

[54] **SEAM CONNECTION AND METHOD FOR MANUFACTURING THE SEAM**

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[30] **Foreign Application Priority Data**

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[51] Int. Cl.B21d 51/00

[58] Field of Search.....113/1 E, 120 K, 120 Y, 113/121 A, 121 C; 220/67, 5 R, 5 A, 76, 79

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Assistant Examiner—M. J. Keenan
Attorney—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

This application involves a method of forming spiral sheet metal seams of the type that are required between the side walls and ends of a steel drum. The seam is made in a spiral having a seal in its heart. The sheets which define the spiral are in mutual contact for the full length of at least one of them.

4 Claims, 11 Drawing Figures

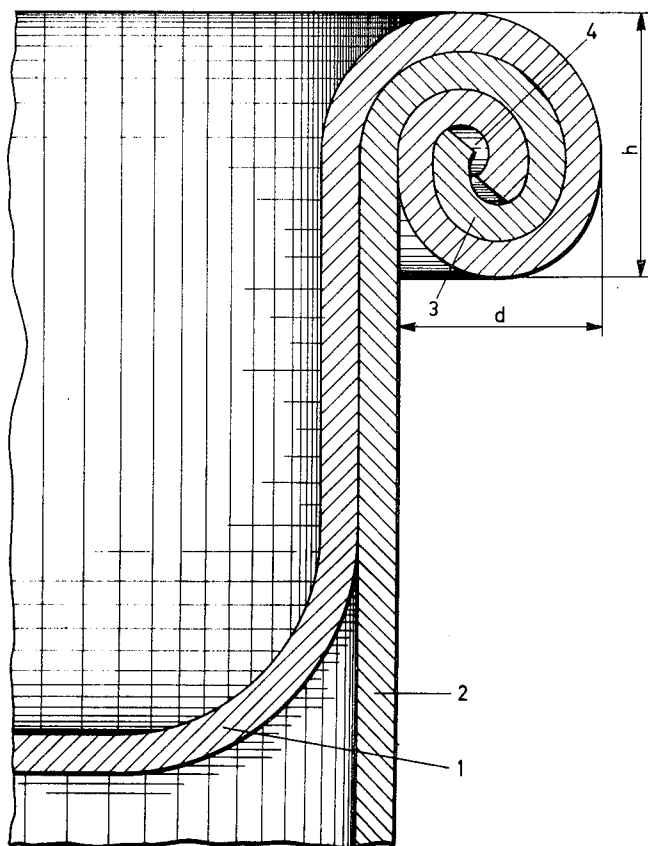


FIG. 1 PRIOR ART

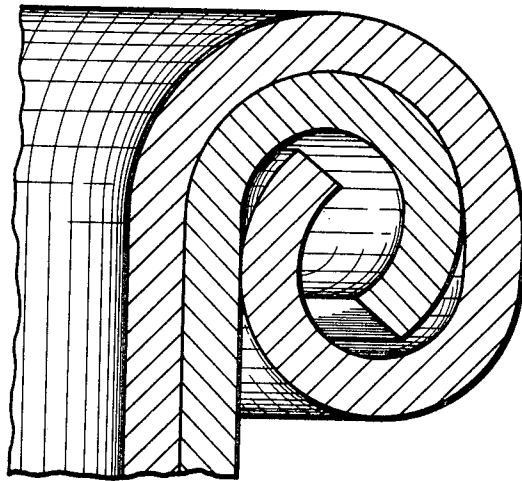


FIG. 2 PRIOR ART

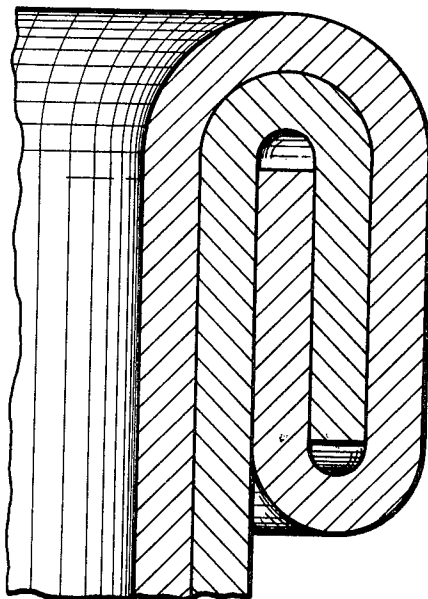


FIG. 3

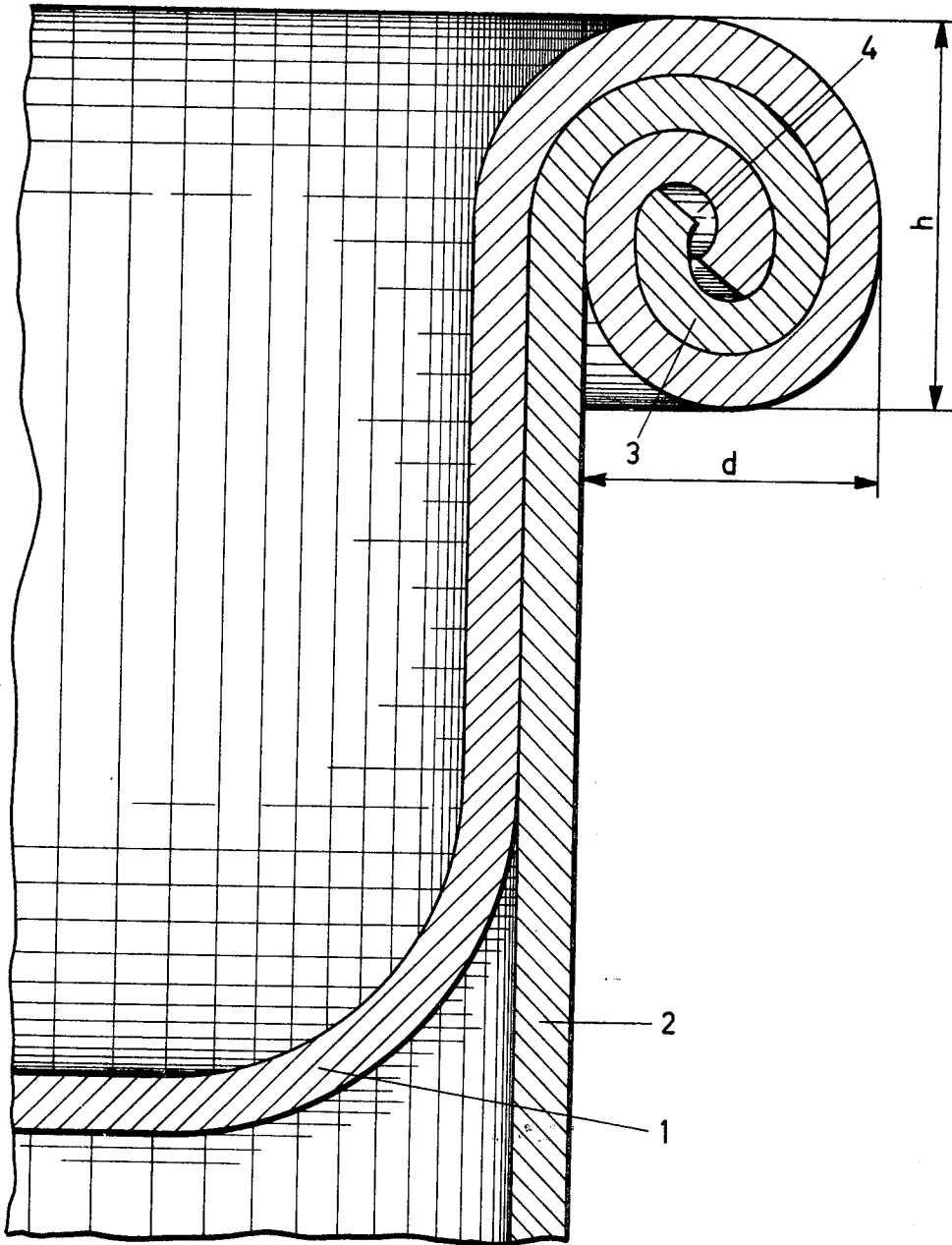


FIG. 4

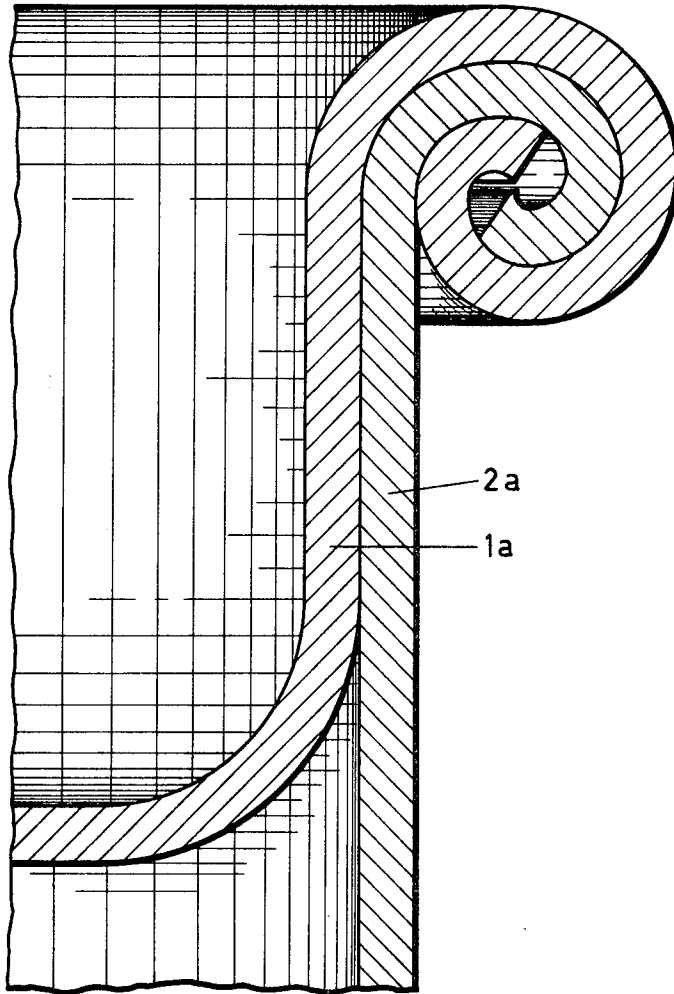


FIG. 5a FIG. 5b FIG. 5c FIG. 5d

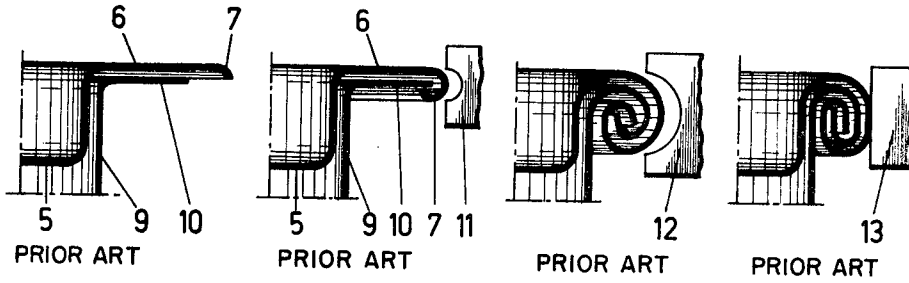


FIG. 6

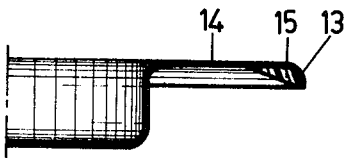


FIG. 7

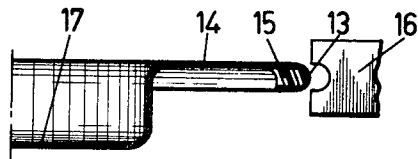
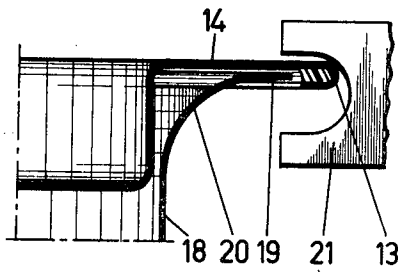


FIG. 8



SEAM CONNECTION AND METHOD FOR MANUFACTURING THE SEAM

The present invention relates to a method of forming a seam connecting the edges of at least two sheets of metal in which the edge of one of the sheets is bent about 360° or more and to the product so formed. The state of the art respecting such method and product is to be found in British Pat. No. 1,153,872 and in published Dutch patent application 64,06427.

Seams are produced according to the known method by rolling the sheet edges which have to be connected in a profiled seaming roller which gives the edge of the sheet which has to form the outer layer of the seam a protruding portion with respect to the other sheet edge, the outer edge of said protruding portion being bent somewhat in the direction of seaming before the real seaming operation is started. A sealing compound is applied during the manufacturing of the seam.

When the rolling operation is finished the sheet edges grip around each other, but there is still however a large clearance between them. To close said clearance and to obtain a seam which is tight, the rolled sheet edges are rolled flat in such a way that a seam is obtained in which the sheet edges grip around each other by means of sharp folds. With a simple double seam as generally known at least one of the sheet edges is folded twice over 180°. With the seam according to FIG. 6 of the above-mentioned British specification at least one of the sheet edges is folded three times over 180°. The greater the number of folds the more difficult it is to arrange the sheet edges within the seam at the proper place with respect to each other. Said edges should overlap each other as much as possible. In practice it is difficult to locate said edges at the proper place with respect to each other since there always are differences in qualities of material and thickness of the sheets which affect the length of the sheets to be seamed.

The flattening of the seam according to prior art practice causes increased strain hardening at the region of the sharp folds and this has the effect of making the seam subject to bursting under load. Furthermore where the prior art seams are used in making metal drums, dropping of the drum has been found to cause leakage. It appears that, because the seam is more or less rectangular in section, it has different bending resistance in different directions so that deformation caused by dropping the drum makes the seam buckle and unroll enough to cause leakage. Flattening also involves the risk of overseaming, an expression which means that during flattening the material is pressed inwardly over the counter pressure member.

For the manufacturing of a seam it is well known to use seaming rollers. The aforementioned British specification describes a method for the manufacturing of a triple seam in which first of all by means of a first seaming roller the protruding sheet edge is folded back upon the other sheet edge after which by means of another seaming roller both edges are rolled into a still open spiral shape, which subsequently by means of a third roller is flattened to form the well known triple seam containing seven layers. Said seven layers can be considered to be seven cylinders fitting into each other. In general a sealing compound is injected during said operations said sealing compound e.g. being a rubber water emulsion.

Said known method requires that after assembling the preshaped parts three different seaming rollers have to engage the sheet edges to manufacture the closed seam. This is true as well when instead of a triple seam the more usual double seam is made. The seam obtained whether double or triple, has the disadvantage that the cylindrical portion of the seam results into different moments of inertia with respect to the different axis of bending since the substantially rectangular cross section is longer in axial direction than in radial direction in the case of a seam of a drum. When during transportation deformation occurs torsion is the result with the before mentioned opening of the seam.

Further it is almost impossible to obtain an air tight connection and very often not possible to obtain a liquid tight connection with double seams and triple seams as well. The sealing compound which during the seaming operation is injected is spread at random between the layers of the sheets due to the seaming operation and accordingly does not form a coherent layer which layer furthermore loses volume by drying so that small openings are formed. In case one applies the sealing compound prior to the seaming operation to avoid said disadvantage the sheet edges which during the seaming operations shift over each other will cut the sealing compound, displace it by shifting it and will scratch it into pieces.

It is observed that attempts have been made to manufacture a round seam. To this end, however, first of all the sheet edges were welded together and subsequently bent into an open roll.

It is therefore an object of the present invention to provide a seam which is free of the defects of prior art constructions.

It is a further purpose of the invention to provide a method by means of which it is possible to manufacture the seam according to the invention without the objections inherent in the known methods of manufacturing seams.

According to the invention this is achieved by first of all bending the aforementioned outer edge by means of a separate seaming roller to conform to a very small radius over about 180° without touching or preventing the assembly of it with the other sheet edge. After this, a sealing means or compound is applied in the hollow space thus formed and conditioned. Then both sheet edges are closely rolled upon each other into a closed spiral shaped cross section by means of one single seaming roller. Thus primarily the sheet edge of the protruding portion is formed with a hollow or channel-like portion in which the sealing means are applied. This bent portion has such a small radius that it forms the core for the further folding or rolling operation. It is filled with sealing means. During the further seaming operation said other edge is cored in said bent hollow edge namely in the sealing compound or means present in it but cannot, however, shift with respect to said edge so that the sealing material, although being compressed and ensuring the sealing, cannot be shifted or scraped away. By the fact that the folding or rolling takes place by means of one single seaming roller only two rollers are necessary for making the closed seam. Accordingly the number of operations is reduced by one with the end result of a closed massive seam with moments of inertia which are equal or at least almost equal in axial and radial direction respectively.

In the case of connecting the flange of a cover with the flange at the edge of a drum which means the connection of sheet edges extending perpendicularly to the axis of the cylindrical portions of cover and drum, then in accordance with the invention it is necessary that to enable the assembly of drum and cover that the edge of the drum at the location of transition towards the flange is given a radius which is considerably larger than the radius of curvature at the location of transition of the flange of the cover towards the cylindrical portion of the cover, whilst further the inner diameter of the edge of the cover bent over substantially 180° during the first operation is a little bit larger than the outer diameter of the flange of the drum. This is necessary to enable the placement of the cover upon the drum body after the application of the sealing material to the bent edge of the cover. This larger radius is necessary to enable the inner layer to be wound with the outer layer into a closed spiral without undesirable deformations or upsettings. These might occur if the flanges of drum body and cover at the location of the transitions would have radii which would correctly fit into each other. The portions to be rolled or folded around each other have different arc length. With the known method described in the aforesaid British patent the cylindrical portions of cover and drum body support upon each other during the seaming operation and accordingly the edges must shift with respect to each other whilst according to the method of the invention the edges cannot shift with respect to each other so that the relative movement during the seaming operation has to take place backwards which means in the direction of the cylindrical portions. In view of the fact that said cylindrical portions are not allowed to shift, with respect to each other the space required is obtained by means of the larger radius.

Thus, according to the present invention the sheet edges are rolled into a proper spiral shaped winding which is substantially closed up to its heart. This means that when folding the sheet edges said edges are closely rolled around each other such that at the end of the rolling operation a seam is obtained which is almost massive, or in other words without any clearance between the sheet edges, and which can no longer be flattened and need not to be flattened. The earlier mentioned tolerances are of no importance any more since the quantity of material to be folded is equal to the quantity in the closely rolled finished seam. By the fact that said seam has a proper spiral shape its height and width are almost equal to each other. If the seam is used for connecting a wall and bottom of a container such as a drum, this means that at least in radial direction the present invention has a larger moment of inertia of the seam as compared with the known seam starting from the same quantity of material and accordingly this invention has a larger strength in that direction where it is desired most.

Seams according to the present invention have virtually equal bending resistance in all directions, are leak resistant and yet may be made with fewer steps and less material than prior art processes.

According to the invention it is preferred that the sealing means are brought in the final condition before the seaming operation is done. This means that in case a liquid is applied said liquid first has to be dried to obtain a closed, well adhering film. It is also possible to apply a loose ring of synthetic resin or rubber which fits

into the hollow space. According to the invention the use of polyurethane sprayed into the hollow space and allowed to set is preferred.

The invention now will be further elucidated with reference to the drawings.

FIG. 1 shows a prior art seam in cross section after the seaming operation and before the flattening operation.

FIG. 2 is a cross section through the seam of FIG. 1 in its finished flattened form.

FIG. 3 is a cross section through a seam according to the invention.

FIG. 4 shows a different embodiment of the seam according to the invention.

FIG. 5a to d inclusive show schematically the manufacturing of a triple seam according to the method known from British specification No. 1,153,872.

FIG. 6 shows the form of the cover according to the invention.

FIG. 7 shows the same cover after bending the edge over 180°.

FIG. 8 shows diagrammatically the situation of the portions to be connected before the seaming operation starts.

FIG. 1 clearly shows how after the known rolling operation the bent sheet edges engage each other with large clearance. To close the seam to obtain the form shown in FIG. 2 a flattening operation by means of rolls has to take place. The seam is then higher than it is thick.

In FIG. 3 one embodiment of the seam according to the invention has been shown in the form of an uninterrupted spiral shaped winding.

FIG. 4 shows another embodiment of the seam according to the invention differing from the one according to FIG. 3 in that the sheet edges are rolled over a smaller angle.

Whereas according to the embodiment of FIG. 3 the outer plate 1 has been rolled over more than 540° and the inner sheet over more than 360° in the embodiment of FIG. 4 the outer sheet 1a has been folded over a little bit more than 450° and the inner sheet 2a over a little bit more than 270°.

FIG. 3 and FIG. 4 respectively show a cover 1 and 1a respectively and a side wall 2 and 2a respectively of a drum and said two parts are connected with each other by means of the seam 3 having the form of a closed spiral shaped winding. Since the example shown shows a circular seam the sheet edges during the seaming operation have to be deformed towards a smaller diameter which causes an increase of the metal sheet thickness. This happens with each seam and accordingly also with the seam according to the invention. This thickness increase, however, promotes the filling of the seam center whereas it has no particular advantage for flattened seams.

Whereas for the manufacturing of the known seam a seaming roller is used having a groove the diameter of which being such that an open almost spiral shaped winding is formed which can be flattened, it is necessary for the manufacturing of the spiral shaped winding according to the invention to use a seaming roller the groove of which having dimensions of which height and depth correspond to the dimensions h and d shown in FIG. 3 of the drawings.

FIG. 5a to d inclusive relate to the manufacturing of the prior art seam by the prior art process.

FIG. 5a shows a cover 5 with flange 6 and protruding portion 7 as well as a drum body 9 with flange 10.

FIG. 5b shows how by means of a first rolling operation with the roller 11 the protruding portion 7 is folded back upon the flange 10.

FIG. 5c shows how by means of a further roller 12 the seaming operation is performed during which the flange 6 is turned three times so that in cross section seven layers are formed which seam, however, is not closed.

FIG. 5d shows how by means of the roller 13 the open seam of FIG. 5c is closed by flattening to produce an almost rectangular seam as viewed in cross section.

The final form obtained is similar to the one shown in FIG. 2.

During said flattening operation it is in practice very difficult to properly define the degree of flattening. The tolerance in plate thickness and hardness and the degree of wear of the machine lead to adjusting the pressure force rather high. This, however, means that thicker and softer sheets are compressed too much and said over-deformation reduces the deformability of the material very often to such a degree that if during transportation further deformations occur this will lead to cracks of the sheet.

For the method according to the invention one starts from a cover shape as shown in FIG. 6, which form in principle does not deviate from the form as shown in FIG. 5a. Said cover is stamped out of a flat sheet and has an outer edge 13 at the flange 14 which is already somewhat bent inwardly. In said area it is possible already to apply sealing material such as polyurethane indicated at 15.

The next operation shown in FIG. 7 is that the edge 13 provided with the sealing material 15 or not is curved by means of the roller 16 into a hollow edge with a very small radius. If the sealing material has not been applied before said operation it has to be applied now and if necessary brought into its final condition e.g. by drying hardening, vulcanization, glueing of a rubber ring or the like.

Thereafter the cover 17 and drum 18 are assembled. FIG. 8 shows that the edge of the drum has been provided with a flange 19 the transfer area between flange edge and drum body having a large radius of curvature 20. The outer diameter of the flange 19 is smaller than the inner diameter of the curved edge portion 13 filled with sealing means.

By means of the roller 21 the further seaming operation takes place. This is done from the position shown in FIG. 8 by means of one single roller 21 forming the sheet edges into a complete closed spiral which flanges independence of their width will be rolled into each other over two times 180° to e.g. three times 180° the center or heart being formed by the circular cross section of the hollow edge 13 made with the aid of the roller 16.

The radius of the groove in the roller 21 is defined by the sheet thickness and the number of windings to be made. If the spiral winding is 2.5 times 180° the outer side of the seam in principle is circular. If the winding is continued to e.g. three times 180° then the upper half of the seam may have a little different circular form

than the lower half. The result of the last possibility has been shown in FIG. 3. FIG. 4 shows a seam with a spiral shape of 2.5 times 180° and an outer shape which, in principle, is circular.

5 What is claimed is:

1. A cylindrical sheet metal container of large volume including circumferential beads comprising a cylindrical container body having a first flange-like sheet edge; a circular cover having a second flange-like sheet edge; a seam connection between the first and second sheet edges, said seam connection including said first and second sheet edges wherein said first sheet edge is bent about an angle of more than 270° and said second sheet edge is bent about an angle of more than 360° , as seen from the beginning of curvature of the respective first and second edges, and wherein said first and second sheet edges are in a spiral shaped winding of gradually changing radii and are in metal-to-metal contact throughout the entire cross-section of said seam connection; and a sealing compound exclusively in the center of said seam connection, said sealing compound completely filling said center and being under pressure.

2. A method of manufacturing a triple seam connection for a container between a cylindrical body of said container and a round cover, said body and said cover being made of sheet metal and having, respectively, first and second flanges which extend in a radial plane with respect to the axis of the container, said second flange forming the outer layer of the seam connection and having a portion which extends with respect to said first flange, said portion having an outer edge which is initially bent in the general direction of sealing before a seaming roll operation begins, comprising the steps of:

- a. bending said outer edge of said second flange about 180° into a U-shaped bend with a first seaming roller having in cross-section a semi-circular groove of a very small radius, said bending being done without folding said body and without said U-shaped bend surround said first flange;
- b. applying a sealing compound in the U-shaped bend;
- c. forming the first flange in which a side-wall of said body merges into said first flange with a radius which is considerably larger than the radius of curvature at the junction of said second flange and an adjacent cylindrical portion of said cover;
- d. mounting said first and second flanges together; and
- e. rolling said first and second flanges closely into each other with a radially operating second seaming roller having, when viewed in cross-section, a semi-circular groove bottom in which said second flange is bent over more than 360° and said first flange is bent over more than 270° to form a seam connection having a closed spiral shaped cross-section.

3. The method of claim 2 in which the sealing compound is brought into its final condition before the seam connection is made.

4. The method according to claim 3 in which the sealing compound is polyurethane.

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