

PATENT SPECIFICATION

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DRAWINGS ATTACHED



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(54) AUTOMATIC WELDING MACHINE FOR WELDING AN ANNULAR
 JOINT BETWEEN CONCRETE PILE SECTIONS EACH HAVING A STEEL
 END STRUCTURE

(71) We, NIPPON CONCRETE KOGYO
 KABUSHIKI KAISHA, a Japanese corporation,
 of 8-3, 1-chome, Shimbashi, Minato-ku,
 Tokyo, Japan, do hereby declare the inven-
 tion, 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 state-
 ment:—

This invention relates to an automatic
 welding machine for welding an annular
 joint between concrete pile sections each
 having a steel end structure.

According to the present invention, there
 is provided an automatic welding machine
 for welding an annular joint between con-
 crete pile sections each having an end struc-
 ture including a steel end plate and a re-
 inforcing steel band integral therewith, the
 machine comprising in combination a
 mounting structure fixable to one of the
 concrete pile sections in embracing relation
 thereto and a welding unit which can be
 suspended on the mounting structure when
 the latter is fixed to said pile section and
 adapted to travel about the mounting struc-
 ture when suspended thereon; the mounting
 structure including an annular frame divided
 into two half frames, a split guide rail and
 a split ring gear both formed around the
 periphery of said frame, and a number of
 adjusting bolts carried by said frame and
 extending radially inwardly therethrough for
 abutting engagement with markers formed
 in the peripheral surface of the reinforcing
 band of said one concrete pile section; said
 welding unit including a drive mechanism
 comprising a drive motor, a drive gear
 adapted to be driven from said drive motor
 via speed reduction means and which
 meshes with said split ring gear on
 said frame when the welding unit is
 suspended on the mounting structure, a
 guide wheel which is held in engage-
 ment with said split guide rail on said frame
 and adapted to roll along said split guide

rail under the guidance thereof when the
 welding unit is suspended on the mounting
 structure, and an abutting wheel adapted to
 be held in rolling engagement with the last-
 mentioned reinforcing band, said welding
 unit further including a welding wire feed
 mechanism comprising a feed motor, a wire
 feeder adapted to be driven from said feed
 motor via speed reduction means, a wire
 guide cable, a wire reel and a welding torch
 mechanism comprising a welding torch and
 an adjustable torch supporting structure in-
 cluding means for effecting angular and
 vertical adjustments of the welding torch
 relative to an annular weld groove that is
 defined by said end plates between the ad-
 joining concrete pile sections.

For a better understanding of the inven-
 tion and to show how the same may be
 carried into effect, reference will now be
 made by way of example to the accompany-
 ing drawings, in which:—

Figures 1 to 6 illustrate one form of auto-
 matic welding machine wherein

Figure 1 is a side view of the welding
 machine as set between two concrete pile
 sections to form a welded joint therebetween,

Figure 2 is an enlarged vertical cross-
 sectional view of part of the machine of
 Figure 1 shown mounted on the lower of
 the two concrete pile sections,

Figure 3 is an enlarged side view of the
 welding unit of the welding machine of
 Figure 1,

Figure 4 is a rear view of the welding
 unit shown in Figure 3,

Figure 5 is a plan view of the welding
 unit shown in Figure 3, and

Figure 6 is a further side view, partly in
 section, of the welding unit of Figure 3;

Figure 7 is a side view illustrating the
 manner in which the welding machine of
 the preceding Figures is used for forming a
 welded joint between two concrete pile sec-
 tions disposed in an inclined position,

Figure 8 is a side view partly in section

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of a second form of welding machine, and Figure 9 is a side view showing a further form of welding machine.

Referring to Figures 1 to 6, two concrete pile sections P and P₁ to be joined end to end and each have mounted thereon end structures consisting of steel end plates E and E₁ respectively welded to steel reinforcing bands B and B₁ that surround the respective end portions of the pile sections P and P₁. The welding machine includes an annular mounting frame A which, in use of the machine, is mounted on the band B on the concrete pile section P which has been previously struck into the ground. The mounting frame A is in two halves which are hinged at 7 (Figure 2) to facilitate mounting thereof on the pile section P. At their free ends, the two halves of the frame A are connected together by a hook or clasp 1 (Figure 1), the frame A thus embracing the band B and hence the pile section P.

The mounting frame A is provided with an annular guide rail 2 upon which guide wheels 5 of a welding unit of the welding machine can run. The frame A also has a ring gear 3 which is in mesh with a drive pinion 6 of the welding unit. The welding unit can thus travel around the annular frame A. It will be appreciated that both the guide rail 2 and the ring gear 3 are made in two halves carried on the respective half frames of the mounting frame A, and complete their respective annular forms when the frame A is closed about a band on a pile section.

The mounting frame A is also provided with a number of adjusting bolts 4 extending radially from the frame for enabling the frame A to be supported on the pile section P in a correct position in which, at all its circumferential points, the frame is radially equally spaced from the periphery of the pile section and lies at the same height, or lies in a plane at right angles to the pile axis. In these conditions, once the tip of a welding torch of the welding unit is properly set opposite the peripheral edge of the adjoining contacting surfaces of the steel pile end plates E and E₁, the tip remains in a correct position relative to an annular peripheral groove existing between the end plates E and E₁ during the travel of the welding unit around the periphery of the mounting frame A.

The frame A is centred relative to the pile section P by adjustment of the bolts 4 to provide a uniform radial spacing between the frame A and the periphery of the pile section P. The height of the frame A, or its position axially of the pile section P, is determined by placing the ends of the adjusting bolts 4 in engagement with appropriate positioning marks, for example, recesses b previously formed in the tubular

steel reinforcing band B that is welded to the end plate E.

The welding unit of the welding machine also has a travel mechanism which includes a drive motor 12, a drive pinion 6 adapted to be driven from the motor 12 through an appropriate speed reducing mechanism, a guide wheel 5 held in rolling engagement with the guide rail 2 of the mounting frame A, and a pair of rubberised wheels 14 that abut the peripheral surface of the concrete pile section P to maintain the welding unit in an upright position. The unit otherwise would tend to tilt towards the pile section P if suspended only on the guide rail 2.

Although it is preferable to provide a pair of guide wheels 5 as shown in the Figures thereby to impart a greater stability to the welding unit while avoiding any undesirable concentration of the gravity load in the area of rolling engagement, it will be appreciated that only one guide wheel 3 may be provided. Similarly, only one wheel 14 need be provided.

In order to accommodate varying diameters of concrete pile sections used (in practice, for example, 450 mm or 400 mm in diameter), the guide wheels 5 are angularly adjustable on their mountings and adjustable in position with respect to their own axes, as are also the abutting wheels 14.

Further, for convenience for when the concrete pile is struck in an inclined position, the travel mechanism may include two pairs of abutting wheels arranged at the top and bottom of the unit W for example, as shown in Figure 7 at 14 and 14a, for the purpose of enabling the travel mechanism to be positively guided even when it assumes a position as indicated by the chain lines at W¹ in the Figure.

Referring to Figure 6, provided on the welding unit W is a wire feed mechanism for feeding welding wire M, the unit W including a drive motor 16 for operating the wire feed mechanism, a speed reducer 17, a feeder, a wire guide cable 19 and a wire reel 20. The feeder includes a pair of opposing feed gears 18, which are driven via the speed reducer 17 from the drive motor 16 which motor can be, for example, a d.c. servo-motor.

In operation of the wire feed mechanism, the welding wire M from the wire reel 20 is drawn through the interior of the hollow wire guide cable 19 and, passing between the opposing feed gears 18, is forced out through the welding torch T. As shown in Figures 3 and 5, the wire reel 20 is incorporated in a compact form within the welding unit W, but it may conveniently be arranged on the ground, as shown in Figure 8.

The welding torch T of the welding unit must mounted thereupon in such a

manner that it can be adjusted angularly on its mounting as well as in its vertical position thereby to enable it correctly to position the tip of the welding wire M relative to an annular groove that is formed between the adjoining end plates of the concrete pile sections being joined. To this end, the welding torch T is supported by a structure including a support member 22, a handle 23 for angular adjustment on its mounting and another handle 24 for vertical adjustment, as shown in Figures 3 and 5. It will be appreciated that, by adjusting the handles 23 and 24, the tip of the torch T can be adjusted to assume any desired position and direction. Although the welding torch T with such a supporting structure may be formed integrally with the welding wire feed mechanism described above, it is desirable for convenience in practice and bearing in mind that the welding torch T has to be adjustably supported, to form the torch support and wire feed mechanisms separate from each other, making only the welding torch T both angularly and vertically adjustable.

Figure 8 illustrates a modification of the welding-wire feed mechanism described above and includes, instead of the wire reel 20, a wire bobbin case 21 located on the ground or other fixed surface and connected with a tubular form of guide cable 19.

Figure 9 illustrates a modified form of adjustable welding-torch support mechanism. In this form, the welding torch T is formed integrally with a welding-wire feed mechanism which includes a feed motor 16a operable to drive a pair of feed rolls 18a. A torch support plate 26 is rotatably mounted on the shaft 25 of one of the feed rolls 18a. Threadably engaged with the torch support plate 26 is an adjusting bolt 28 which is threaded through a projection 27 formed on the casing of the motor 16a. Also formed on this motor casing is a stationary pin 30 which extends through an arcuate groove 29 formed in the support plate 26 to limit the pivotal movement thereof. With this arrangement, when the adjusting bolt 28 is turned in either direction, the torch support plate 26 is rotated about the shaft 25 together with the welding torch T. In this manner, the welding torch T can be finely adjusted relative to the weld groove between the pile end plates E and E₁ and such adjustment can be made with ease even during the welding operation if desired.

An operating handle 31 is provided for turning the base frame 32 of the feed motor 16a to the right or left relative to the structure of the welding unit W. An adjusting handle 33 is provided with a compression spring for pressing down the upper gear of the feeder for fine adjustment of the delivery

pressure of the pair of feed rolls 18a acting on the welding wire M.

WHAT WE CLAIM IS:—

1. An automatic welding machine for welding an annular joint between concrete pipe sections each having an end structure including a steel end plate and a reinforcing steel band integral therewith, the machine comprising in combination a mounting structure fixable to one of the concrete pile sections in embracing relation thereto and a welding unit which can be suspended on the mounting structure when the latter is fixed to said pile section and adapted to travel about the mounting structure when suspended thereon; the mounting structure including an annular frame divided into two half frames, a split guide rail and a split ring gear both formed around the periphery of said frame, and a number of adjusting bolts carried by said frame and extending radially inwardly therethrough for abutting engagement with markers formed in the peripheral surface of the reinforcing band of said one concrete pile section; said welding unit including a drive mechanism comprising a drive motor, a drive gear adapted to be driven from said drive motor via speed reduction means and which meshes with said split ring gear on said frame when the welding unit is suspended on the mounting structure, a guide wheel which is held in engagement with said split guide rail on said frame and adapted to roll along said split guide rail under the guidance thereof when the welding unit is suspended on the mounting structure, and an abutting wheel adapted to be held in rolling engagement with the last-mentioned reinforcing band, said welding unit further including a welding wire feed mechanism comprising a feed motor, a wire feeder adapted to be driven from said feed motor via speed reduction means, a wire guide cable, a wire reel and a welding torch mechanism comprising a welding torch and an adjustable torch supporting structure including means for effecting angular and vertical adjustments of the welding torch relative to an annular weld groove that is defined by said end plates between the adjoining concrete pile sections.
2. An automatic welding machine substantially as hereinbefore described with reference to Figures 1 to 7 or Figure 8 or Figure 9 of the accompanying drawings.

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manner that it can be adjusted angularly on its mounting as well as in its vertical position thereby to enable it correctly to position the tip of the welding wire M relative to an annular groove that is formed between the adjoining end plates of the concrete pile sections being joined. To this end, the welding torch T is supported by a structure including a support member 22, a handle 23 for angular adjustment on its mounting and another handle 24 for vertical adjustment, as shown in Figures 3 and 5. It will be appreciated that, by adjusting the handles 23 and 24, the tip of the torch T can be adjusted to assume any desired position and direction. Although the welding torch T with such a supporting structure may be formed integrally with the welding wire feed mechanism described above, it is desirable for convenience in practice and bearing in mind that the welding torch T has to be adjustably supported, to form the torch support and wire feed mechanisms separate from each other, making only the welding torch T both angularly and vertically adjustable.

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