PATENT REQUEST : STANDARD PATENT

I/We being the person(s) identified below as the Applicant(s), request the grant of a patent to the person(s) identified below as the Nominated Person(s), for an invention described in the accompanying standard complete specification.

Full application details follow:

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[54] Invention Title:
Process and device for roller seam welding of containers

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[Signature]

a member of the firm of
DAVIES COLLISON CAVE for
and on behalf of the
applicant(s)
PROCESS AND DEVICE FOR ROLLER SEAM WELDING OF CONTAINERS

1. Process for the roller seam resistance welding of very thin sheet metal containers, in particular of can bodies, characterized in that the container seam is butt welded, preferably without wire.

18. Apparatus for the roller seam welding without wire of container bodies of very thin sheet metal, preferably tinplate, characterized in that a first roller head (5) which can be rotatably driven and which has two electrodes (2,3) and an electrode cleaning device are provided, which cleaning device cleans the electrodes continuously or discontinuously, that a second electrodeless roller head (8) is provided and that the bodies (1) can be fed by a feed device to the roller heads (5,8) with their seam edges butted together.
19. Apparatus for the roller seam welding without wire of container bodies of very thin sheet metal, preferably tinplate, characterized in that a feed device is provided which conveys the bodies into the weld area with their edges overlapping one another, that essentially non-current-carrying first rollers (40, 41) are provided in the area of overlap and that current-carrying second rollers (42, 43) are provided as electrodes beside the first rollers.
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INVENTION TITLE:

Process and device for roller seam welding of containers

The following statement is a full description of this invention, including the best method of performing it known to me/us:-
The invention relates to a process for the roller seam resistance welding of thin sheet metal containers, and of can bodies in particular. The invention also relates to a device for carrying out the process.

"Thin" or "very thin" metal sheets are metal sheets with a thickness of approximately 0.1 to 0.5 mm. These may be tinned (tinplate) or provided with other coatings, or uncoated (blackplate). The welding of tinplate containers in particular, and especially can bodies, with an overlapping seam using a copper wire intermediate electrode, is known. Hitherto this has proved to be the only technically and economically successful process, as the tin coating on the sheet causes severe contamination of the electrode, which in industrial usage can only be overcome by the constantly self-renewing copper wire electrode.

Investigations have also been made into the possibility of roller seam welding an overlapping seam without wire, with tungsten or molybdenum welding rollers (Paul Schindele, "Investigations into the Welding Properties of Tungsten and Molybdenum Alloys in the Resistance Roller Seam Welding of Electrolytically Tinned Very Thin Sheet", Munich Institute of Technology thesis, 1983; summary published in "neue verpackung" 5/84). In practice, no such process has found acceptance.
In the welding of steel tubes, it is known to make a longitudinal butt weld by roller seam welding. In this case, copper electrode rollers can be used since no tinning is present. The minimum wall thickness of steel tubes welded by this process is 0.4 mm, and a high force has to be exerted on the tube by pressure rollers beside the seam (Deutscher Verband für Schweisstechnik e.V., Leaflet DVS 2911). For the welding of can bodies of very thin tinned sheet (e.g. with a thickness of approximately 0.19 mm), where the circumstances are altogether different, and where, unlike tube welding, a continuous seam is not produced, the technology of steel tube welding has not yet inspired any ideas.

Although welding with copper wire electrodes produces outstanding results, it has the drawback that the cost of the copper wire is high. Therefore, the object is to provide an industrial process for the welding of containers made of very thin sheet, and in particular tinplate, which does not have this drawback.

According to the invention this is achieved by welding the container seam as a butt weld, preferably without wire.

Surprisingly it has been found that very thin tinned sheets can be butt welded, and in particular butt welded without wire, and that a sealed weld can be obtained. Moreover, it has been found that butt welding results in a reduction in the deposition of tin on the electrode rollers (which is not the case with an
overlapping seam), as the electrodes can be arranged so that the electrode/sheet contact temperature remains well below the melting point of tin. Furthermore, it has been found that the welding power input can be reduced in comparison with the overlapping seam, resulting in a lower thermal contact load.

As an alternative to the said solution, it is also possible to make an overlapping weld, preferably without wire, by feeding current to the weld via primary rollers and by mashing the overlapping seam by means of secondary rollers, by which means the abovementioned advantages can again be achieved.

The welding current, which is usually an alternating current, is preferably controlled so that the current is reduced at the end of the welded seam. This may also be advantageous at the start of the welded seam of the following can body.

Also, the electrodes are preferably cleaned, either continuously or intermittently, to remove any contamination by tin.

The device for carrying out the process is characterised by the features of claims 19 and 20.

Examples of ways of carrying out the invention will now be explained in detail with reference to the drawings, in which:

Fig. 1 shows schematically a partial view of a can body in the course of welding;

Fig. 2 shows an enlarged detail view of the weld
and adjacent area, illustrating the current flow;

Fig. 3 shows a further detailed view of the weld and adjacent area;

Fig. 4 shows a partial illustration of the elements of an apparatus for welding without wire;

Fig. 5 shows a partial view, in vertical section, of the roller heads at the welding point; and

Fig. 6 shows schematically an example of an embodiment with an overlapping seam weld.

Fig. 1 shows schematically a can body 1, of which only part is represented, and which is being butt welded by roller seam welding. This roller seam welding is being performed by two electrodes 2 and 3 which are separated from one another by insulation 4 and which form a welding roller 5 arranged outside the can body. Inside the can body 1, an inner roller 8 is rotatably mounted on a bracket 7. This roller 8 is not electrically conducting. In the illustrated example, the roller 8 comprises two discs 9 and 10 of a hard metallic material and a central insulating layer 11. Also provided are calibrating rolls 12, arranged outside the can body in a known manner, to ensure the roundness of the can body. In addition to the calibrating rolls 12 which are illustrated, further calibrating rolls not visible in the drawing are normally provided around the circumference of the can body 1. The can body is guided between the welding roller 5 and the opposite roller 8 so that the edges butt together without overlapping. This can be accomplished by means of suitable guide rails (called
"Z-rails") which are known in themselves from the setting-up of an overlapping seam and are therefore not illustrated here, but in this case are set up so that there is no overlap and the two longitudinal edges of the can body are butted together. Thus an H-shaped rail is required. The guide rail may bring the ends of the can body together so that they are level with each other and are still separated by a small gap of eg. 0.1 mm. The longitudinal edges which are to be welded can then be brought into contact with one another by the calibrating rolls.

Fig. 2 shows schematically, on an enlarged scale, the weld area of a can body 1 which is in course of being butt welded. Here again the external welding roller 5 is formed by the two electrodes 2 and 3 separated by the insulation 4. In the example shown here, the inner roller 8 consists of a single piece of insulating material, eg. ceramic material. In Fig. 2, the butt joint of the can body sheet is seen, and the current flow i through the butt joint is schematically indicated. It can be seen that when butt welding is performed by this technique a high welding temperature is generated mainly in the region of the butt weld. Transfer of current from the electrodes 2 and 3 to the sheet metal of the can body 1 on the other hand occurs laterally of the actual weld area ie. outside the region of highest temperature. This is in direct contrast to the known lap welding process using a copper wire electrode, and results in relatively slight contamination of the electrode roller 5 with tin, as the tin is melted
essentially only in the region of the actual butt weld.

The welding parameters for this type of butt welding have proved to be quite noncritical. Very thin sheets of the type normally used for can bodies, with electrolytic tinning, and with a thickness of approximately 0.2 mm, may be used. The welding force may be freely selected within a wide range, eg. 500 N. The welding current may lie eg. in the 2kA range, and the welding frequency in the range of several hundred hertz, eg. 650 Hz. The welding current form may likewise be freely selected eg. as sinusoidal. With the arrangement shown, sealed butt welds in can bodies can be obtained at high rates of travel in this way (eg. at a rate of travel of over 80 m/min).

Fig. 3 shows another way of producing weld. Here again, only part of the can body 1 is shown, and upper electrodes 2 and 3 are provided which together with the intermediate insulating layer 4 form the upper roller head 5. Calibrating rolls 12 are likewise shown only in part. The lower roller head 8 in the interior of the can body is in this case a built-up assembly, comprising, for good wearing properties, a first steel ring 9 and a second steel ring 10 which are separated by an electrically insulating intermediate layer 11, eg. of ceramic material. In this case the lower roller head can be rotatably driven, for which purpose a belt 15 is provided, driven by a motor which is not shown, so that the lower roller head 8 moves synchronously with the advance of the can body. This helps
to reduce the slip of the can body feed. The welding parameters in this embodiment can be selected as in the example already given.

The intermediate insulating layer 4, and the intermediate insulating layer 11 or as the case may be the lower roller head 8, may - as shown in Figs. 2 and 3 - bear on the sheet of the can body 1 in the area of the weld, keeping the edges of the can body exactly flush with each other. Alternatively, it is possible to form the intermediate layers or the lower roller head so that no contact is made directly in the weld area by the intermediate layers or the lower roller head. In this case the individual intermediate layer or lower roller head 8 may be provided with a peripheral groove eg. in the immediate area of the weld. The advantage of this alternative is that it further reduces the pick-up of tin by the intermediate layer or by the lower roller head. The cross-section of the groove may be eg. semicircular, triangular or rectangular. It would also be possible to set back the intermediate layers 4,11 over their entire width between the electrodes, but there would then be less positive guidance of the edges in the weld area.

Preferably, the upper, current-supplying welding roller 5 with the two electrodes 2 and 3 and also the lower roller 8 may each be provided with internal cooling, e.g. water cooling. This brings about a further reduction in the wear of the electrodes and in the pick-up of tin or contamination of the electrodes.
The welding roller 5 with the electrodes 2 and 3 may also be provided with a cleaning device which enables any tin contamination to be removed either from time to time or continuously. For this purpose the cleaning device may possess corresponding scraping or abrasive means. The intermediate layers or as the case may be the lower roller head may also be cleaned in this way.

The materials of the upper roller head with the welding electrodes and those of the lower roller head may be chosen from a large group of suitable materials. Particular attention should be paid to the wearing properties of the material, in order that a large number of welding processes can be performed in industrial applications. The electrode rollers are preferably formed from a material with a Vickers hardness higher than 200, advantageously higher than 300. For the electrodes, preferably titanium-zirconium-molybdenum (TZM) alloy or tungsten-thorium oxide (WThO₂) can be used, and the insulation between the electrodes can preferably consist of ceramic material. The lower roller head is preferably made of steel ECN35 with an intermediate insulating layer of ceramic material, e.g. aluminium oxide or zirconium oxide. The lower roller head can preferably also be made of silicon carbide (SiC) or silicon nitride (Si₃N₄).

The electrodes or secondary circuit are preferably provided with a parallel resistance of 4.5 mOhm to prevent sparking between the electrodes between the can bodies. However, this may be omitted if, as is favoured,
the welding current is reduced at the end of the can body and, if need be, switched off between the individual can bodies.

Fig. 4 shows highly schematically the elements of an apparatus for carrying out the process. Can bodies 1 are conveyed on a conveyor unit 16 to the welding point, where they are held by calibrating rolls 12. (Usually, more calibrating rolls are provided than the two that are illustrated in Fig. 4 for the sake of simplicity). The calibrating rolls can be provided with a drive 17 to drive them in the can body conveying direction. Welding is performed by means of the roller head 5 located outside the can body. Inside the can body, the roller head 8 which has already been described, and which carries no electrodes, is provided. The roller head 5 is rotatably driven by a drive motor 18. The welding transformer 19 which converts the primary voltage into the secondary welding voltage rotates with the roller head 5. Such rotating welding transformers are known, and the illustrated transformer 19 will therefore not be described in more detail here. The transfer of the primary voltage to the rotating transformer is effected by means of sliding contacts 20,21. The arrangement of roller head 5, welding transformer 19 and drive motor 18 is vertically adjustable as a unit to allow for wear of the electrodes at the roller head 5. Vertical guides 23,24 are provided for this purpose. These may be eg. screw actuators driven by a drive motor 25 to adjust the vertical position of the
electrodes. The internal water cooling of the roller head may be effected by means of a conduit 26 which passes centrally through the motor and the welding transformer. The previously mentioned dressing or cleaning of the electrodes may be effected eg. by means of a grinding wheel 27 driven by a motor 28. Grinding may be performed continuously, or discontinuously only when the need arises. The removal of contamination and electrode material by the grinding wheel 27 can be compensated by the facility for vertical adjustment of the roller head 5 by means of the drive mechanism 23,24,25.

Fig. 5 shows a sectional view of another embodiment of apparatus with a roller head 5 likewise having two electrodes 2 and 3 and an intermediate insulating layer 4. Here the roller head 5 is arranged on a rocker arm 30, and a current feed 31 for the electrode 3 passes through a sliding contact 32. The roller head 5 is driven by a drive motor not shown in the drawing, which drives a flange 33. Cooling water can be supplied centrally through a bore 34. The inner roller 8 is in this case constituted by a ceramic roller, and a number of calibrating rolls 12 are provided to hold the can body in the correct position.

Fig. 6 shows a further embodiment for welding without wire, in this case for welding an overlapping seam. An upper roller 41 and a lower roller 40 are provided to mash the overlapping seam. These rollers are not electrically conducting, and consist eg. of ceramic
material (the ceramic materials which have already been mentioned may also be used here). Electrode rollers 42 and 43, which constitute the current-carrying electrodes; are arranged beside the overlapping seam. The result is a current flow as indicated in the drawing by the current path i. Also provided are calibrating rolls 12 for the can body 1, which are only partly illustrated here. Owing to the large electrode surface area of the rollers 42 and 43 outside the actual weld area, electrode contamination is slight in this embodiment also, even though the welding is performed without wire. The ceramic rollers 41 and 40 are not, or are only very slightly contaminated, as they are not wettable by tin. The rollers 42 and 43 may also be dressed by grinding or scraping to keep the electrodes clean. Cleaning may also be provided for the rollers 41 and, if need be, 40.

Although the invention has been explained with reference to tinplate (very thin tinned sheet), this is intended only as a particularly preferred example. The invention may also be applied to very thin sheets which have other coatings, or are uncoated.

Under certain circumstances it may be advantageous to use an intermediate wire electrode when making the butt weld.

The reference numerals in the following claims do not in any way limit the scope of the respective claims.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Process for the roller seam resistance welding of very thin sheet metal containers, in particular of can bodies, characterized in that the container seam is butt welded, preferably without wire.

2. Process according to claim 1, characterized in that the welding electrodes (2,3) are arranged outside the container on either side of the butt joint to be formed and that an electrodeless roller (8) extends over the butt joint inside the container.

3. Process according to claim 2, characterized in that the welding electrodes (2,3) are combined with an electrically insulating intermediate layer (4) to form a welding roller (5) which is rotatably driven by means of a drive unit.

4. Process according to claim 2 or 3, characterized in that the inner roller is formed from insulating material, in particular ceramic material.

5. Process according to claim 2 or 3, characterized in that the inner roller is formed from metal discs (9,10) with an electrically insulating intermediate layer (11).

6. Process according to any one of claims 2 to 5,
characterized in that the inner roller is rotatably driven.

7. Process for the roller seam resistance welding of very thin sheet metal containers, in particular of can bodies, characterized in that an overlapping seam is formed which is acted on by non-current-carrying rollers (40,41) and that the welding current is supplied by means of additional electrodes (42,43) provided on either side of a mashing station.

8. Process according to any one of claims 1 to 7, characterised in that at least the electrodes are cleaned continuously or discontinuously.

9. Process according to claim 8, characterized in that the electrodes are cleaned by scraping or grinding.

10. Process according to any one of claims 1 to 9, characterized in that the position of the electrodes is adjustable to follow the welded seam.

11. Process according to any one of claims 1 to 10, characterized in that the welding current is reduced at the end of the welded seam.

12. Process according to any one of claims 1 to 11, characterized in that the welding current is reduced or switched off between individual containers to be welded.
13. Process according to any one of claims 1 to 12, characterized in that an electrical resistance is connected parallel with the welding electrodes.

14. Process according to any one of claims 1 to 6 and 8 to 13, characterized in that the container edges to be welded are aligned so as to butt one another by a rail with guides for both edges, in particular by an H-shaped rail.

15. Process according to claim 7, characterized in that the non-current-carrying rollers and the electrode rollers are rotatably driven.

16. Process according to claim 7, characterized in that the non-current-carrying rollers are formed from insulating material, in particular ceramic material.

17. Process according to any one of claims 1 to 16, characterized in that the container body to be welded is guided in the weld area by a plurality of calibrating rolls at least one of which is rotatably driven.

18. Apparatus for the roller seam welding without wire of container bodies of very thin sheet metal, preferably tinplate, characterized in that a first roller head (5) which can be rotatably driven and which has two electrodes (2,3) and an electrode cleaning device are provided, which cleaning device cleans the electrodes
continuously or discontinuously, that a second electrodeless roller head (8) is provided and that the bodies (1) can be fed by a feed device to the roller heads (5, 8) with their seam edges butted together.

19. Apparatus for the roller seam welding without wire of container bodies of very thin sheet metal, preferably tinplate, characterized in that a feed device is provided which conveys the bodies into the weld area with their edges overlapping one another, that essentially non-current-carrying first rollers (40, 41) are provided in the area of overlap and that current-carrying second rollers (42, 43) are provided as electrodes beside the first rollers.

20. Apparatus according to claim 19, characterized in that a cleaning device is provided for the continuous or discontinuous cleaning at least of the current-carrying second rollers.

21. Apparatus according to any one of claims 18 to 20, characterized in that the electrode rollers are formed from a material with a Vickers hardness higher than 200, and preferably higher than 300.

22. Apparatus according to claim 21, characterized in that the rollers are formed from titanium-zirconium-molybdenum (TZM) or from tungsten-thorium oxide (WthO₂).
23. A process for roller seam welding or apparatus therefor substantially as hereinbefore described with reference to the drawings.

24. The steps, features, compositions and compounds disclosed herein or referred to or indicated in the specification and/or claims of this application, individually or collectively, and any and all combinations of any two or more of said steps or features.

DATED this THIRD day of JULY 1995

Elpatronic AG

by DAVIES COLLISON CAVE
Patent Attorneys for the applicant(s)
ABSTRACT

Can bodies of tinplate are butt welded without using a wire electrode.

(Fig. 1)
END