

The invention relates to a process for electrically and mechanically connecting a metal strip serving as a current collector to the electrode of a galvanic cell which has as the support a metal foam structure which is filled with active mass containing an organic binder.

The defect-free attachment of current collectors to battery electrodes has as a prerequisite at the provided contact points an open metal support part which is not contaminated by active material, so that contact resistances during spot welding can be kept as low as possible. In ultrasound welding, a clean contact surface is a condition for a comparatively high power consumption.

It is known, for example, from DE-AS 2 211 233 to uniformly coat strip-shaped wire nettings of nickel, nickel-plated iron or copper evenly with an active mass powder, to cut to size individual surfaces therefrom, to stiffen these by bending the edges round flat and to weld current collectors to discrete points of these reinforced edge parts once the points concerned have first been cleaned of compressed active material. This cleaning is difficult and often remains incomplete.

When producing sintered foil electrodes, conventionally a solid-metal edge of the sintered strip is kept free of impregnation with the active material, if necessary it being possible for collector vanes to be welded to this edge without problems. For keeping the edge free, however, appropriate measures already have to be taken when applying the porous nickel sintered layers to the supporting foil strip. This means an additional amount of work by comparison with the support strip being processed in an integrated manner.

However, in accordance with DE-PS 2 535 469, it is possible to weld a metal current collector directly onto a sintered electrode if the active material embedded in the porous electrode structure, e.g. nickel hydroxide, is first reduced to the metal

at the provided contact point by dropping on a solution of hydrazine hydrate or sodium boranate.

For re-chargeable battery systems, electrodes based on metal foam structures are also used as supports and current collectors. The galvanically produced strip-shaped foam structures can easily be filled with active mass as a result of their high porosity, of 95 to 97%, by making up a slurry or paste, and are particularly suitable for producing winding electrodes. For example, current collector vanes are attached in such a way that the selected contact points are compressed and freed of adhesive even before the mass is introduced, that the support strip is then impregnated with the active mass, dried and subsequently rolled, and in that once the protective masks have then been removed the points not contaminated by the pasty or suspended mass are connected to the current collectors by welding.

This procedure is also involved and furthermore inefficient as, because of the change in length which the strips undergo on being subsequently rolled to the intended final thickness and which can be up to 20%, the final positions of the contact points cannot be precisely determined from the outset and a certain amount of waste cuttings has to be accepted during the later punching out or cutting to length of the electrodes.

It is known from JA-A-55-14685 (Patent Abstracts of Japan, Vol. 4, No. 44 (E-5)(526)) to introduce active mass into a metal foam structure provided with current collectors and then to impregnate the filled electrode with a PTFE dispersion. By blowing a stream of compressed air against the current collectors, residues of the active mass and the PTFE are removed. If strip-shaped support material is used, this procedure also has the disadvantages mentioned above.

The object of the invention is thus to specify a pre-treatment of metal foam structure electrodes which are in themselves ready before welding on a vane current collector, a pre-treatment

ensuring a clean and homogeneous metal connection.

In accordance with the invention, the object is achieved by a process as defined in Claim 1.

In accordance with this, a method has proved successful in which the contact point provided is exposed to heating and that subsequently the active material in the pores of the metal foam, this material having been altered by the action of heat, is then removed by a blowing-out procedure.

Since the active mass which is introduced into the metal foam structure as a paste or a slurry contains an organic binder, it is the thermal destruction of this organic substance which robs the active material, in addition to moisture, primarily of its capacity to adhere to the pore walls, so that after heating it behaves like a dry powder and can easily be blown away by a stream of compressed gas, in particular a stream of compressed air.

There may serve as the heat source for the thermal decomposition for example a heated die, a laser beam or an induction heating means. During this, the necessary temperature, depending on the thermal resistance of the binder to be removed, is to be set in a range between 300°C and 550°C.

It is particularly advantageous to direct a stream of hot air whereof the temperature is in the range specified, which is however preferably approximately 450°C, in a controlled way towards the point to be treated before the cleaning of all the non-metallic residues is carried out with a stream of compressed air. For the reliable removal thereof, stream pressures of 7 to 8 bar are necessary, with the compressed gas streaming out of a narrow nozzle. The gas throughput associated with this is too high for a stream of compressed air of this type also to be used at the same time as an instrument of thermal destruction and thus to be used as a heat source, because the energy consumption

required for the temperature control of such air quantities for example at 450°C cannot be acceptable. Conversely, the stream of hot air which can be used is too weak additionally to take on the function of blowing out.

It is furthermore favourable to cover the electrode strip with a metal sheet which is a good heat conductor, for example a copper sheet, and using this to mask the attachment point for the current collector in order by means of this mask to concentrate the heat flow onto the surface element which is necessary for the weld connection and which is approximately congruent with the contour of the current collector strip.

In these circumstances, the binder is destroyed within 3 to 12 seconds, in most cases within 5 to 7 seconds, without any but negligible oxidation of the support metal occurring in this region.

The concentrated action of heat is also served if a hot air stream is directed onto the contact point from two sides. Once the binder of the active material has been destroyed in this way, the treated point can easily be blown free using compressed air or a fan stream. This provides the basis for a defect-free weld connection to the current collector.

The advantage of the measures according to the invention from a production technology point of view consists primarily in the fact that the current collector is attached only once the support strip has already undergone all the treatments connected with mass impregnation, including subsequent rolling and drying, so that no exposed vanes are in the way of rapid transportation of the strip over rollers, guide devices, cylinders and the like, or can themselves even be damaged during transportation. The positions of the contact points to be cleaned of active material on the electrode strip can be matched precisely to the distribution provided therefor. It is even more advantageous to treat in accordance with this process the electrodes which have

already been cut to their final size. The treatment according to the invention only affects that small portion of the electrode surface which is necessary for the weld collection to the current collector strip.



## CLAIMS

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1. Process for electrically and mechanically connecting a metal strip serving as a current collector to the electrode of a galvanic cell which has as the support a metal foam structure which is filled with active mass containing an organic binder, characterized in that before the current collector is welded on the contact point provided is exposed to a heat source which brings about thermal destruction of the organic binder, and is subsequently exposed to the action of a compressed gas stream.
2. Process according to Claim 1, characterized in that the contact point is heated by a hot air stream to a temperature of 300°C to 550°C, preferably to approximately 450°C.
3. Process according to Claim 2, characterized in that the contact point is heated with a hot air stream from two sides.
4. Process according to Claim 1, characterized in that the contact point is heated using a heated die, a laser beam or an induction heating means.
5. Process according to one of Claims 1 to 4, characterized in that the contact point to be treated is delimited by covering the rest of the electrode surface by means of masks.
6. Process according to Claim 5, characterized in that there are used as masks metal sheets which are good heat conductors, in particular copper sheet.