

**DEVICE FOR SIMULTANEOUS SHAPING AND WELDING OF CONNECTOR PIPES FOR
COMPRESSORS USING A CENTRALISING PIN; PROCESS OF SHAPING AND WELDING
CONNECTOR PIPES FOR COMPRESSOR USING SUCH DEVICE**

Field of the Invention

The present invention relates to a device and process for shaping and welding,
5 simultaneously performed, pipe connectors (also known as dowels) primarily intended for
use in compressors. More specifically the process presented here concerns the
simultaneous shaping and welding of copper pipes - used as connectors for suction, process
and discharge - to the hermetic compressors metal housing for refrigeration, with the aim of
reducing steps of the production process, making it more efficient and economical.

10 Background of the Invention

As is known in the art, the hermetic compressors are devices widely used in
refrigeration systems in general, the components being responsible for providing the
circulation of the refrigerant fluid through the tubing of the cooling systems. The suction and
discharge connector pipes have the function of conducting the refrigerant gas through the
15 compressor housing, connecting the inside thereof to the pipes of the refrigeration system.
The connector tube of process has the function to be the pathway of oil and / or refrigerant
fluid injection during installation of the compressor in the refrigeration system. It should be
clarified that such connector pipes are typically made of copper due to the ease of
connection by brazing with the pipes of the system.

20 It happens, however, that the proper operation of such equipment also depends on
the perfect sealing conditions between these connector pipes and the compressor metal
housing, being such connector pipes produced in copper and the compressor housing
generally manufactured in steel, such welding process becomes significantly complicated.

The most known form of assembly provides the use of brazing additional materials
25 which are arranged between the hole of the compressor housing and the connector tube as
disclosed, for example, in document JP2010038087. Although this document involves the
use of a connector pipe without needing prior conformation, such process presents however
the disadvantage of needing the use of addition material for welding.

An alternative technique is presented in document CN101780602 (see Figures 2
30 and 3 attached) which provides the use of upper 200 and lower 201 electrodes disposed in
order to involve the entire outer surface of connector pipes 110, these electrodes being
responsible for the passage of a electrical current from 30,000 to 50,000 Amperes for about
30 to 80 milliseconds to heat the copper and make it pliable to, by applying a compressive
force, weld the flange copper of the connector tube 110 on the surface of the housing 2 with
35 which it is in contact. It happens, however, that such process requires the existence of a
flange (111) in the body of the copper dowel - that is, the need of further steps in the
process, making it more complex and more expensive compared to the solution proposed

herein.

Another example of installation of connector pipe in hermetic compressors was disclosed in document PI0603392-0, in which connector pipes 110 previously conformed and also necessarily provided with flanges 111 - which constitute the coupling means of the piece - are welded directly to housing 2 of compressor C by means of the application of electrical current through electrodes 200/201. The drawbacks of this process relate to the fact that it is required a prior conformation of flange 111 before the welding operation, requiring a complex operation additional to the production process, and it is more expensive when compared to the solution proposed herein.

Note that all processes of the current state of the art demand the introduction of the ends of connector pipe 110 inside the suction and discharge holes of compressor C. Therefore, it is noted that the current state of the art lacks a welding process which, besides being more efficient, simple and economical, also allows the welding between the parts is of the "top" type, thus eliminating the need of previous shaping of the copper pipes to the production of flanges for welding and eliminating the need to use addition material for brazing. The current technique also lacks a process that allows the shaping and welding of connector pipes to compressor casings to be made in a single step and, therefore, significantly more rapid and economical.

Objectives of the Invention

Therefore, it is one objective of this invention to provide a process which simultaneously performs shaping of flange and welding of connector pipes, such connector pipes being copper pipes lacking flange and which, therefore, require no previous shaping prior to its connection (welding) to the compressor housing.

It is also an object of this invention to provide a process for top welding between copper connector pipes and the housing, usually steel, of the compressors.

Another among the objectives of the present invention is to provide a process that simultaneously performs shaping of a flange and welding of connector pipes, which preferably uses a servomotor as element for the generation of force and displacement of the connector pipes against the compressor housing.

It is yet another among the objectives of this invention to provide a process using a stopper for applying compressive force to the connector pipe.

Another objective of the invention is to provide a process in which the welding between the connector tube and the compressor housing is made by applying a force comprised within the range of 200 to 500 kgf in place of the force of about 1100 kgf employed for the welding made by known techniques.

Furthermore, it is an objective of the invention to describe a welding process which uses a guide pin that, besides providing alignment between the connector pipe and the

housing hole, it also prevents constriction of the through hole of gas and the connector pipe, during simultaneous shaping and welding steps, also preventing the housing deformation caused by the force of welding, because it is executed with lower electrode of diameter larger than that of the connector pipe.

5 Summary of the Invention

The above objectives are achieved by means of a simultaneous shaping and welding device of connector pipes for compressors, such connector pipes being defined by substantially cylindrical bodies which engage to gas through holes existing in the housing of the compressors which constitute its suction and discharge channels.

10 In one of the main embodiments of the present invention, said device comprises:

- a upper electrode-holder cooperating with one of the poles of an inverter set and with transformers;

- a upper electrode cooperating with the upper electrode-holder and with the upper region of the connector pipe;

15 - a welding force application stop cooperating with the upper electrode-holder and with the upper end of the connector pipe;

- a lower electrode-holder cooperating with the other pole of an inverter set and with transformers;

20 - an electrical insulation means cooperating with the inner surface of the lower electrode-holder;

- a lower electrode holder cooperating with the lower electrode-holder and with the compressor housing, being the inner diameter of the bottom electrode equal to or greater than the outer diameter of the upper electrode, and

25 - A centralizing pin coupled to the internal region of the electrical insulation means and cooperating with the gas through hole of the compressor housing and with the connector pipe.

Also according to one of the preferred embodiments of the invention, the lower electrode-holder, the electrical isolation means, the lower electrode and the centralizing pin comprise the lower components of the shaping and welding device.

30 In addition to the upper electrode-holder, the upper electrode and the welding force application stop comprise the upper components of the shaping and welding device.

In short, the device constructed according to a preferred embodiment of the invention comprises means for allowing the top welding between the connector pipe and the compressor housing.

35 Preferably the inner diameter of the connector pipe is equal to the diameter of the gas through hole of the compressor housing.

Also in a preferred form, the welding force application stop of the instant device

functions with intensity comprised within the range of 200 to 500 kgf, more specifically in the range of 330 to 400 kgf.

Preferably the upper device allows the application of current pulses without occurring simultaneous displacement.

5 The objectives of the invention are also achieved by means of a shaping and welding process of connector pipes for compressors which comprises the use of a shaping and welding device of connector pipes for compressor in order to perform the following steps:

- positioning the upper components of the shaping and welding device by means of coupling of the upper electrode around the connector pipe, until the stop for force application
10 located inside the upper electrode-holder reaches the top edge of the connector pipe;

- driving the displacement mechanism, preferably a servomotor to provide the approximation of the connector pipe to the surface of the compressor housing using as positional parameter the end of the centralizing pin which passed through the gas through hole of the compressor housing;

- activating the compression and welding force, and its maintenance during an stabilization time;

- applying the first pulse of electrical current with intensity ranging between 30 and 50 kA, without allowing displacement of the upper device;

- suspending the application of current and allowing the displacement of the upper
20 device with a consequent increase in the welding force to form the flange;

- applying the second current pulse effectively consisting in the welding time of the piece;

- suspending the current application with maintenance of the force application to provide better welding condition;

- shifting the upper electrode to the rest position.

It should be noted that this shaping and welding process comprises, in short, means for shaping and welding, simultaneous and in loco, flange to weld the connector pipe to the compressor housing.

Brief Description of the Drawings

30 The present invention will be hereinafter further described based on the drawings. The figures show:

Figure 1 - a view in elevation of a compressor provided with connector pipes for connection to the pipes of a general cooling system;

Figure 2 - a longitudinal sectional view of a connector pipe used in the current state
35 of the art;

Figure 3 - a schematic sectional view of the components used in the current state of the art to effect the welding between the copper connector pipes and the compressor;

Figure 4 - in longitudinal section view of a copper pipe which can be used for shaping the connector pipe by the process of the present invention;

Figure 5 - a schematic sectional view of the components used in the shaping and welding process of connector pipes of the present invention;

5 Figure 6 - a variables diagram of the welding process employed in the present state of the art;

Figure 7 - a variables diagram of the shaping and welding process of the present invention.

Detailed Description of the Invention

10 The invention will now be described in detail based on the accompanying drawings, to which are given number reference to facilitate the understanding.

The simultaneous shaping and welding process object of the present invention aims the proper fixation of copper connector pipes 1 to the housing of the hermetic compressors 2, such connector pipes 1 (Figure 4) defined by substantially cylindrical bodies and of uniform and rectilinear outer surfaces 11 - unlike the connector pipes 110 of the current state of the art (Figure 2), which necessarily must be previously shaped to be fitted with flanges 111 to act like welding surface to the housing 2.

As can be seen in details by Figure 5 attached, the shaping device of the present invention is comprised, superiorly by an upper electrode-holder 3 which acts connected to one of the poles of the inverter set and transformers, which maintains coupled, in its end, an upper electrode 4 of substantially cylindrical conformation to be coupled to the upper region of the connector pipe 1. The lower component of the shaping device comprises a lower electrode-holder 5 connected to the other pole of the inverter set and transformers, such lower electrode-holder accommodates an electrical isolation means 6, the centralizing pin 7 and a lower electrode 8 whose inner diameter is equal to or greater than the outer diameter of the upper electrode 4, in order to prevent that the electrical current supplied by electrodes 4 and 9 is applied to the inner and outer point of housing 2, which could cause premature wear of the centralizing pin.

For comparative purpose, it should be clarified that as can be seen from Figure 3 attached, in the welding process used in the current state of the art, lower 201 and upper 200 electrodes are overlapped during welding, resulting in a too high heating that, sometimes, eventually also affect the structure of the compressor housing itself, besides reducing the lifetime of centralizing pin 203, as explained above.

Furthermore, the current technique demands two separate steps for installing the connector pipes to the compressors housings: a previous step of shaping the same to make flange, and another one for welding the pipes already flanged to the compressor housing. In the proposed invention, the two procedures are simultaneously performed in a single step of

the process, making it faster and more economical.

As can be seen in Figure 5, with the device and procedure presented here, the welding is made of top, so that it is possible to use connector pipes 1 with inner diameter equivalent to the diameter of the gas through hole to which the same will be connected. With such a configuration, the welding surface of connector pipe 1 becomes, therefore, its lower edge, eliminating the need of existence of flange which requires prior shaping of the copper pipe. In the present technique, besides being necessary the existence of flange previously shaped on the connector pipe, its end must have a diameter that allows its coupling to the male type hole of the compressor housing (see Figure 3).

In addition to this facility, it must be noted that the use of centralizing pin 7 prevents the copper, once made ductile by the passage of electrical current from the electrodes 4 and 9, to find passage to deform the inner region of the housing hole 2, that is, it does not obstruct the passage of gas and thus does not interfere with the performance of the compressor.

Another important point herein refers to the compressive force used to implement the process. In the welding processes of the present technique, it is required a compressive force of about 1100 kgf intensity. During the application of this intensity of force, it is made the application of a single current pulse of 30 to 50 kA. The diagram illustrated in Figure 6 shows graphically the variables current, force and displacement of the upper electrode of the known processes.

In the process of the present invention, due to the construction of the welding device and preferential use of a servomotor, the compressive force necessary for the welding of connector pipe 1 preferably comprises 200 to 500 kgf – that is, much lower than the one demanded by the known processes. Furthermore, in the proposed process, the welding is performed in two steps, namely, by applying two pulses of current: the first pulse for heating the copper, making it more pliable, facilitating the shaping step of the flange, and the second pulse to the effective welding. The Diagram in Figure 7 schematically illustrates the variables used in the process, besides illustrating the effects of each step of the process.

Thus, the steps of the shaping and welding process of connector pipes for compressors object of the present invention are:

- positioning the inner region of housing 2 of compressor C on the lower components of the shaping and welding device, so that centralizing pin 7 is fitted into the fluid through hole;

- positioning connector pipe 1 within upper electrode 4, until the stop for force application 10 located inside upper electrode-holder 3 reaches the top edge of connector pipe 1;

- driving servomotor to provide approximation of connector pipe 1 to the surface of

the compressor housing 2, using as positional parameter the end of centralizing pin 7 that passed through the gas through hole of compressor housing C;

- activating the compression and welding force, and maintenance of said force for a stabilization time;

5 - applying the first pulse of electrical current with an intensity ranging between 30 and 50 kA, without allowing displacement of the upper device, that step may be termed pre-heating time;

- suspending the current application and allowance displacement of the upper device with consequent elevation of the welding force for shaping the flange;

10 - applying the second pulse of current that will consist, effectively, of piece welding time;

- suspending the application current with maintenance of the application of force to provide better welding condition;

- shifting the upper electrode to the rest position.

15 Thus, at the end of the process, the lower end of copper connector pipe 1 which shaped during heating provided by the application of electrical current pulses has settled around the gas through hole of the compressor housing and, due to the force applied by the stop, if acceded to it.

20 The process object of the present invention also has the advantage that, by virtue of being shaped in loco, it causes the welding material to be integral to the material / body of the connector pipe, thus minimizing the existence of weak points likely to suffer damages or ruptures that could compromise the efficiency of the equipment.

25 It is noteworthy that although preferred constructive ways of the present invention have been shown, it is understood that any omissions, substitutions, inversion of electrical poles and constructive changes can be made by a technician versed in the subject, without departing from the spirit and scope of protection required. It is also expressly stated that all combinations of elements which perform the same function in substantially the same way to achieve the same results are within the scope of the invention. Substitutions of elements of an embodiment described by others are also fully intended and contemplated.

30 It should, however, be understood that the description given based on the figures above refers only to some of embodiments feasible to the system of the present invention, while its actual scope is set out in the appended claims.

CLAIMS

1. Simultaneous shaping and welding device of connectors pipe for compressors C, such connector pipes 1 being defined by substantially cylindrical bodies which are coupled to gas through holes existing in housing 2 of compressors C, which constitute its suction, discharge channels and process, CHARACTERIZED in that said device comprises:

- an upper electrode-holder 3 cooperating with one of the poles of an inverter set and transformers;

- an upper electrode 4 cooperating with upper electrode-holder 3 and the upper region of connector pipe 1;

- a stop 10 of welding force application cooperating with upper electrode-holder 3 and the upper end of connector pipe 1;

- a lower electrode-holder 5 cooperating with the other pole of an inverter set and transformers;

- an electrical insulation means 6 cooperating with the inner surface of lower electrode-holder 5;

- a lower electrode 8 cooperating with lower electrode-holder 5 and housing 2 of compressor C, the inner diameter of lower electrode 9 being equal to or greater than the outer diameter of upper electrode 4, and

- a centralizing pin 7 coupled to the inner region of electrical insulating mean 6 and cooperating with the gas through hole of housing 2 of compressor C and connector pipe 1.

2. Device according to claim 1, CHARACTERIZED in that lower electrode-holder 5, electrical insulation means 6, lower electrode 8 and centralizing pin 7 comprise the lower components of the shaping and welding device.

3. Device according to claim 1, CHARACTERIZED in that upper electrode-holder 3 upper electrode 4 and stop 10 of welding force application comprise the upper components of the shaping and welding device.

4. Device according to claim 1, CHARACTERIZED in that it comprises means to allow the top welding between connector pipe 1 and housing 2 of compressor C.

5. Device according to claim 1, CHARACTERIZED in that the inner diameter of connector pipe 1 is equal to the diameter of the gas through hole of housing 2 of compressor C.

6. Device according to claim 1, CHARACTERIZED in that stop 10 of welding force application functions with the intensity comprised within the range of 200 to 500 kgf.

7. Device according to claims 1 and 6, CHARACTERIZED in that stop 10 of welding force application functions with intensity comprised within the range of 330 to 400 kgf.

8. Device according to claim 1, CHARACTERIZED in that the upper device allows the application of current pulses without occurring simultaneous displacement.

9. Shaping and welding process of connector pipes for compressors, CHARACTERIZED in that it comprises the use of a shaping and welding device of connector pipes 1 for compressors C according to any one of claims 1 to 8 to perform the following steps:

- 5 - positioning the inner region of housing 2 of compressor C on the lower components of the shaping and welding device, so that centralizing pin 7 is fitted into the fluid through hole;
- positioning the upper components of the shaping and welding device by means of coupling of upper electrode 4 around connector pipe1 , until the stop for force application 10 located inside upper electrode-holder 3 reaches the top edge of connector pipe 1;
- driving the displacement mechanism, preferably a servomotor, to provide the approximation of connector pipe 1 to the surface of housing 2 of compressor C using as positional parameter the end of centralizing pin 7 which passed through the gas through hole of compressor C housing;
- 15 - activating the compression and welding force, and maintenance thereof during an stabilization time;
- applying the first pulse of electrical current with intensity ranging between 30 and 50 kA, without allowing displacement of the upper device;
- suspending the application of current and allowing the displacement of the upper 20 device with a consequent increase in the welding force to form the flange;
- applying the second current pulse which will, effectively, consist of the piece welding time;
- suspending the current application with maintenance of the force application to provide better welding condition;
- 25 - shift the upper electrode to the rest position.

10. Shaping and welding process of connector pipes for compressors according to claim 9, CHARACTERIZED in that it comprises means for welding and shaping, simultaneously and in loco, of flange to weld connector pipe 1 to housing 2 of compressor C.