PATENT SPECIFICATION (11) 1 561 795

1 561 795

(21) Application No. 40163/76 (22) Filed 28 Sept. 1976
(31) Convention Application No. 7 530 836 (32) Filed 8 Oct. 1975 in
(33) France (FR)
(44) Complete Specification published 5 March 1980
(51) INT. CL.³ B23K 11/02
(52) Index at acceptance
B3R 10 14 2K

(54) THE WELDING OF STUD-LIKE MEMBERS TO TUBES

(71) We, SOCIETE DES FABRICATIONS BIRAGHI-ENTREPOSE, a French Body Corporate of 75 rue de Tocqueville, 75017 Paris, France, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to the welding of stud-like members to tubes.

The manufacture of certain heat exchange tubes involves the fitting on the outer periphery the tubes of elongate cylindrical members which are termed "studs". These members are welded and are positioned regularly in accordance with the generatrices of the tube and the transverse planes thereof. Between one transverse plane and the next the studs are generally angularly displaced in such a way that they are staggered relative to the generatrices of the tube. More specifically, the distance between the consecutive transverse planes is termed the "longitudinal studding pitch" and the distance separating two consecutive studs in the same transverse plane is termed the "peripheral pitch". These two pitches are generally independent and determined as a function of the tube diameter and stud dimensions in such a way as to obtain, on the one hand, a regular distribution of the studs in the transverse plane and, on the other hand, the desired thermal efficiency.

According to the invention, there is provided a method for fixing, by resistance welding, stud-like members to a tube by means of an automatic machine comprising support means which supports the tube, a device for rotating the latter in a stepwise manner and a carriage equipped with welding electrodes and mounted so as to move longitudinally of the tube, wherein at least two stud-like members are simultaneously welded to the tube in two separate transverse planes and on two diametrically opposed generatrices of the tube, the simultaneous welding operation being repeated until at least two complete or partial rings of welded members have been produced.

Further according to the invention, there is provided a resistance welding machine for carrying out the above method, comprising support means for supporting the tube, a device for rotating the tube stepwise about its axis, and a carriage movable longitudinally of the tube, said carriage carrying at least one pair of opposed electrodes arranged to lie on opposite sides of the tube, the electrodes having longitudinal axes which are parallel and located in a plane containing the axis of rotation of the tube, the longitudinal axis of each electrode extending transversely to the axis of the tube, at least one of the electrodes being mounted on the carriage in such a way that the distance between the longitudinal axes of the electrodes longitudinally of the tube can be adjusted to the required value.

Still further according to the invention, there is provided a resistance welding machine comprising support means for supporting a tube, a device for rotating the tube stepwise about its axis, and carriage means movable longitudinally of the tube, said carriage means carrying a pair of opposed hollow electrodes having longitudinal axes lying in a common plane and on opposite sides of the longitudinal axis of the tube, the longitudinal axes of the electrodes being parallel and extending transversely of the tube axis and each hollow electrode being arranged to receive a stud-like member to be welded to the peripheral surface of the tube such that the stud-like member projects substantially radially relative to the tube, means for

advancing each electrode towards the tube so that a stud-like member carried by the electrode can be welded to the tube, and means for adjusting the distance between the longitudinal axes of the electrodes longitudinally of the tube.

When only two members are welded simultaneously, after each welding cycle of two rings, the carriage is longitudinally displaced alternately, through half the distance between the two transverse planes of the two rings and one and a half times the distance. If four members are simultaneously welded, the corresponding longitudinal displacement after each cycle is, alternately, half the distance between two consecutive rings and three and a half times this distance.

The invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, the sole figure of which is a schematic plan view of a resistance welding machine.

The drawing shows an automatic resistance welding machine which comprises a frame 1, on which slides a carriage 2 supporting two electrode holders 3 each equipped with a hollow electrode 4 into which a stud to be welded is placed.

A tube 5 to be studded is placed on supports (not shown) whose height can be adjusted and which permits the rotation of the tube about its longitudinal axis. Jaws 6 which grip one of the ends of the tube 5 are mounted on a shaft 7 which can be rotated in stepwise manner by an appropriate drive device 8.

The carriage 2 is coupled to a drive motor via, for example, a nut and screw device, the screw being arranged along the frame to effect longitudinal displacement of the carriage.

The electrodes 4 are arranged in a common horizontal plane which also contains the axis of shaft 7, the electrodes 4 facing one another but with their axes being laterally spaced and substantially parallel. At least one of the electrode holders 3 is mounted in adjustable manner on the carriage 2 to enable the distance between the axes of electrodes 4 to be adjusted to the desired value. In addition, the two electrode holders 3 are mounted so as to slide transversely on the carriage and are actuated by rams 3*a* which are preferably double-acting. Electric cables connect the electrodes to a generator (not shown).

The machine is used in the following manner.

The longitudinal studding pitch, i.e. the distance between two consecutive rings of studs, is determined as a function of the diameter of tube 5, the dimensions of the studs and the required thermal efficiency. The distance between the axes of two electrodes 4 is then set to a distance corresponding to twice the longitudinal pitch.

With the carriage 2 located at one end of the frame, preferably the end adjacent to the tube drive jaws 6, the two electrodes 4 provided with the studs to be welded are simultaneously advanced towards the tube by means of the rams 3*a*, until the studs are applied against the tube wall. The immediate passage of electrode current ensures the heating of the studs and their welding to the tube so that the studs project radially from the outer surface of the tube.

The electrodes are then retracted by the rams 3*a* and the drive device 8 is actuated to rotate the tube about its axis through an angle corresponding to the required peripheral pitch. Two further studs are welded and the cycle is repeated until sufficient studs have been welded to form two complete rings located in two transverse planes of the tube.

Then, with the electrodes located in their retracted position, the drive motor of the carriage 2 is actuated to advance the carriage by a distance corresponding to one longitudinal pitch. Simultaneously, the drive device 8 is actuated so that tube 5 rotates through an angle corresponding to half the peripheral pitch.

The stud welding cycle then begins again and continues until two further complete transverse rings of studs have been welded.

At the end of the second stud welding cycle and with the electrodes in their retracted position, the drive motor of carriage 2 is put into operation until the carriage has advanced by three longitudinal pitches. Simultaneously, the drive device 8 is actuated so that the tube 5 is rotated through an angle corresponding to half the peripheral pitch.

A new stud welding cycle can then be performed and the operations described hereinbefore are repeated until the entire tube (or an appropriate length thereof) has been covered with studs.

The peripheral pitch can be set in arbitrary manner relative to the longitudinal pitch as a function of the desired characteristics for the studded tube, and the staggering of the studs can be eliminated by omitting to rotate the tube between two consecutive welding cycles.

Moreover, for certain applications the tubes need only be studded over a portion of their periphery. In this case, the respective electrodes will be supplied both with studs and electric power only as required and the angular advance of the tube during the welding cycles will be controlled according to the required stud pattern.

The process described can be performed with a machine having more than one pair of electrodes, for example two or three pairs, or even a random number of electrodes greater than two, because it can always be considered that two adjacent facing electrodes constitute a pair of electrodes. Clearly, the cycle of longitudinal displacements of the electrode holder carriage will depend on the number of electrodes and can easily be determined by those skilled in the art. Thus, for example, in the case of two pairs of electrodes, the longitudinal displacement of the carriage mey correspond alternately to one longitudinal pitch and then seven longitudinal pitches.

WHAT WE CLAIM IS:—

1. A method for fixing, by resistance welding, stud-like members to a tube by means of an automatic machine comprising support means which supports the tube, a device for rotating the latter in a step-wise manner, and a carriage equipped with welding electrodes and mounted so as to move longitudinally of the tube, wherein at least two stud-like members are simultaneously welded to the tube in two separate transverse planes and on two diametrically opposed generatrices of the tube, the simultaneous welding operating being repeated until at least two complete or partial rings of welded members have been produced.

2. A method as claimed in claim 1, wherein only two members are welded simultaneously and after each welding cycle of two complete or partial rings, a longitudinal displacement of the carriage takes place, corresponding alternately after each cycle to half the distance between the two transverse planes of the two rings of welded members, and to one and a half times this distance.

3. A method as claimed in claim 1, wherein four members are welded simultaneously and after each welding cycle of four complete or partial rings, a longitudinal displacement of the carriage is performed, corresponding alternately after each cycle to half the distance between two consecutive rings, and to three and a half times this distance.

4. A method as claimed in any one of claims 1 to 3, wherein simultaneously with the longitudinal displacements of the carriage, the tube is rotated about its axis by an angle corresponding to half the peripheral distance separating two consecutive members of the same ring.

5. A resistance welding machine for carrying out the method as claimed in any one of claims 1 to 4, comprising support means for supporting the tube, a device for rotating the tube stepwise about is axis, and a carriage movable longitudinally of the tube, said carriage carrying at least one pair of opposed electrodes arranged to lie on opposite sides of the tube, the electrodes having longitudinal axes which are parallel and located in a plane containing the axis of rotation of the tube, the longitudinal axis of each electrode extending transversely to the axis of the tube, at least one of the electrodes being mounted on the carriage in such a way that the distance between the longitudinal axes of the electrodes longitudinally of the tube can be adjusted to the required value.

6. A resistance welding machine comprising support means for supporting a tube, a device for rotating the tube stepwise about its axis, and carriage means movable longitudinally of the tube, said carriage means carrying a pair of opposed hollow electrodes having longitudinal axes lying in a common plane and on opposite sides of the longitudinal axis of the tube, the longitudinal axes of the electrodes being parallel and extending transversely of the tube axis and each hollow electrode being arranged to receive a stud-like member to be welded to the peripheral surface of the tube such that the stud-like member projects substantially radially relative to the tube, means for advancing each electrode towards the tube so that a stud-like member carried by the electrode can be welded to the tube, and means for adjusting the distance between the longitudinal axes of the electrodes longitudinally of the tube.

7. A method for welding stud-like members to a tube substantially as hereinbefore described with reference to the accompanying drawings.

8. A welding machine substantially as hereinbefore described with reference to the accompanying drawings.

MATHISEN, MACARA & CO.,
Chartered Patent Agents,
Lyon House, Lyon Road,
Harrow, Middlesex, HA1 2ET.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1980.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1561795 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*