

Electrode assembly for gas-tight
electric storage batteries

The present invention relates to electrode assemblies for gas-tight electric storage cells and batteries, in particular, but 5 not exclusively, for round cells. Such an assembly comprises a positive band electrode, a negative band electrode and a separator which are spirally coiled or wound together with the separator interposed between the electrodes to form an electrode set or winding.

10 Electrode sets or windings such as referred to above are commonly made on a winding mandrel, which is removed after the winding has been made.

It has been found by experience that freshly coiled electrode windings tend to unwind or stretch after the winding material 15 has been removed. In order to prevent this and ensure a proper fitting in the cell housing, the electrode winding is provided with a binder by wrapping it with a self-adhesive insulating material. The binder is wrapped onto the electrode winding while the electrode winding is still on the winding mandrel. In wrapping the winding, 20 the insulating material is taken from a supply roll, fastened to the electrode winding, wound round the latter several times, and cut. Applying this type of electrode binding is however complex and time consuming.

An object of the invention is therefore to provide a wound electrode 25 set provided with means for preventing it unwinding and which avoids the disadvantage referred to above.

In accordance with the invention, there is provided an electrode assembly for a gas-tight electric storage battery or cell, comprising: a positive band electrode, a negative band electrode and a separator, 30 which are spirally wound together with the separator interposed between the electrodes to form an electrode set; and means for holding the electrodes and the separator together to prevent them unwinding: characterized in that said means is a metal

ring encircling the electrode set.

The metal ring should preferably, since it remains on the electrode winding and must not "spread" for reasons of fit, have a wall thickness of about 0.05 to 0.2 mm and a width of about 8 to 20 mm. The ring diameter may be any arbitrary value, but is governed by the size of the round cell which is to accommodate the electrode set. Ring diameters of between 20 and 30 mm are necessary for marketable cells.

The ring may be simply slipped over the tightly wound electrode set.

The ring may be manufactured by apparatus comprising:

- (a) means for advancing a metal strip along a predetermined path;
- (b) a cutting knife for cutting transverse bands from one end of the strip;
- 15 (c) two shaping tools movable by directions transverse to the direction of advance of the metal strip, and a shaping and welding pin, the shaping tools being adapted to shape said bands about the pin to form rings, the end portions of each band when shaped to form a ring overlapping each other, said pin being movable
20 axially and longitudinally with respect to the direction of advance of the metal strip to and from a position in which it is disposed between the shaping tools when operated to effect shaping of one said band about said pin;
- (d) and means for welding together the overlapping ends of each
25 ring while located on the pin.

It will be appreciated that the width of the metal strip should

be somewhat greater than the circumference of the rings to be produced. It will be further appreciated that the diameter of the shaping and welding pin should be equal to the diameter of the rings to be produced.

- 5 Electrode assemblies according to the invention may be manufactured by a method comprising:

advancing a metal strip along a predetermined path;

cutting transverse bands from one end of the metal strip;

- 10 shaping each band into a ring about a pin, the end portions of the band when shaped into the ring overlapping each other;

while the ring remains on the pin, welding together said overlapping end portions;

removing the ring from the pin; and

- 15 positioning the ring to encircle an electrode set formed by a positive band electrode, a negative band electrode and a separator, which are spirally wound together with the separator interposed between the electrodes, the metal ring holding the electrodes and the separator together to prevent them unwinding.

- 20 The invention is further described below by way of example with reference to the accompanying drawings, wherein:

Figure 1 is a perspective view of an electrode assembly according to the invention; and

Figure 2 is a perspective view of an apparatus for use in manufacturing electrode assemblies according to the invention.

- 25 Referring to Figure 1, an electrode assembly 1 comprises a positive band electrode, a negative band electrode and a separator 2 interposed between the two electrodes. The electrodes and the separator are wound spirally to form an electrode set, the outer end of the separator overlapping the outer end of the inwardly adjacent electrode, which is

not visible in the figure. The other electrode, which is visible in the figure, is denoted by reference numeral 5 and is provided with a conductor lug 6.

A ring 3 encircles the electrode set to hold the electrodes and the separator together to prevent them unwinding. The ring 3 contacts and lies against the electrode 5 but is out of contact with the other electrode. Consequently the ring 3 cannot cause a short circuit between the electrodes. The ring 3 is manufactured as described below and has a weld joint 4.

The arrows in Figure 2 indicate the directions of movement of the relevant parts.

Referring to Figure 2, apparatus for manufacturing rings, such as ring 3 referred to above, comprises a common base plate 25 on which are mounted a feed device 9, a tool mount 10 provided with a cutting knife 11 and a guide 14 for a shaping and welding pin 13. The pin 13 is movable axially by means of a working cylinder 12. Two shaping tools 15 and 16 are mounted on a common pivot 17 below the base plate 25 and are movable by means of respective working cylinders 18 and 20. The pivot 17 is carried by the base plate 25. On the base plate 25 is also mounted a welding head holder to which is secured a welding head 23. The welding head 23 is movable by means of a working cylinder 24. Line 22 is an imaginary vertical centre line of the tool mount 10.

In use of the apparatus, a metal strip 8 is unwound from a reel 7 and intermittently advanced in the longitudinal direction of the strip by the feed device 9 and is passed through the tool mount 10 to project beyond the cutting knife 11. The projecting portion, provided by each advance of the strip 8, is denoted by reference numeral 21. We hereinafter refer to such projecting portions as "bands".

The width of the strip 8 (which equals the length of each band 21) is somewhat greater than the circumference of the pin 13.

The width of each band 21, i.e. the amount by which the strip 8 projects beyond the cutting knife 11 after each advance of the strip, is equal to the desired width of the rings to be made.

After each advance of the metal strip 8, the working cylinder 12 moves the pin 13 from an initial position, as shown in the figure, to a working position immediately in front of the cutting knife 11 and above the band 21. The shaping tool 15 is then swivelled by the working cylinder 18 from an initial position as shown in the figure towards the pin 13 and to engage with the band 21. The band 21 is thereby partially severed by the cutting knife 11 from the remainder of the strip 8 and the severed part, which is engaged by the tool 15, is shaped and pressed around the pin 13 by the tool 15. Simultaneously the pin 13, together with the guide 14, is displaced, due to the pressure exerted by the tool 15, horizontally and laterally by about 1 mm over the cutting line 22 of the tool mount 10.

Whilst the shaping tool 15 remains holding the severed part of the band 21 against the pin 13 and the pin remains in its displaced position, the shaping tool 16 is swivelled by the working cylinder 20 from an initial position as shown in the figure towards the pin 13 and to engage with the band 21. The tool 16, in pressing the band around the pin 13, displaces the pin, together with the tool 15 and the guide 14, horizontally and laterally in the opposite direction to its above-mentioned horizontal and lateral movement by approximately 1 mm over the cutting line 22. The band 21 is thereby completely severed by the cutting knife 11 from the remainder of the strip 8 and the part of the band engaged by the tool 18 is shaped and pressed around the pin 13. It will be understood that the complete severance of the band 21 from the remainder of the strip 8 is achieved because of the lateral horizontal movements of the pin 13 effecting shearing. The band thereby forms a ring 3 separated from the strip 8 and encircling the pin 13, the ends of the band overlapping each other.

The welding head 23 is then lowered from an initial position

as shown in the figure by means of the working cylinder 24 and welds the overlapping portions 4 of the ring 3 together.

The welding head 23 and the shaping tools 15 and 16 are then returned to their initial positions, the ring 3 remaining in the pin 13.

The pin 13, carrying the ring 3, is then returned to its initial position and causes the ring 3, when adjacent the guide, to fall from the pin into a collector (not shown).

The width of the rings manufactured can be varied by varying the length of the portion of the strip 8 fed through the tool mount 10 for the production of each ring.

The metal strip 8 is of nickel or nickel-plated steel and its thickness may be 0.09 mm. The diameter of the pin 13 depends on the desired diameter of the rings 3 to be manufactured.

The contours of the portions of the shaping tools 15 and 16 which engage the band 21 are such as to match the size and shape of the pin 13. I.e. said portions have concave semi-circular surfaces of a radius equal to the sum of the radius of the pin 13 plus the thickness of the strip 8.

It will be appreciated that the apparatus described above can be incorporated into a process for the continuous production of electrode assemblies or batteries and the mutual coordination and interrelationship of the various functional elements therefore suitably takes into account the manufacturing procedure.

The structural elements of the apparatus are advantageously mounted on the common base plate 25, as described.



CLAIMS

1. An electrode assembly for a gas-tight electric storage battery or cell, comprising: a positive band electrode, a negative band electrode and a separator, which are spirally wound together with the separator interposed between the electrodes to form an electrode set; and means for holding the electrodes and the separator together to prevent them unwinding; characterized in the said means is a metal ring encircling the electrode set.
2. An electrode assembly according to claim 1, wherein the wall thickness of the metal ring is 0.05 to 0.2 mm and the width of the metal ring is 8 to 20 mm.
3. An electrode assembly according to claim 1, wherein the ring is formed from a band, the ends of which overlap each other and are fastened together.
4. An electrode assembly according to claim 1, substantially as described herein with reference to and as illustrated in Figure 1 of the accompanying drawings.
5. A gas-tight electric storage cell or battery, incorporating an electrode assembly according to any preceding claim.
6. An electric storage cell according to claim 5, being a round cell.
7. An electrode assembly according to claim 1, wherein



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the metal ring has been manufactured by apparatus comprising:

(a) means for advancing a metal strip along a predetermined path;

(b) a cutting knife for cutting transverse bands from one end
5 of the strip;

(c) two shaping tools movable in directions transverse to the direction of advance of the metal strip, and a shaping and welding pin, the shaping tools being adapted to shape said bands about the pin to form rings, the end portions of each
10 band when shaped to form a ring overlapping each other, said pin being movable axially and longitudinally with respect to the direction of advance of the metal strip to and from a position in which it is disposed between the shaping tools when operated to effect shaping of one said band about said pin, the pin
15 being movable transversely of the direction of advance of the metal strip when the band is being shaped into the ring; and

(d) means for welding together the overlapping ends of each ring while located on the pin.

8. An electrode assembly according to claim 7, wherein operation
20 of the shaping tools to shape the band causes the band to be cut from the strip by the cutting knife.

9. An electrode assembly according to either of claims 7 and 8, wherein the two shaping tools are pivotal about a common axis.



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10. An electrode assembly according to any of claims 7 to 9, wherein the shaping tools are movable by means of working cylinders.

11. An electrode assembly according to any of claims 7 to 10, wherein the welding means comprises a welding head, the welding
5 head and the shaping and welding pin being movable towards each other for when the end portions of each said ring are welded together and away from each other.

12. An electrode assembly according to any of claims 7 to 11,
10 wherein the shaping and welding pin is movable by means of a working cylinder.

13. An electrode assembly according to claim 7, substantially as described herein with reference to and as illustrated in Figure 2 of the accompanying drawings.

14. A method of manufacturing electrode assemblies according
15 to claim 1, comprising:

advancing a metal strip along a predetermined path;

cutting transverse bands from one end of the metal strip;

shaping each band into a ring about a pin, the end portions of the band when shaped into the ring overlapping each other;

20 while the ring remains on the pin, welding together said overlapping end portions;



(23)

removing the ring from the pin; and

positioning the ring to encircle an electrode set formed by
a positive band electrode, a negative band electrode and a
separator, which are spirally wound together with the separator
5 interposed between the electrodes, the metal ring holding the
electrodes and the separator together to prevent them unwinding.

15. A method according to claim 14, wherein the shaping
of band to form the ring presses the strip against a knife
to cut the band from the ring.

10 16. A method according to claim 14, substantially as described
herein with reference to the accompanying drawings.

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