The piping cleaning method of air conditioner of any one of claims 1 to 15, wherein said compound has a side surface composed of at least one film material (21) of plastic film material or elastomer film material, and a liquid (22) in its inside of said film material. 25
19. The piping cleaning method of air conditioner of claim 18, wherein said compound has a nonwoven cloth (23) disposed at the side surface of said film material. 30
20. The piping cleaning method of air conditioner of claim 18, wherein said compound has a cloth disposed at the side surface of said film material, and said cloth is a woven cloth of ultrafine fibers (26). 35
21. The piping cleaning method of air conditioner of any one of claims 1, 2 and 5 to 15, wherein said compound has a molded element made of oleophilic fibers, and said molded element has a bulk density in a range of 0.1 to 0.6 g/ml. 40
22. The piping cleaning method of air conditioner of any one of claims 1, 2 and 5 to 15, wherein said compound has a molded element made of lipophilic fibers, and oil retained in the molded element, and said molded element has a bulk density in a range of 0.05 to 0.6 g/ml. 45
23. The piping cleaning method of air conditioner of claim 3, wherein 55
- at least one of said plurality of compounds is an oleophilic compound, and
at least one of said plurality of compounds is a hydrophilic compound, said compound having at least one selected from the group consisting of
- (i) an oleophilic side surface,
(ii) a bulk density in a range of 0.1 to 0.6 g/ml; and
(iii) a molded element made of oleophilic fibers, said molded element having a bulk density in a range of 0.1 to 0.6 g/ml.
24. The piping cleaning method of air conditioner of claim 4, wherein said hydrophilic compound has a bulk density in a range of 0.1 g/ml to 0.6 g/ml.
25. The piping cleaning method of air conditioner of claim 24, wherein the side surface of said hydrophilic compound has a woven cloth of an ultrafine fiber (30, 32).
26. The piping cleaning method of air conditioner of claim 22, wherein said oil includes hard alkyl benzene.
27. The piping cleaning method of air conditioner of claim 26, wherein said oil has a dynamic viscosity of 9.0 to 74.8 mm²/s at 40°C, and has a high viscosity at high temperature of the environmental conditions.
28. The piping cleaning method of air conditioner of any one of claims 20, 21 and 25, wherein said ultrafine fibers have a fiber diameter of 0.3 denier or less.
29. The piping cleaning method of air conditioner of any one of claims 20, 21, 25, and 28, wherein said ultrafine fibers are at least split type fibers (16) or peeling type fibers (17).
30. The piping cleaning method of air conditioner of any one of claims 1 to 29, wherein said compressed gas has a conveying pressure in a range of 0.5 to 5 kgf/cm².
31. The piping cleaning method of air conditioner of any one of claims 1 to 29, wherein said compressed gas is a dry gas of which dew point is -30°C or less.
32. The piping cleaning method of air conditioner of any one of claims 1 to 31, wherein said compressed gas includes at least either air or nitrogen.
33. The piping cleaning method of air conditioner of any one of claims 1 to 32, wherein

said step (a) includes a step of inserting said compound from one opening of said piping, said step (b) includes a step of feeding said compressed gas into said piping from one opening of the piping, and
 said step (c) includes a step of discharging the foreign mater existing in the piping from other opening of the piping together with the compound.

34. The piping cleaning method of air conditioner of claim 1, wherein said compound has a bellows shape.

35. The piping cleaning method of air conditioner of claim 3 or 4, wherein said steps (a), (b), and (c) include:

a step of inserting a first compound of said plurality of compounds from an opening of said piping,
 a step of feeding said compressed gas into the piping from the opening, and conveying said first compound in the piping while keeping contact with the inner wall of the piping, and
 a step of discharging the foreign mater existing in the piping from the piping together with the first compound, followed by:

a step of inserting a second compound of said plurality of compounds from an opening of said piping,
 a step of feeding said compressed gas into the piping from the opening, and conveying said second compound in the piping while keeping contact with the inner wall of the piping, and
 a step of discharging the foreign mater existing in the piping from the piping together with the second compound.

36. The piping cleaning method of air conditioner of claim 3 or 4, wherein said steps (a), (b), and (c) include a step of inserting a first compound and a second compound of said plurality of compounds into said piping, and moving said first compound and second compound in the piping by said compressed gas.

37. The piping cleaning method of air conditioner of any one of claims 1 to 36, further comprising the steps of:

(d) dismounting an existing indoor unit from said piping,
 (e) dismounting an existing outdoor unit from said piping,
 (f) connecting a new indoor unit to said piping,

and
 (g) connecting a new outdoor unit to said piping,

wherein the foreign matter is removed from the piping at said steps (a), (b), and (c) after dismounting said existing indoor unit and outdoor unit, and then said new indoor unit and outdoor unit are connected to said piping.

38. The piping cleaning method of air conditioner of claim 1,

wherein said compound has an lipophilic property, and
 said step of conveying the compound in the piping includes the steps of:

putting oil into the piping from one opening of the piping, and
 conveying the oil, together with the compound, in the piping.

39. The piping cleaning method of air conditioner of claim 1,

wherein said step of conveying the compound in the piping includes the steps of:

soaking the compound with oil, and
 conveying the compound soaked with oil in the piping.

40. The piping cleaning method of air conditioner of claim 1,

wherein said step of conveying the compound in the piping includes the steps of:

soaking the compound with oil,
 putting further oil into the piping from one opening of the piping, and
 conveying the compound soaked with oil, together with the further oil, in the piping.

41. The piping cleaning method of air conditioner of claim 1,

wherein said step of feeding the compressed gas into the piping includes the step of:

controlling the compressed gas to a predetermined pressure.

42. The piping cleaning method of air conditioner of claim 1,

wherein said step of feeding the compressed gas into the piping includes the step of:

detecting when the compound is discharged from the piping.

43. The piping cleaning method of air conditioner of claim 1,

wherein said step of feeding the compressed gas into the piping includes the step of:
controlling the compressed gas while changing to a desired pressure.

44. The piping cleaning method of air conditioner of claim 1,

wherein said step of feeding the compressed gas into the piping includes the steps of:

controlling the compressed gas to a desired pressure, and
detecting when the compound is discharged from the piping.

45. The piping cleaning method of air conditioner of claim 42 or 44,

wherein said step of detecting when the compound is discharged from the piping includes the step of:

detecting the pressure of the compressed gas in the piping at the compound inserting side of the piping.

46. The piping cleaning method of air conditioner of claim 41, 43 or 44,

wherein said step of controlling the compressed gas to a desired pressure includes the step of:

detecting a flow rate of the compressed gas in the piping at the compound inserting side of the piping.

47. The piping cleaning method of air conditioner of any one of claims 42 to 46,

wherein said step of feeding the compressed gas into the piping includes the step of:

detecting a pressure of the compressed gas by a pressure gauge installed in the connection piping for connecting the piping and the compressed gas generating device.

48. A compound used in an air conditioner as set forth in any one of claims 1 to 47.

49. A compound (7) used for cleaning the inside of a piping (6) installed between an indoor unit (2, 3, 4, 5) and an outdoor unit (1) of an air conditioner, said compound removing the foreign matter in the piping by passing through the piping while contacting with the inner wall of said piping, said compound comprising of;

an outer circumference nearly coinciding with the circumference of the section of the inner wall of the piping, and
a front surface nearly coinciding with the sectional shape of the piping.

50. The compound of claim 49, wherein the section of said outer circumference is nearly circular.

51. The compound of claim 49 or 50, wherein said outer circumference and front surface have an integrally formed molded element.

52. The compound of claim 49 or 50, wherein said outer circumference, the front surface, and the inside enclosed by the outer circumference and front surface have a fiber molded element made of fibers.

53. The compound of claim 49 or 50, further containing a liquid, wherein said outer circumference is formed of a film, and the inside covered with the outer circumference is filled with said liquid.

54. The compound of claim 49 or 50, wherein said outer circumference, the front surface, and the inside enclosed by the outer circumference and front surface have a foamed molded element.

55. The compound of any one of claims 49, 50, 51 and 52, wherein said outer circumference has a groove (12a) formed on the outer circumference thereof.

56. The compound of any one of claims 49, 50, 51, and 52, further comprising an O-ring elastomer disposed on the outer circumference, wherein said O-ring elastomer can contact with the inner wall of the piping.

57. The compound of any one of claims 49, 50 and 51, wherein said front surface has a recess, and when conveyed in the piping with said recess positioned in the conveying direction, the foreign matter is collected in the recess.

58. The compound of any one of claims 49, 50 and 51, wherein said outer circumference is shaped like bellows, and is free to expand and contract in the conveying direction.

59. The compound of any one of claims 49, 50, 51, 52 and 53, wherein said outer circumference has hair fibers.

60. The compound of any one of claims 49, 50, 51, 52 and 53, wherein said outer circumference has a nonwoven cloth.

61. The compound of any one of claims 49, 50, 51, 52 and 53, wherein said outer circumference has ultrafine fibers.

62. The compound of any one of claims 52, 60 and 61, further comprising an oil, wherein said oil is impregnated in said fiber molded element, ultrafine fibers,

or nonwoven cloth.

63. The compound of claim 49, further comprising an oil, wherein said oil is soaked in the compound.

64. The compound of claim 63,
wherein said compound has a first molded body positioned at the upstream side of the piping, and a second molded body positioned at the downstream side; and
at least one of said first molded body and second molded body is soaked with the oil.

65. The compound of claim 63,
wherein said compound has a first molded body positioned at the upstream side of the piping, and a second molded body positioned at the downstream side; and
at least one of said first molded body and second molded body has a foamed body.

66. The compound of claim 63,
wherein said compound has a first molded body positioned at the upstream side of the piping, and a second molded body positioned at the downstream side; and
at least one of said first molded body and second molded body has a nonwoven cloth.

67. The compound of claim 63,
wherein said compound has a first molded body positioned at the upstream side of the piping, and a second molded body positioned at the downstream side; and
at least one of said first molded body and second molded body has a foamed body, and the other one of said first molded body and second molded body has a nonwoven cloth.

68. The compound of claim 49,
wherein said compound further has a rope disposed on at least one side of the rear side and front side.

69. The compound of claim 68,
wherein said rope is wound around the peripheral end of at least one side.

70. The compound of claim 68,
wherein at least one side has a curved surface formed by winding of said rope.

71. A cleaning apparatus for cleaning a piping (6) installed between an indoor unit (2, 3, 4, 5) and an outdoor unit (1) of an air conditioner, comprising:

a compound (7) inserted into said piping from

one opening end of the piping and discharged from other opening end, and
a compressed gas generator (8, 9, 10) for generating a compressed gas for pressing the compound the piping,

wherein said compound is conveyed in the piping while contacting with the inner wall of the piping and being pressed by said compressed gas, and foreign matter existing in the piping is discharged from the piping together with the compound.

72. The cleaning apparatus of claim 71, wherein said compound has a tubular molded element.

73. The cleaning apparatus of claim 71, wherein said compound has a fiber molded element formed of fiber material.

74. The cleaning apparatus of claim 71, wherein said compound has a foamed molded element.

75. The cleaning apparatus of claim 71, wherein said compound has an outer circumference made of a film material, and a liquid contained in the inside enclosed by said film material.

76. The cleaning apparatus of any one of claims 71, 72, 73, 74 and 75, wherein said molded element has hair fibers disposed on the outer circumference.

77. The cleaning apparatus of any one of claims 71, 72, 73, 74 and 75, wherein said molded element has a nonwoven cloth disposed on the outer circumference.

78. The cleaning apparatus of any one of claims 71, 72, 73, 74 and 75, wherein said molded element has ultrafine fibers disposed on the outer circumference.

79. The cleaning apparatus of any one of claims 73, 74, 76, 77, and 78, wherein said compound further contains an oil, and said oil is impregnated in said fiber molded element, foamed molded element, hair fibers, ultrafine fibers, or nonwoven cloth.

80. The cleaning apparatus of claim 71,
wherein said compound further includes an oil, and said oil is soaked in the compound.

81. The cleaning apparatus of claim 80,
wherein said compound has a first molded body positioned at the upstream side of the piping, and a second molded body positioned at the downstream side; and
at least one of said first molded body and second molded body is soaked with the oil.

- 82.** The cleaning apparatus of claim 80,
 wherein said compound has a first molded
 body positioned at the upstream side of the piping,
 and a second molded body positioned at the down-
 stream side; and
 at least one of said first molded body and sec-
 ond molded body has a foamed body.
- 83.** The cleaning apparatus of claim 80,
 wherein said compound has a first molded
 body positioned at the upstream side of the piping,
 and a second molded body positioned at the down-
 stream side; and
 at least one of said first molded body and sec-
 ond molded body has a nonwoven cloth.
- 84.** The cleaning apparatus of claim 80,
 wherein said compound has a first molded
 body positioned at the upstream side of the piping,
 and a second molded body positioned at the down-
 stream side; and
 at least one of said first molded body and sec-
 ond molded body has a foamed body, and
 the other one of said first molded body and sec-
 ond molded body has a nonwoven cloth.
- 85.** The cleaning apparatus of claim 71,
 wherein said compound further has a rope
 disposed on the front side.
- 86.** The cleaning apparatus of claim 85,
 wherein said front side has a curved surface
 formed by winding of said rope.
- 87.** The cleaning apparatus of claim 71, further comprising:
 a pressure regulator for controlling the pressure
 of the compressed gas.
- 88.** The cleaning apparatus of claim 71, further comprising:
 a detector for detecting when the compound
 is discharged from the piping.
- 89.** The cleaning apparatus of claim 71, further comprising:
 a pressure regulator for controlling the pressure
 of the compressed gas, and
 a detector for detecting when the compound is
 discharged from the piping.
- 90.** The cleaning apparatus of claim 88 or 89,
 wherein said detector is installed near the
 opening of the piping positioned at the insertion side
 of the compound.
- 91.** The cleaning apparatus of any one of claims 87 to
 91,
 wherein said pressure generating device in-
 cludes a flow rate detector for detecting the flow rate
 of the compressed gas, and
 said flow rate detector is installed near the
 opening of the piping positioned at the insertion side
 of the compound.
- 92.** The cleaning apparatus of any one of claims 81 to
 91,
 wherein said pressure generating device in-
 cludes a pressure generating source (8), a connec-
 tion piping (9), and a pressure gauge connected to
 the connection piping, and
 said pressure gauge detects the pressure of
 the compressed gas in the piping.
- 93.** The cleaning apparatus of claim 71, further comprising:
 an inserting jig for inserting the compound into
 the piping, wherein said inserting jig includes
 a first opening to be inserted into the piping, and
 a second opening capable of inserting the com-
 pound therein.
- 94.** The cleaning apparatus of claim 93,
 wherein said inserting jig has a nearly circular
 shape.
- 95.** The cleaning apparatus of claim 93,
 wherein said first opening has a smaller aper-
 ture than said second opening.
- 96.** The cleaning apparatus of claim 93,
 wherein said piping has a flare nut,
 said first opening has a joint to be connected to
 said flare nut, and
 said second opening has a cylindrical shape.
- 97.** The cleaning apparatus of claim 93,
 wherein said piping has a flare nut,
 said first opening has a joint to be connected to
 said flare nut,
 said second opening has a conical shape, and
 said joint and conical portion are formed inte-
 grally.
- 98.** An inserting jig (40, 42, 43, or 45) for inserting a
 compound used for cleaning of a piping (6) installed
 between an indoor unit (2,3, 4 or 5) and an outdoor
 unit (1) of an air conditioner,
 said compound capable of removing foreign
 matter in the piping while passing through the

piping,
said piping having a circular inner section, and
said compound having a nearly circular outer
section,
said inserting jig comprising of:

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a first opening to be inserted into the piping,
and
a second opening capable of inserting the
compound therein.

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99. The inserting jig of claim 98,
wherein said inserting jig has a nearly circular
shape.

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100. The inserting jig of claim 98,
wherein said first opening has a smaller aper-
ture than said second opening.

101. The inserting jig of claim 98,
wherein said piping has a flare nut,

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said first opening has a joint to be connected to
said flare nut, and
said second opening has a cylindrical shape.

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102. The inserting jig of claim 98,
wherein said piping has a flare nut,

said first opening has a joint to be connected to
said flare nut,
said second opening has a conical shape, and
said joint and conical portion are formed inte-
grally.

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Fig. 1

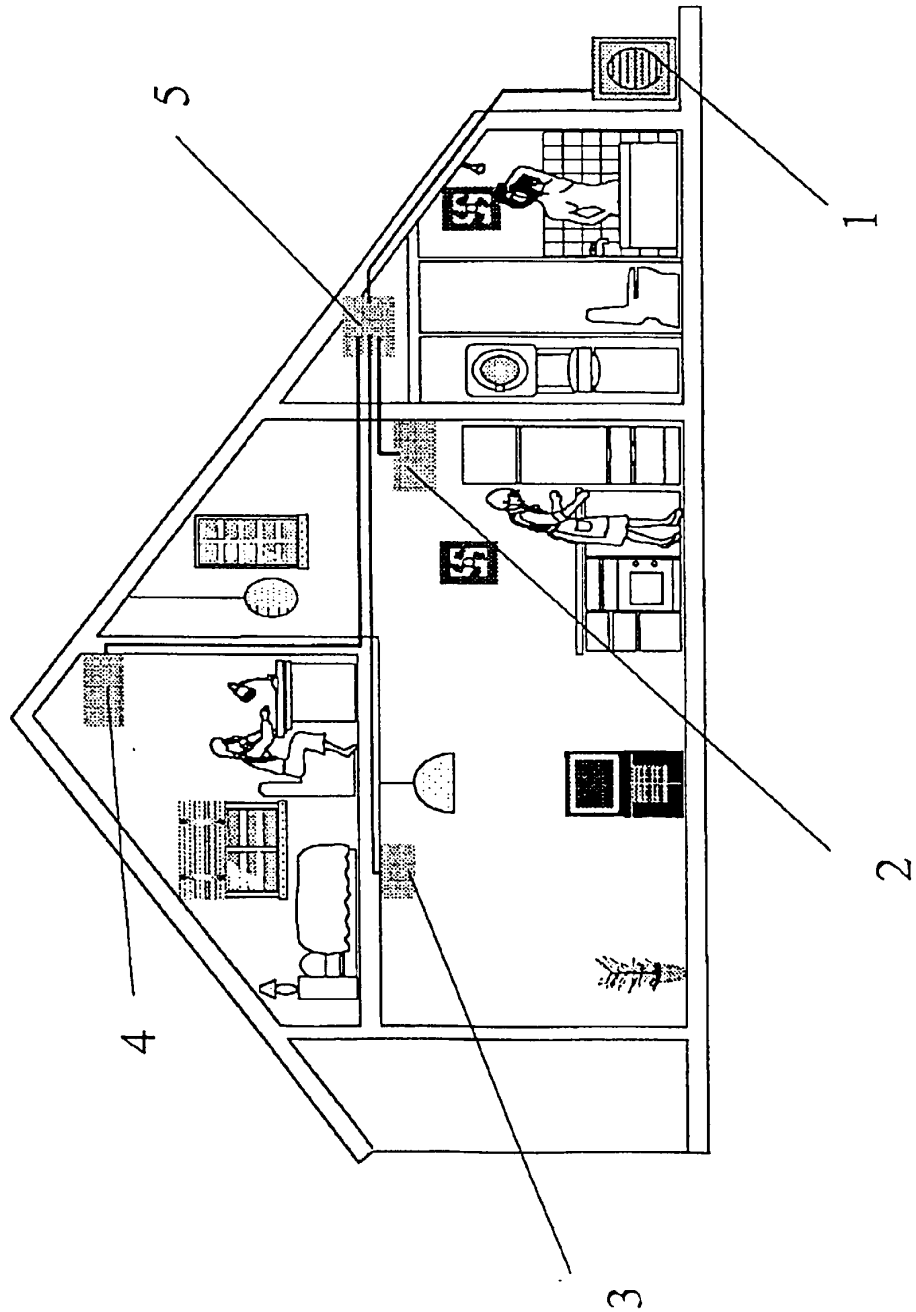
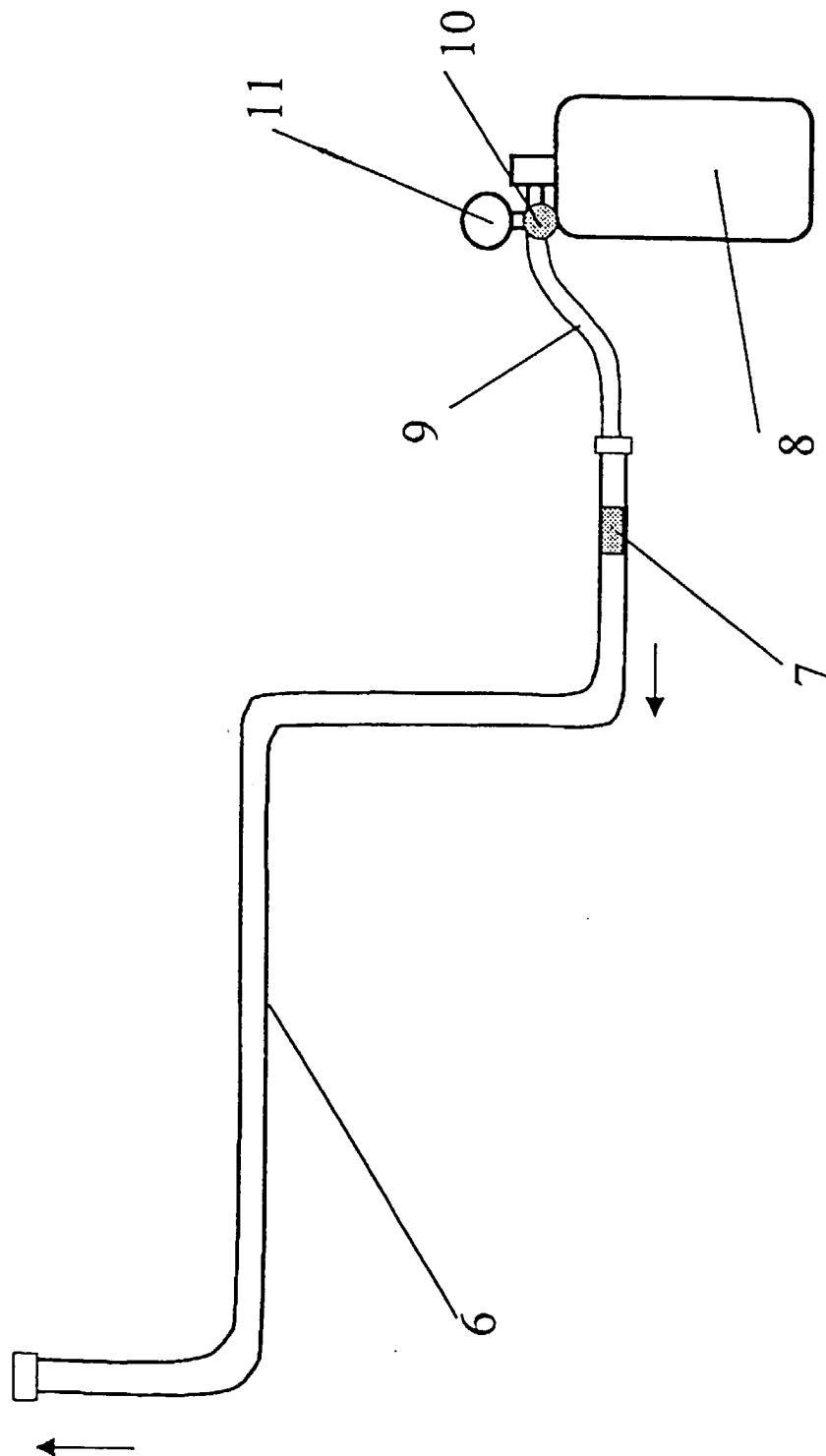
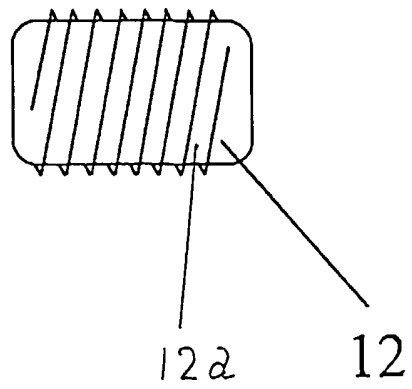


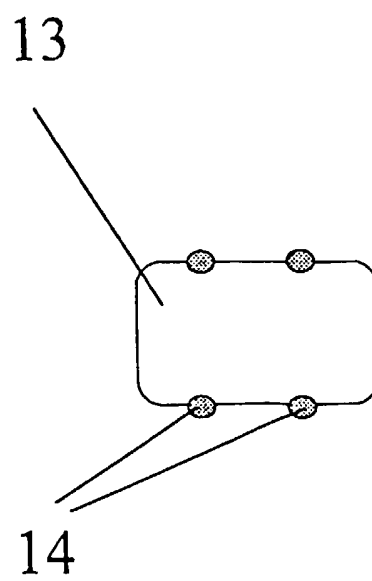
Fig. 2



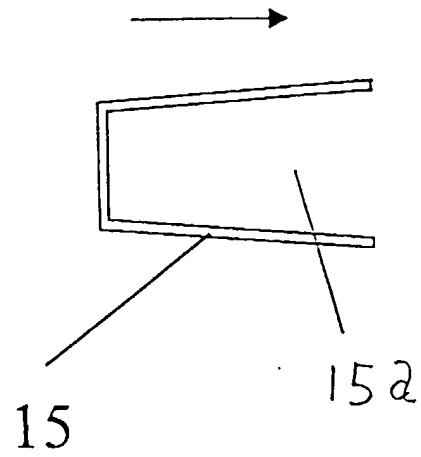
F i g. 3



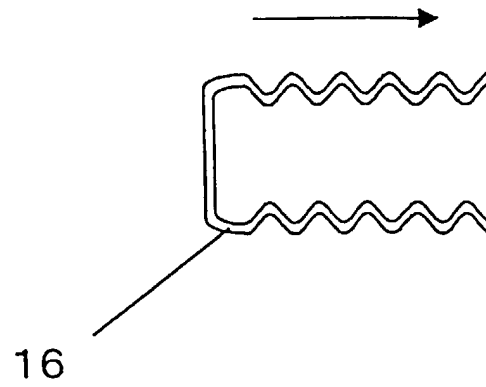
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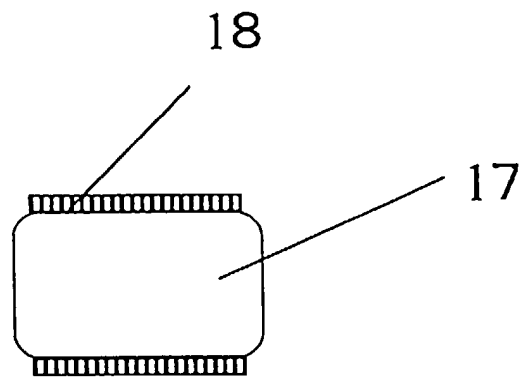
F i g . 5



F i g . 6



F i g. 7



F i g. 8

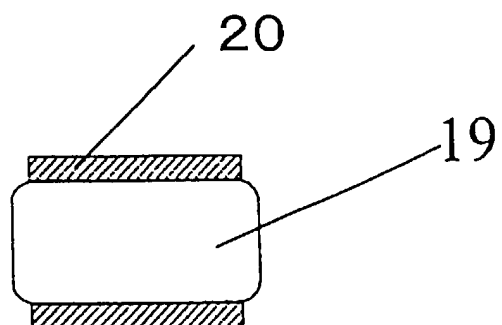
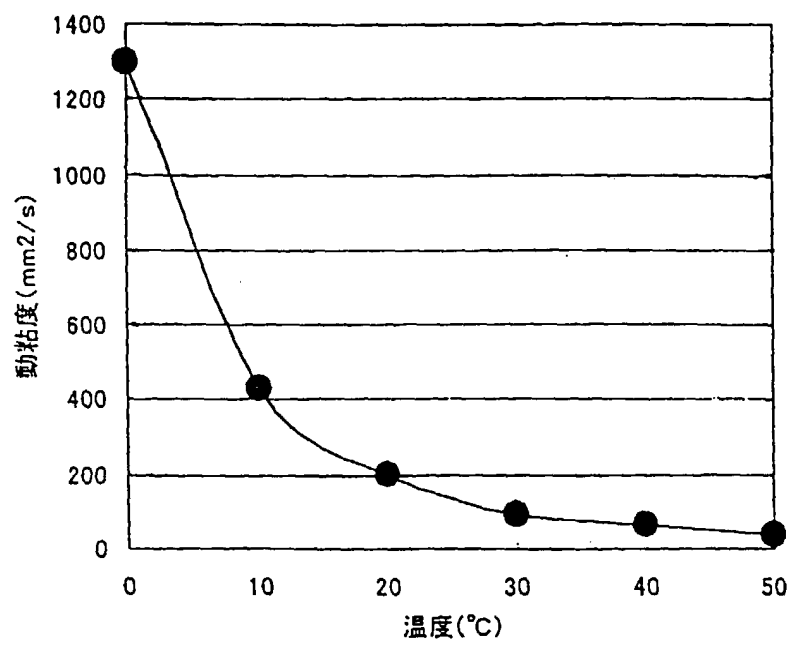
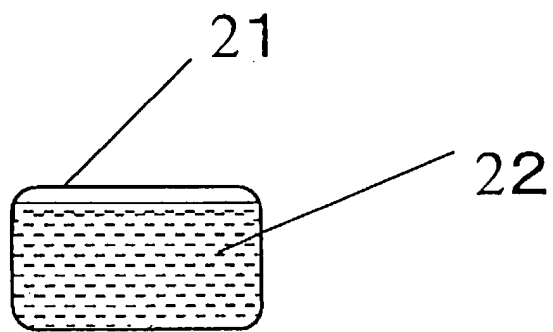


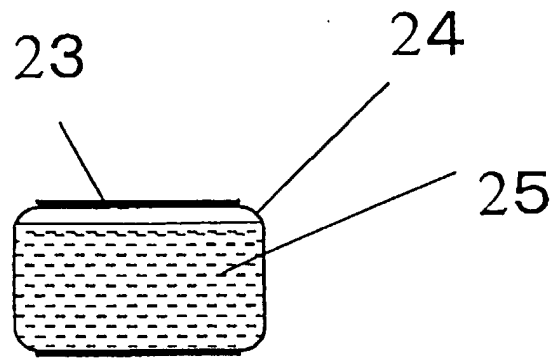
Fig. 9



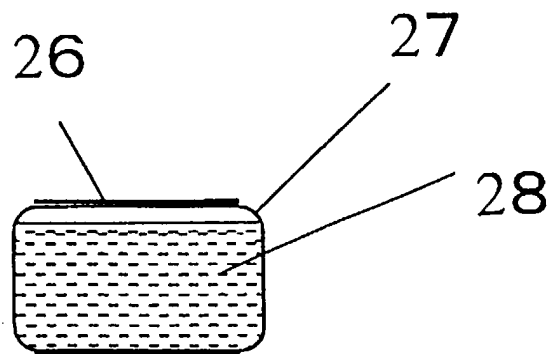
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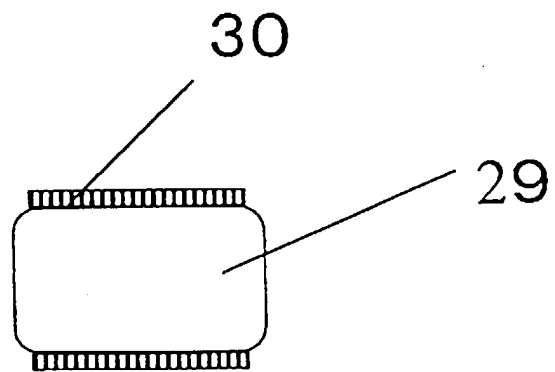
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F i g. 1 2



F i g. 1 3



F i g. 1 4

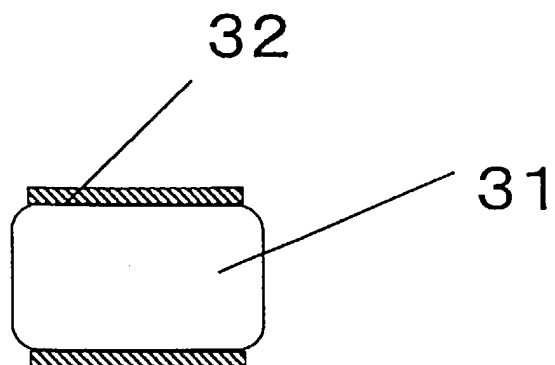
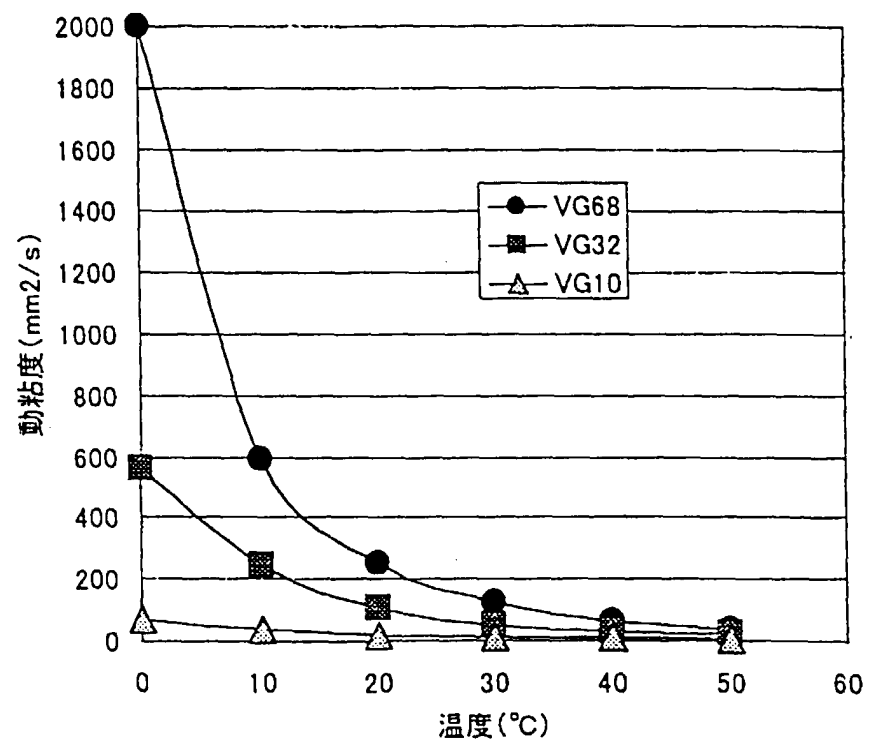
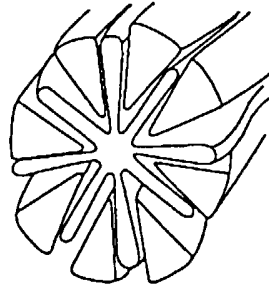


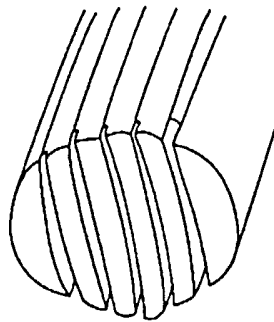
Fig. 15



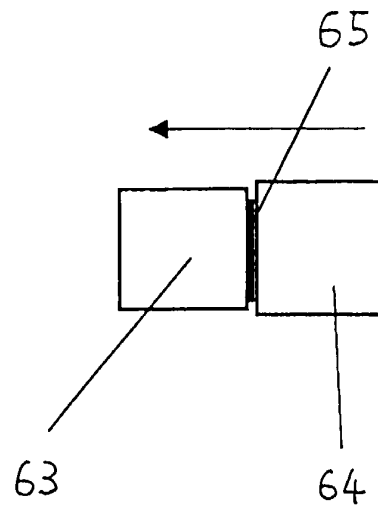
F i g. 1 6



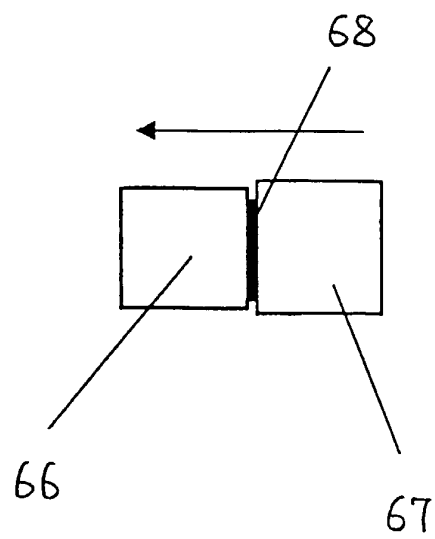
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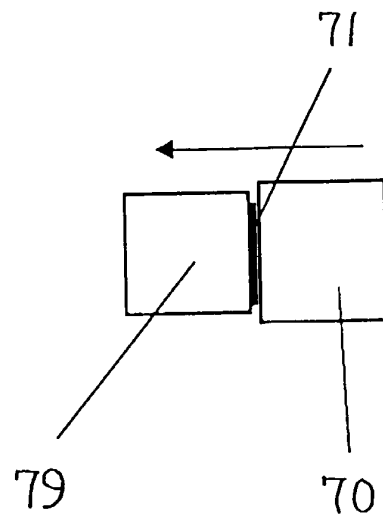
F i g. 18



F i g. 19



F i g. 2 0



F i g. 2 1

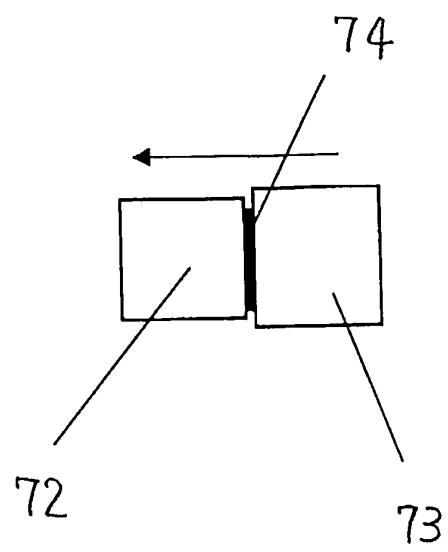


Fig. 22

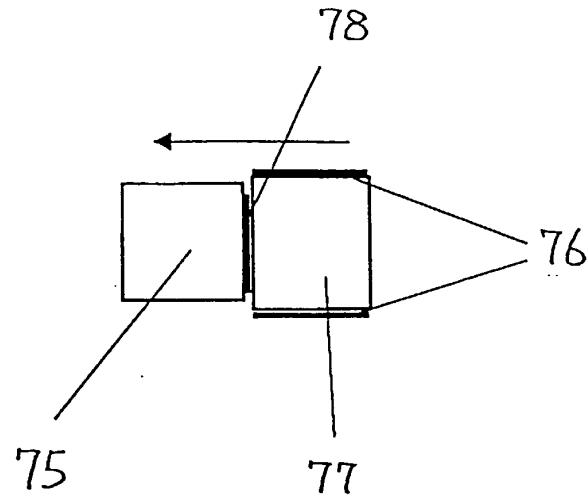
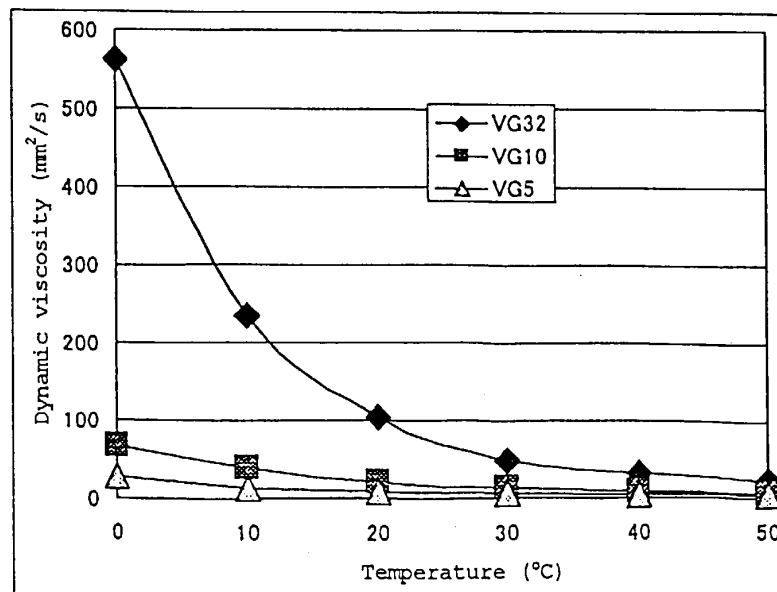
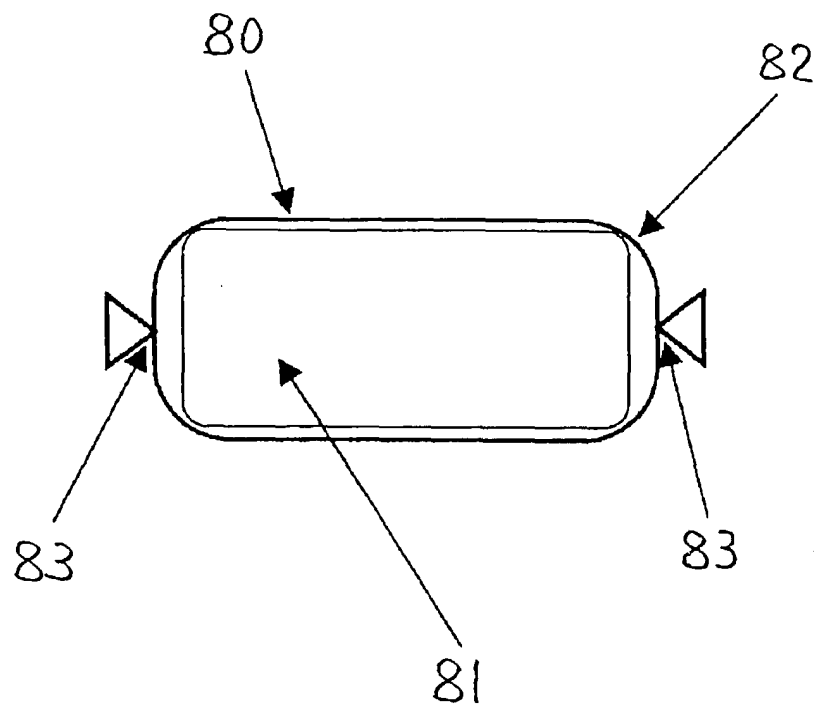


Fig. 23



F i g. 2 4



F i g. 25

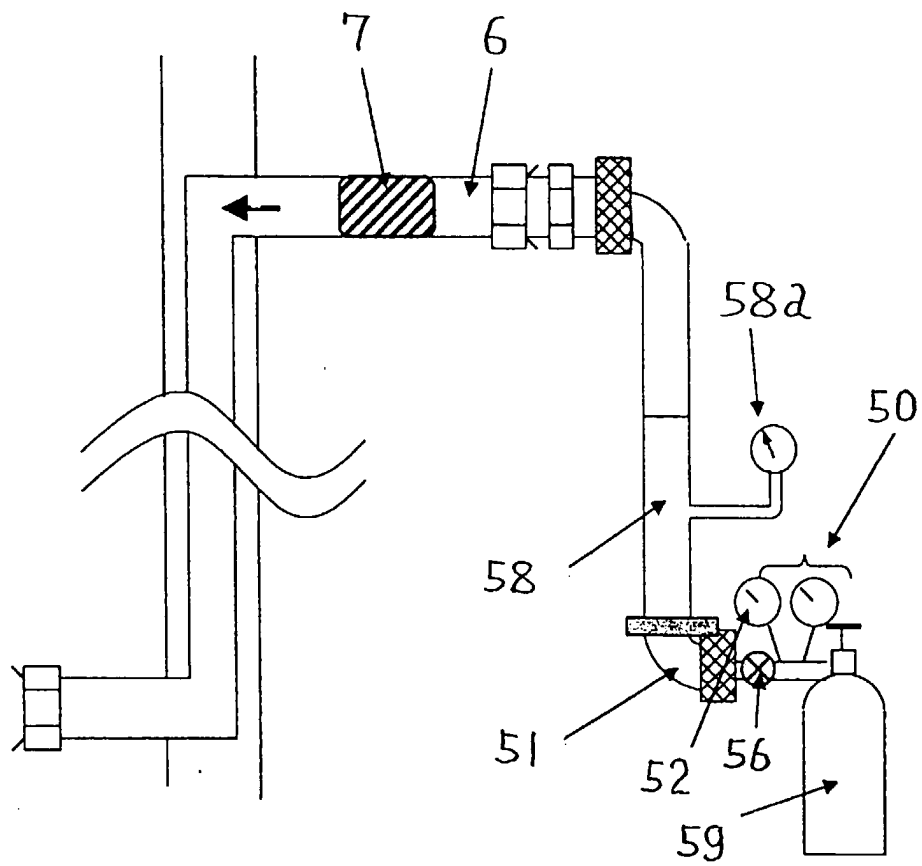


Fig. 26 (a)

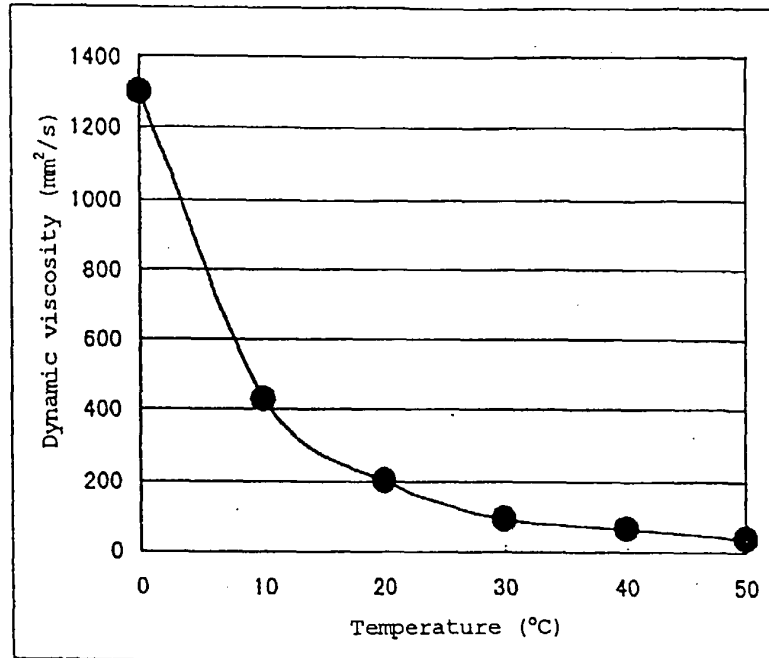
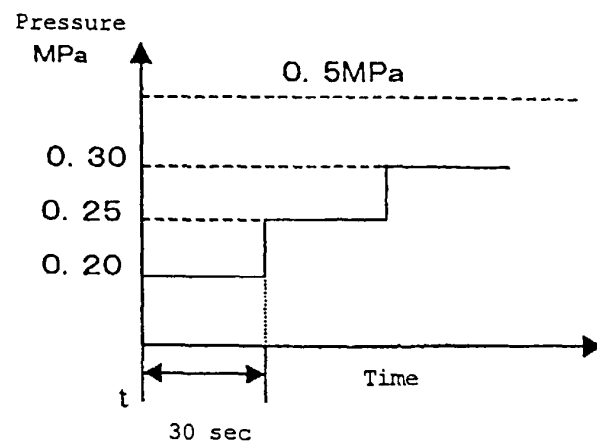
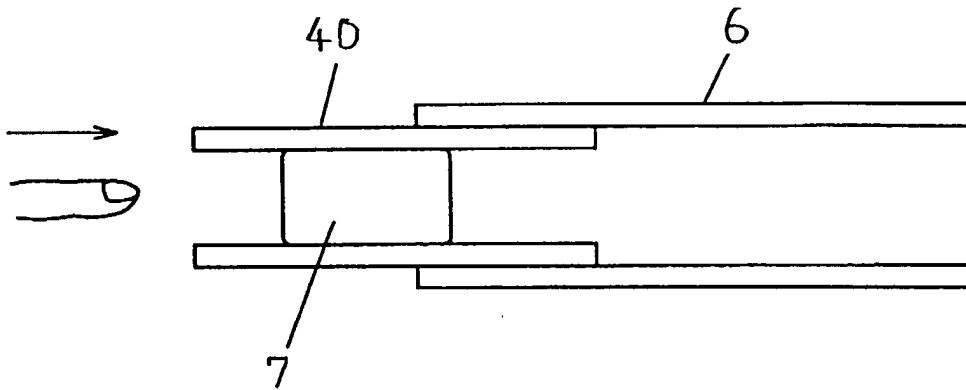


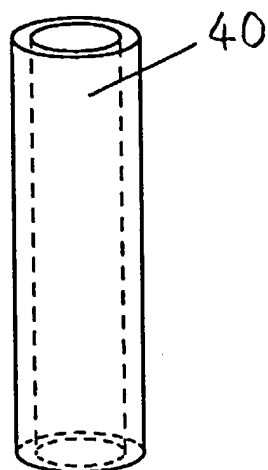
Fig. 26 (b)



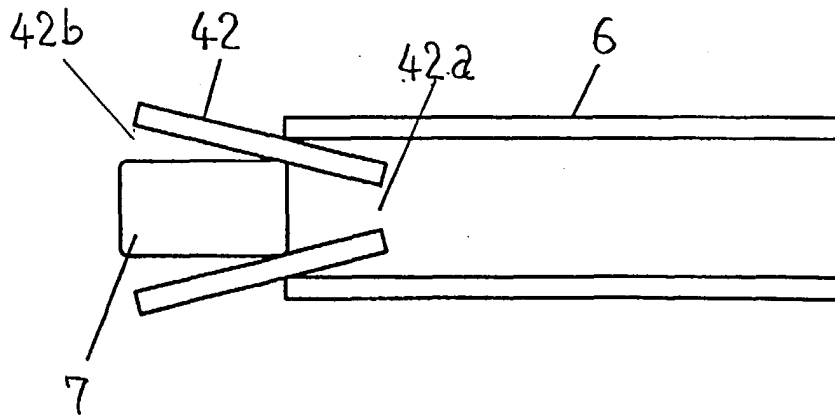
F i g. 27 (a)



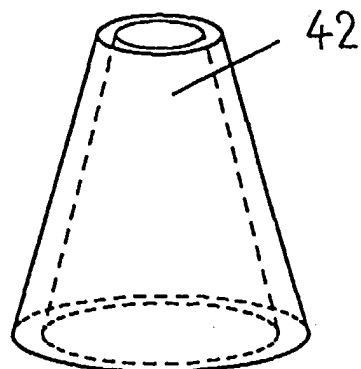
F i g. 27 (b)



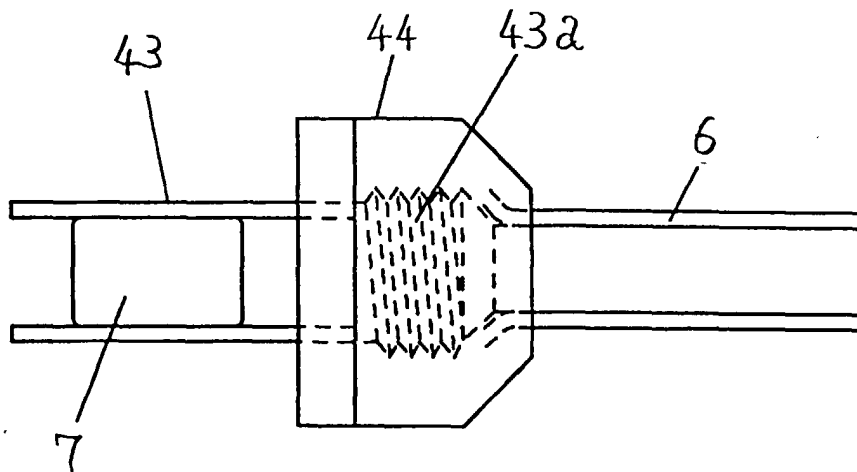
F i g . 2 8 (a)



F i g . 2 8 (b)



F i g. 29 (a)



F i g. 29 (b)

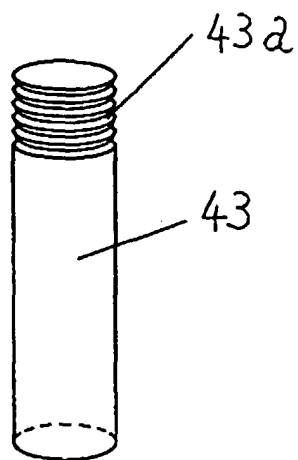


Fig. 30 (a)

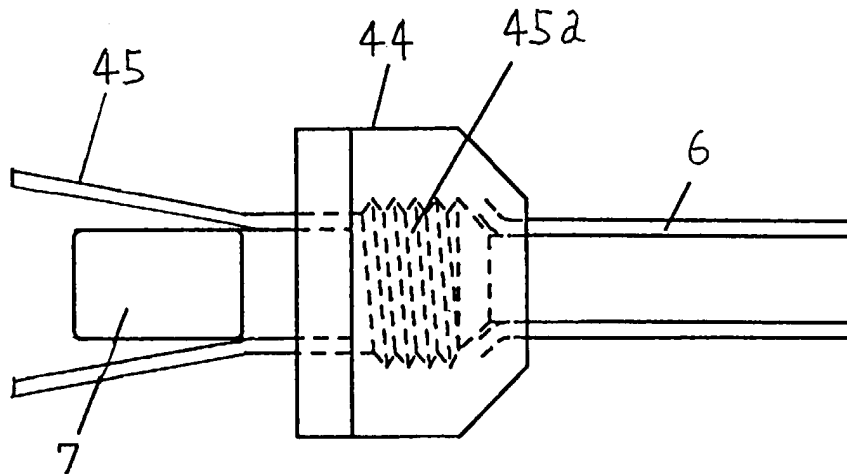
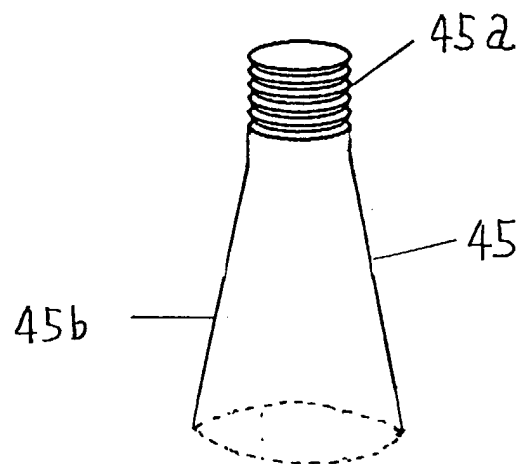


Fig. 30 (b)





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 12 4725

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 555 585 A (FOWLER JEFFREY B) 17 September 1996 (1996-09-17)	1-3,6-9, 13-25, 32,33, 37,39, 48-52, 54,55, 57, 59-66, 71-83, 93-95, 98-100	F25B47/00 B08B9/04 F28G1/12
Y	* the whole document *	5,10,11, 26,27, 30,35, 36,41, 43,47, 56, 68-70, 85-87,92	
A		4,27-29, 31,38, 40,42, 44-46, 53,58, 67,84, 88-91, 96,97	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F25B B08B F28G
Y	EP 0 952 407 A (MITSUBISHI ELECTRIC CORP) 27 October 1999 (1999-10-27) * column 2, line 37 - line 46 *	5,26,27	
Y	PATENT ABSTRACTS OF JAPAN vol. 017, no. 591 (C-1125), 28 October 1993 (1993-10-28) & JP 05 177178 A (YOKOHAMA RUBBER CO LTD:THE), 20 July 1993 (1993-07-20) * abstract *	11,56	
		-/--	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 February 2001	Examiner De Graaf, J.D.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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European Patent
Office

Application Number

EP 00 12 4725

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 12 4725

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	US 2 906 650 A (E O WHEATON) 29 September 1959 (1959-09-29) * column 2, line 20 - line 62 * * figure 2 *	10	
Y	DE 41 11 452 A (BUEHLER GMBH) 15 October 1992 (1992-10-15) * column 1, line 18 - line 21 *	30	
Y	EP 0 828 132 A (KYOKUTO RUBBER CO LTD) 11 March 1998 (1998-03-11) * figures 3,9-13 *	35	
Y	DE 21 36 148 A (SCHIEMENTZ GEORG) 1 February 1973 (1973-02-01) * claim 3 * * figure 1 *	36	
Y	US 4 373 225 A (V ECKARDSTEIN KARL-ERNST ET AL) 15 February 1983 (1983-02-15) * figure 3 *	41,43, 47,87,92	
Y	US 1 673 890 A (E H SMITH) 19 June 1928 (1928-06-19) * figures 1-3 *	68-70, 85,86	
A	PATENT ABSTRACTS OF JAPAN vol. 007, no. 092 (M-208), 16 April 1983 (1983-04-16) & JP 58 016199 A (TOKYO SHIBAURA DENKI KK), 29 January 1983 (1983-01-29) * abstract *	12,13	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	US 3 725 968 A (KNAPP K ET AL) 10 April 1973 (1973-04-10) * column 5, line 34 - line 37 *	16	
		-/--	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 February 2001	Examiner De Graaf, J.D.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04001)



European Patent
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**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 00 12 4725

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-97

Pipe cleaning method, apparatus and compound used therefor.

2. Claims: 98-102

Insertion jig for a pipe cleaning compound.



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 12 4725

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 263 220 A (CAMPBELL DOUG C) 23 November 1993 (1993-11-23) * figure 1 *	42, 44, 45, 88-90	
A	PATENT ABSTRACTS OF JAPAN vol. 010, no. 385 (M-548), 24 December 1986 (1986-12-24) & JP 61 175497 A (EBARA CORP), 7 August 1986 (1986-08-07) * abstract *		
A	US 3 543 323 A (GIRARD HARRY J) 1 December 1970 (1970-12-01)		
A	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 10, 31 October 1996 (1996-10-31) & JP 08 155413 A (YUNIPETSUKU:KK), 18 June 1996 (1996-06-18) * abstract *		
A	US 4 898 197 A (BARRY PETER L ET AL) 6 February 1990 (1990-02-06)		
A	DE 297 11 840 U (FOERSTER MARTIN) 30 October 1997 (1997-10-30)		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
Place of search THE HAGUE		Date of completion of the search 8 February 2001	Examiner De Graaf, J.D.
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

EPO FORM 1503 03/02 (F04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 12 4725

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-02-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5555585 A	17-09-1996	AT 186662 T	15-12-1999
		AU 663294 B	05-10-1995
		AU 8333891 A	02-03-1992
		WO 9202310 A	20-02-1992
		BR 9106759 A	29-06-1993
		CA 2089269 A	11-02-1992
		DE 69131790 D	23-12-1999
		EP 0542840 A	26-05-1993
		FI 930563 A	31-03-1993
		IL 99143 A	31-12-1995
		JP 6500047 T	06-01-1994
		KR 222188 B	01-10-1999
		NZ 239337 A	26-05-1994
		US 5329660 A	19-07-1994
		ZA 9106307 A	24-06-1992
EP 0952407 A	27-10-1999	JP 2000009368 A	14-01-2000
JP 05177178 A	20-07-1993	NONE	
US 2906650 A	29-09-1959	NONE	
DE 4111452 A	15-10-1992	NONE	
EP 0828132 A	11-03-1998	JP 10089890 A	10-04-1998
		US 5926892 A	27-07-1999
		KR 225984 B	15-10-1999
DE 2136148 A	01-02-1973	NONE	
US 4373225 A	15-02-1983	DE 2927324 A	29-01-1981
		DE 2943967 A	14-05-1981
		AT 3139 T	15-05-1983
		BR 8004187 A	03-02-1981
		EP 0022251 A	14-01-1981
		JP 1505264 C	13-07-1989
		JP 56010383 A	02-02-1981
		JP 63044029 B	02-09-1988
US 1673890 A	19-06-1928	NONE	
JP 58016199 A	29-01-1983	NONE	
US 3725968 A	10-04-1973	NONE	
US 5263220 A	23-11-1993	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 12 4725

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-02-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 61175497 A	07-08-1986	JP 1970945 C JP 6089996 B	27-09-1995 14-11-1994
US 3543323 A	01-12-1970	NL 7017443 A, B	01-06-1972
JP 08155413 A	18-06-1996	NONE	
US 4898197 A	06-02-1990	AU 571845 B AU 591031 A AU 1816583 A AU 572181 B AU 3218784 A WO 8500997 A BR 8407026 A CA 1247310 A EP 0152439 A JP 5057034 B JP 61500060 T KR 9208005 B SU 1618277 A US 4724007 A	28-04-1988 23-11-1989 21-02-1985 05-05-1988 29-03-1985 14-03-1985 30-07-1985 27-12-1988 28-08-1985 23-08-1993 16-01-1986 21-09-1992 30-12-1990 09-02-1988
DE 29711840 U	30-10-1997	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82