US 20040045646A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2004/0045646 A1**

Kuehn (43) **Pub. Date: Mar. 11, 2004**

(54) **METHOD AND DEVICE FOR ANNEALING TUBES**

(76) Inventor: **Friedhelm Kuehn**, Muelheim a.d. Ruhr (DE)

Correspondence Address:
Fay Sharpe Fagan
Minnich & McKee
Suite 700
1100 Superior Avenue
Cleveland, OH 44114-2518 (US)

(21) Appl. No.: **10/398,960**

(22) PCT Filed: **Oct. 2, 2001**

(86) PCT No.: **PCT/EP01/11363**

(30) **Foreign Application Priority Data**

Oct. 18, 2000 (DE)..... 10051606.8

Publication Classification

(51) **Int. Cl.**[7] **C22F 1/08**

(52) **U.S. Cl.** **148/687**

(57) **ABSTRACT**

The invention relates to tubes which are coil-shaped, and a plurality of coils which are annealed together and then coated with a protective gas. Each coil is connected to an individually controllable protective gas supply line and to an individual protective gas exit line. A seal includes a mother plug (**1**), whose through-openings (**6**) are connected to the coils and an adapted father plug (**2**), whose through-openings (**10**) are connected to separate protective gas lines. A plurality of tube supports (**7**) are arranged in a displaceable manner inside the through-openings (**6**) of the mother plug (**1**) and are tightened in a sealed manner inside the through-openings (**10**) of the father plug (**2**) by an actuating element (**9**).

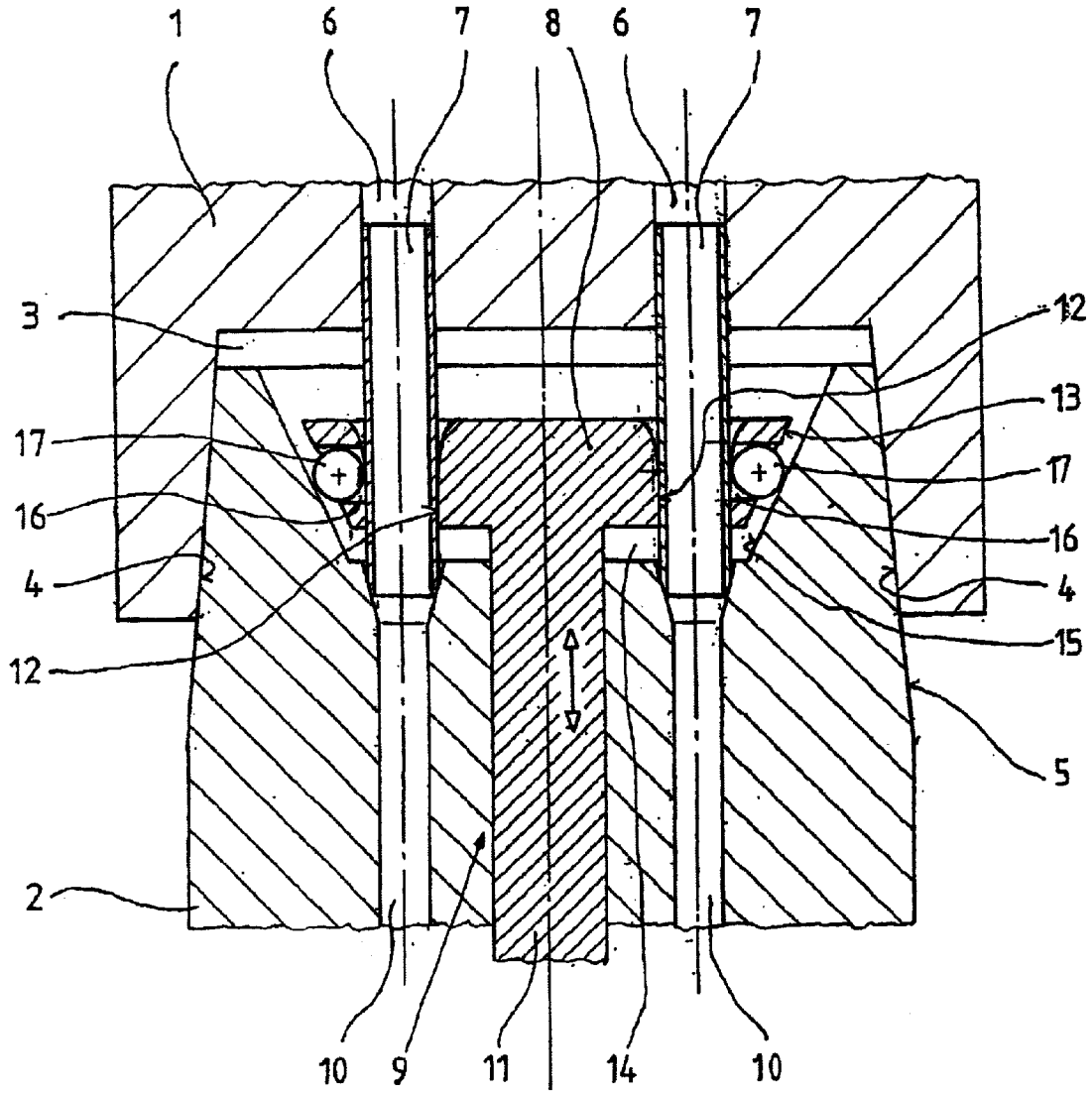

Fig. 1

METHOD AND DEVICE FOR ANNEALING TUBES

[0001] The invention relates to a method for annealing pipes which are wound into coils, a plurality of coils being annealed together and purged during annealing with protective gas.

[0002] A major application of the present invention is the bright annealing of copper pipes such as those employed extensively in refrigeration engineering. They are used for transporting the refrigerant through the relevant heat exchangers. For this purpose, it is essential for the pipes to be purged during annealing with protective gas to remove any deposits from the inside of the pipe, so-called coating. Only a very small amount of residual coating is permitted as otherwise the refrigeration processes are greatly impaired.

[0003] Several coils are arranged in annealing supports stacked one on top of the other and then annealed together. Once the coils have been pushed into the furnace, the protective gas source is connected. It is generally the bottom annealing support which is connected to a protective gas line, the protective gas then being distributed to the individual coils from the bottom annealing support.

[0004] Practice has shown that the individual coils from one and the same charge exhibit different amounts of residual coating.

[0005] The object of the present invention is therefore to achieve a uniform purge flow rate of the different coils in the charge.

[0006] This object is achieved by the aforementioned inventive method, characterised in that each coil is connected to a separately controllable protective gas inlet and a separate protective gas outlet.

[0007] The invention is based on the realisation that the different purge flow rates of the individual coils hitherto determined can only be due to the fact that the individual coils receive different amounts of purging gas. As the parallel supply conditions are uniform and the flow resistances of the individual coils do not differ substantially from each other, the differences in the amount of purging gas can only be due to the fact that the unavoidable losses through leakage are different.

[0008] The invention ensures that each coil is purged separately and that any differences in losses through leakage can be balanced out. Furthermore, the contaminant content of the protective gas leaving the system can be monitored so that it is possible to supply each individual coil with an appropriately adjusted amount of protective gas. In addition, it is possible not only to control the protective gas flow rate but also the purging time and the coil temperature. It Is also possible to not only take the contaminant composition, for example carbon content, as a basis for control. Furthermore, selective adjustment to different admissible amounts of residual coating is possible within one and the same charge.

[0009] In addition, the Invention has one substantial additional advantage. According to the prior art, the contaminated protective gas was fed into the furnace, causing contamination of the furnace inside chamber and the cold coil surfaces. These disadvantages have been eliminated as the contaminated protective gas is removed directly from the coil.

[0010] To perform the inventive method, the coils have to be connected to the separate protective gas lines, both on the inlet and outlet sides. To perform this step with a minimum amount of work, namely in one single action, the invention creates a device to connect a plurality of coils wound from pipes to a facility for supplying and/or removing protective gas, with

[0011] a female plug assigned to the coils with a plug-in opening and a plurality of passages which can each be connected to an appertaining coil,

[0012] a male plug assigned to the facility for supplying and/or removing the protective gas, said male plug fitting into the plug-in opening of the female plug and exhibiting a plurality of passages which can each be connected to an appertaining separate protective gas line,

[0013] a plurality of pipe connection pieces which can each be moved axially in an appertaining passage of the one plug and can be inserted In an appertaining passage of the other plug to form a tight seal, and

[0014] an actuating element assigned to the male plug for moving the pipe connection pieces when the male plug is inserted In the female plug.

[0015] The female plug is mounted on one of the annealing supports, generally on the bottom annealing support, and the male plug forms the real docking station inside the furnace. The male plug and the actuating element can be controlled from outside once the coils are located In the docking station.

[0016] Furthermore it is possible to make do with one single pair of plugs, half of the passages then being used to supply the protective gas and the other half to remove the protective gas. However, two pairs of plugs are generally used which are arranged in any manner to each other and can preferably be operated from one common actuating station. Once the relevant male plug has been inserted in the female plug, the relevant actuating element Is put Into operation to grip the connection pieces and to push them into the relevant passages to form a seal. The passages are preferably provided with a conically tapered entry zone against which the appertaining pipe connection piece can be restrained by the actuating element.

[0017] A further embodiment of the present invention proposes that the actuating element exhibits a head with a continuously tapering circumference which can be moved axially in a recess of the male plug, said recess exhibiting a complementary continuously tapering circumference, wherein the head exhibits a plurality of passages to accommodate the pipe connection pieces and is provided with side openings which lead from the passages to the appertaining circumferential surface and which each contain a movable restraining element which protrudes from the circumferential surface, preferably In the form of a ball.

[0018] During docking, the male plug Is inserted In the plug-in opening of the female plug. Then the actuating element is moved in the direction in which its circumference and that of the recess taper. The restraining elements then come Into contact with the circumference of the recess and are moved inwards towards the passages of the actuating element through which the pipe connection pieces pass.

They grip the pipe connection pieces and push them into their sealing position, pressing into the pipe connections. Any differences in the positions of the pipe connection pieces are automatically compensated for. The actuating element Is kept in its restraining position during annealing and then pushed in the opposite direction to loosen the connection.

[0019] The head of the actuating element may be provided with an actuating rod which is passed centrally through the mal plug and arranged preferably in the form of a circle around the passages of the head. The actuating rod is passed through the furnace wall to form a seal and may be operated via a piston mover arranged outside the furnace.

[0020] The circumference of the head and that of the recess of the male plug may be tapered towards the female plug. The pipe connection pieces are then located in the male plug and are moved by the actuating element In the same direction in which the male plug is inserted in the plug-in opening of the female plug. The kinematics are therefore simple as the male plug does not have to be held separately when the actuating element is moved. However, this design is complicated from the manufacturing point of view, apart from the fact that the pipe connection pieces inside the furnace are wear parts and have to be replaced

[0021] Under certain circumstances, a design In which the circumference of the head and that of the recess are continuously tapered away from the female plug is therefore better. The pipe connection pieces can be moved in the passages of the female plug and are pulled by the actuating element Into the passages of the male plug to form a seal. The pipe connection pieces can therefore be replaced as soon as the annealing supports have left the furnace. An appropriate lock preferably ensures that the pipe connection pieces are not removed with the male plug when the plug-in connection is loosened.

[0022] When the male plug is inserted into the plug-in opening of the female plug, the pipe connection pieces enter the passages of the head of the actuating element. For this purpose, it is advantageous for the passages of the head to widen conically at their entry ends towards the female plug, automatic centring thereby being facilitated.

[0023] Designs in which the head of the actuating element and the appertaining recess of the male plug exhibit a polygonal cross-section and taper in the shape of a pyramid are also conceivable. The advantage of such designs is that the angle of the actuating element relative to the male plug is automatically fixed. From a manufacturing point of view, however, it is simpler to have a design, which is also preferred from this aspect, in which the head of the actuating element and the recess of the male plug exhibit truncated circumferential surfaces and are connected with each other so they cannot turn.

[0024] Furthermore, a further embodiment of the invention proposes that the plug-in opening of the female plug exhibits a circumference continuously widening towards the male plug and that the male plug is provided with a plug-in end which exhibits a complementary, continuously widening circumference. Here a polygonal, shaped-shaped configuration is also conceivable which ensures automatic positioning. However, for manufacturing reasons, truncated configurations with features to fix the reciprocal plug-in position are to be preferred.

[0025] The Invention will now be described in greater detail with the aid of a preferred embodiment of the plug-in connection in conjunction with the enclosed drawing. The drawing shows in:

[0026] **FIG. 1** an axial cross-section through the plug-in connection

[0027] **FIG. 1** show a female plug I for mounting on the bottom annealing support of a stack of coils and a male plug **2** which is Inserted into a plug-in opening **3** of the female plug on the docking station. The plug-in opening **3** exhibits a conical circumferential surface **4** whilst the male plug **2** is provided on its plug-in end with a complementary conical circumferential surface **5**. Furthermore, means not shown in the Figure are provided which permit the insertion of the male plug **2** in the plug-in opening **3** of the female plug **1** only in one or several predefined angles.

[0028] The female plug **1** exhibits a plurality of passages **6** which can be connected to the individual coils and in which pipe connection pieces **7** are arranged so they can be moved. The pipe connection pieces **7** protrude through a head **8** of an actuating element **9** and are restrained in the passages **10** of the male plug **2** by said actuating element to form a seal. The entry zones of the passages **10** are conically widened for this purpose as shown. The passages **10** can be connected to separate protective gas lines.

[0029] The actuating element **9** exhibits an actuating rod **11** which is preferably connected in one piece with the head **8** and which is passed centrally through the male plug **2**. The passages **10** of the male plug **2** are distributed in the form of a circle around the actuating rod **11** of the actuating element **9**.

[0030] The head **8** of the actuating element **9** also exhibits passages **12** through which the pipe connection pieces **7** pass. In order to facilitate Insertion of the connection of the pipe connection pieces **7** in the passages **12** of the head **8** to establish the plug-in connection, the passages **12** are conically widened at their entry ends, as shown.

[0031] The head **8** of the actuating element **9** exhibits a conical circumferential surface **13** and engages in a recess **14** of the male plug **2**, the recess **14** being provided with a complementary conical circumferential surface **15**. Side openings **16** of the head **8** lead from the circumferential surface **13** to the passages **12** and serve to accommodate balls **17** which have the function of restraining elements.

[0032] When the male plug **2** is inserted in the plug-in opening **3** of the female plug **1**, the pipe connection pieces **7** arranged in the female plug **1** enter the passages **12** of the actuating element **9**. The head **8** of the actuating element **9** is located near the bottom of the plug-in opening **3** of the female plug **1** Then the actuating element **9** Is moved downwards in **FIG. 1**. The balls **17** then come to rest on the circumferential surface **15** of the recess **14**, press progressively Into the pipe connection pieces **7** and take said pipe connection pieces **7** with them until they come to rest on the conical entry zones of the passages **10** of the male plug **2** to form a seal. The male plug **2** is secured. Means not shown in the Figure ensure that the actuating element **9** retains a fixed position relative to the male plug **2**.

[0033] The passages **6** of the female plug **1** and the appertaining passages **10** of the male plug **2** can be con-

nected to protective gas supply lines or to protective gas removal lines. Then two such plug-in connections are required to perform the inventive method. Alternatively, it is possible to connect half of the passages to the protective gas supply lines and the other half to the protective gas removal lines. Then one. single plug-in connection is sufficient.

[**0034**] Modifications within the scope of the present invention are perfectly possible. Above all the orientation of the conical surfaces **13** and **15** of the head **8** of the actuating element **9** and the appertaining recess **14** can be reversed. The pipe connection pieces **7** then form one component of the male plug **2** and are pushed Into the relevant sealing zones of the passages **6** of the female plug **1**.

1. Method for annealing pipes which have been wound into coils, a plurality of coils being annealed together and purged during annealing with protective gas,

characterised in that

each coil is connected to a separately controllable protective gas inlet and a separate protective gas outlet:

2. Device to connect a plurality of coils of wound pipes to a facility for supplying and/or removing protective gas, with

a female plug (**1**) assigned to the coils with a plug-in opening (**3**) and a plurality of passages (**6**) which can each be connected to an appertaining coil,

a male plug (**2**) assigned to the facility for supplying and/or removing protective gas, said male plug (**2**) fitting in the plug-in opening (**3**) of the female plug (**1**) and exhibiting a plurality of passages (**10**) which can each be connected to an appertaining separate protective gas line,

a plurality of pipe connection pieces (**7**) which can each be moved axially in an appertaining passage of the one plug and can be inserted in an appertaining passage of the other plug to form a seal, and

an actuating element (**9**) assigned to the male plug (**2**) for moving the pipe connection pieces (**7**) when the male plug is inserted in the female plug (**1**).

3. Device according to claim 2, characterised In that the passages (**10**) into which the pipe connection pieces (**7**) can be Inserted to form a seal exhibit a conically tapered entry zone against which the appertaining pipe connection piece (**7**) can be restrained.

4. Device according to claim 2 or **3** characterised in that the actuating element (**9**) exhibits a head (**8**) with a continuously tapering circumference which can be moved axially in a recess (**14**) of the male plug (**2**), said recess exhibiting a complementary continuously tapering circumference, wherein the head (**8**) exhibits a plurality of passages (**12**) to accommodate the pipe connection pieces (**7**) and is provided with side openings (**16**) which lead from the passages (**12**) to the appertaining circumferential surface and which each contain a movable restraining element which protrudes from the circumferential surface, preferably In the form of a ball (**17**).

5. Device according to claim 4, characterised in that the head (**8**) of the actuating element (**10**) exhibits an actuating rod (**11**) which Is passed centrally through the male plug (**2**).

6. Device according to claim 4 or **5**, characterised in that the circumference of the head (**8**) and the circumference of the recess (**14**) are continuously tapered away from the female plug (**1**).

7. Device according to claim 6, characterised in that the passages (**12**) of the head (**8**) widen conically at their entry ends towards the female plug (**1**).

8. Device according to any one of claims **4** through **7**, characterised in that the head (**8**) of the actuating element (**9**) and the recess (**14**) of the male plug (**2**) exhibit truncated circumferential surfaces (**13**, **15** respectively) and are connected with each other so they cannot turn.

9. Device according to any one of claims **2** through **8**, characterised In that the plug-in opening (**3**) of the. female plug (**1**) exhibits a circumference continuously widening towards the male plug (**2**) and that the male plug (**2**) is provided with a plug-in end which exhibits a complementary, continuously widening circumference.

10. Device according to claim 9 characterised in that the plug-in opening (**3**) of the female plug (**1**) and the plug-in end of the male plug exhibit truncated circumferential surfaces (**4**, **5** respectively) and are provided with features for fixing the reciprocal plug-in orientation.

* * * * *