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(54) **Interconnected battery grids**

(57) An array of grids for the manufacture of multi-cell batteries comprising a line of negative grids (11) and a line of positive grids (12) on the opposite side of a hypothetical median line (20). A grid in one line is opposite a space between grids in the opposite line, and each grid is connected to a grid in the opposite line to an interconnecting lug (14). Initially adjacent grids in a line are connected by links (15) which are severed to separate one cell from its neighbours during manufacture of the battery. An individual grid array is cut from a continuous length of elongate cast grid strip material by severing at (X) (six places).

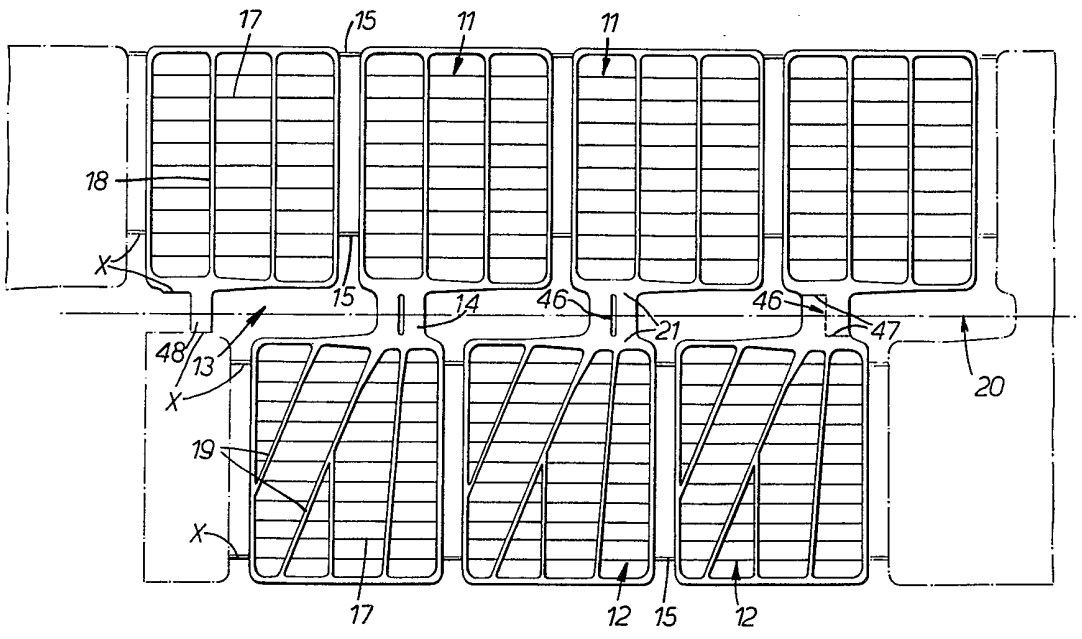

FIG. 1.

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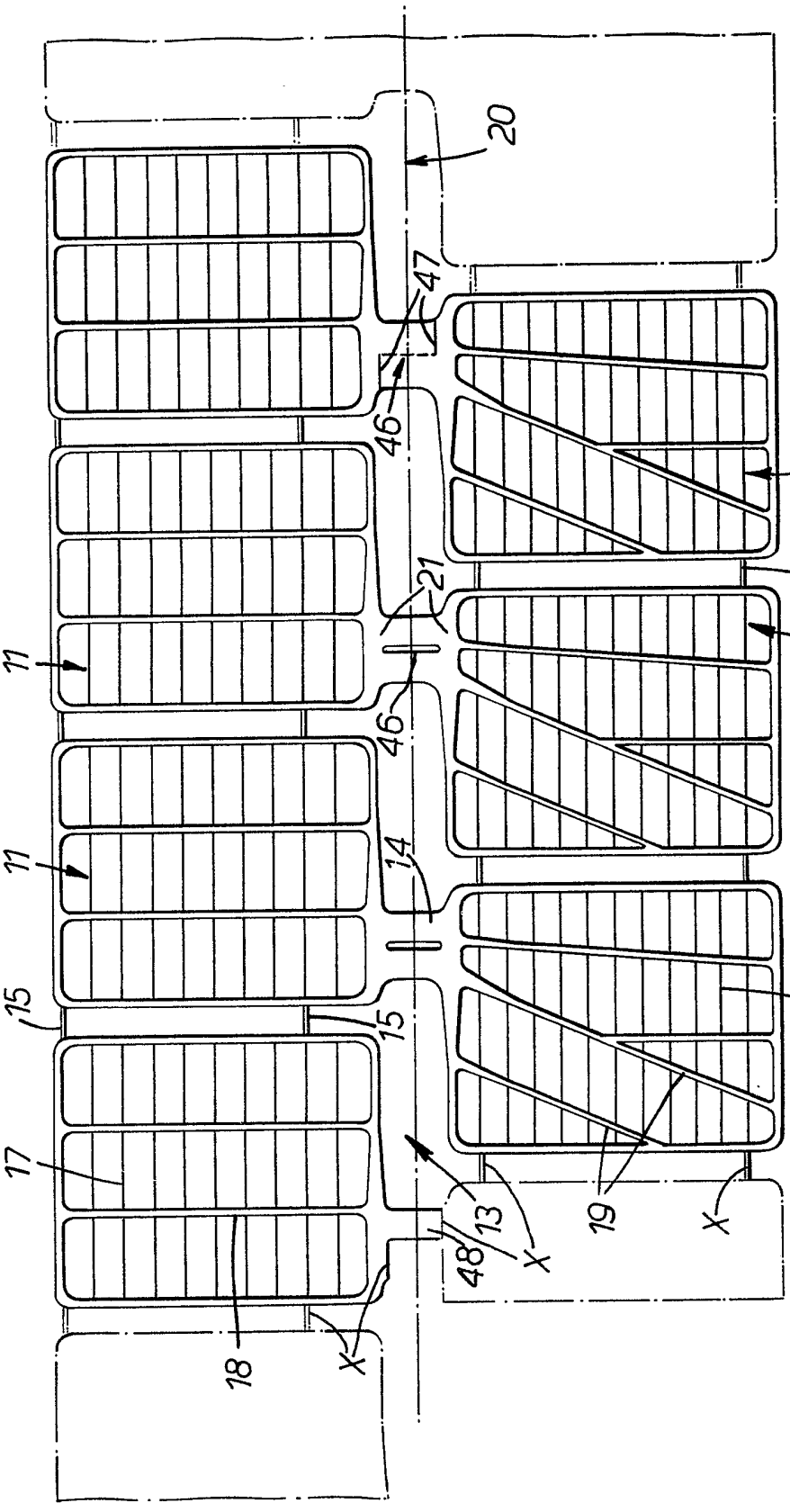

FIG. 1.

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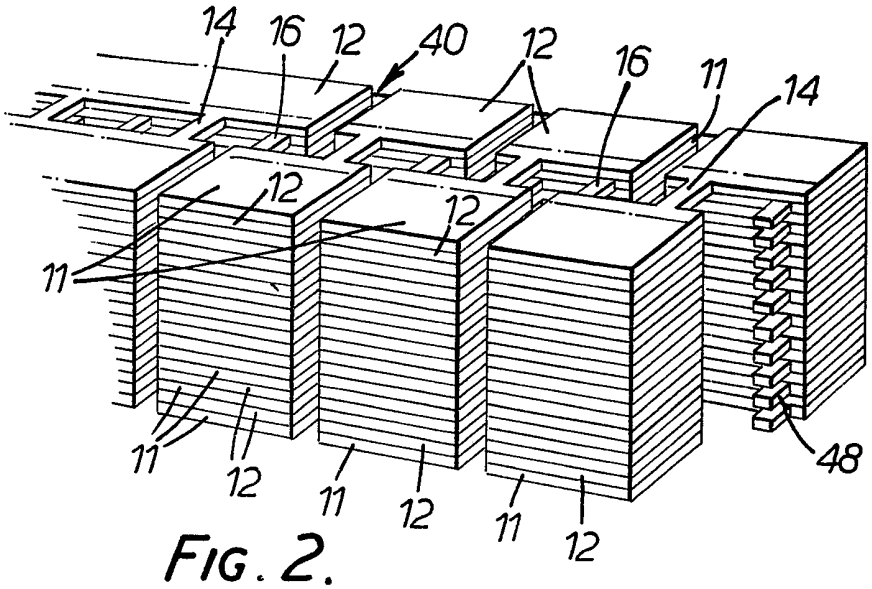
14
16
12
40
12
16
11
14
12
12
11
11
12
11
12
11
12
48

FIG. 2.

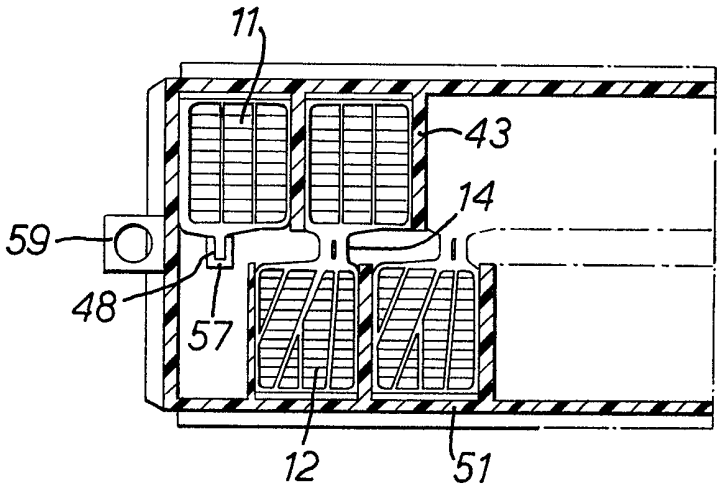
11
43
14
59
48
57
12
51

FIG. 3.

SPECIFICATION

Electric storage batteries

This invention relates to the manufacture of multi-cell electric storage batteries, and one object is to provide a method of manufacture which enables multi-cell batteries to be manufactured with efficient use of the raw materials, and in particular the lead alloy or other material for forming the plate grids.

According to the invention, an elongate grid array for making multi-cell batteries comprises two lines of grids, one line on each side of a hypothetical median line extending along the length of the grid, the grids being formed as bipolar pairs comprising an integral arrangement of a grid in one line, a grid in the other line, and an interconnecting lug extending across the median line.

Preferably, the grids in one line are different from those in the other line.

The difference may be that the grids in one line are for forming positive battery plates, whereas the grids in the other line are for forming negative battery plates. Thus, they may have the same external size and shape as each other, but the grids for forming the positive plates are likely to have mesh components more closely spaced than in the negative plate grids, and are also likely to have current bars which radiate from lugs interconnecting grids, one in each line.

The grids in one line are preferably staggered in relation to those in the other line, so that a grid in one line is opposite a space between grids in the other line. When a battery is built up from a stack of grid arrays, with separator material between the arrays, the arrays will be alternately of one hand and the other so that in each stack of grids for forming one battery cell, there will be alternately positive and negative grids with separator material between them.

Preferably, the grid array is formed by a continuous casting process, perhaps using a drum type casting machine, and the casting may include links between successive grids in the lines which links serve to maintain the grids correctly positioned in relation to each other during the initial stages of manufacture, but which can subsequently be easily removed when it is necessary to separate a cell in one line from its neighbours in the same line during a later stage of production. Such interconnecting links could be the only components of grid material which are not used in the finished battery, so that the wastage rate is very low.

Individual grid arrays are produced by removing certain of the links and cutting the lugs at the same position along the length of the continuous grid, to leave a number of grids in the array dependent on the desired battery voltage.

The continuous strip is preferably pasted before it is cut into individual grid arrays.

Then the pasted arrays are stacked with interleaving separator material by hand before filling, applying terminals posts, boxing and forming.

An interconnecting lug between grids one in each line is conveniently in the form of two separated side-by-side portions for ease in separating the cells of one battery from the cells of the next battery made from the two lines of grids.

The invention may be carried into practice in various ways, and one embodiment will be described by way of example, with reference to the accompanying drawings; in which:

Figure 1 is a drawing of a continuously cast lead strip including a number of grids for manufacturing electric storage batteries;

Figure 2 is a diagram useful in explaining the construction of the batteries as stacks of the grids; and

Figure 3 is a horizontal section of one end of a completed battery.

Battery grids are manufactured from continuously cast elongate strips of lead mesh which may be cast on a casting machine generally of the type described in U.S. Patent Specification No. 4349067 published in September, 14th, 1982, and a short length of the continuously cast mesh is as shown in Figure 1. The casting is in the form of an array of grids in two side-by-side lines, a line of negative grids 11 and a line of positive grids 12. The lines are separated by a gap 13 but at regular intervals along the gap a negative grid is integral with a positive grid through an interconnecting lug 14. The pitch of the lugs 14 is equal to the pitch of the grids in the two lines, so that each grid is connected to one grid in the other line through one of the lugs. There are also cast interconnecting links 15 between grids in each line to give the cast elongate strip some stability, but they are severed during manufacture as will be described below. Each grid is formed with bars extending parallel with the length of the strip, as indicated at 17 and they are closer spaced in the positive grids than in the negative grid. In the negative grids there are also bars 18 extending transversely of the line of the casting, whereas in the positive grids there are current bars 19 extending generally radially from the lugs 14. The grid frames are broadened where they are connected to the lugs 14, as indicated at 21. In general the current bars in the positive grids are wider than those in the negative grids. The thickness of the cast strip to provide grids for a typical automotive battery is about one millimetre.

Cell elements for batteries are made by building up a number of stacks or sandwiches of alternate layers of grids in the elongate cast grid material with adjacent pairs of layers separated by compressible fibrous absorbent separator material in the form of a sheet of micro fine glass fibres. The sandwich may be many layers thick and the number of layers will be related to the current capacity of the battery. In the first, third, fifth and so on, layers of the sandwich the negative grids are on one side of the sandwich, and in the second, fourth and so on layers of grid material, the negative grids are on the other side.

The cast strips are located longitudinally in such a way that in each section of the sandwich a positive grid is in exact register with a negative grid immediately above, or immediately below it, or both. That means that the lugs 14 are staggered generally as shown in Figure 2, so that the grids in the first, third fifth and so on layers are interconnected by lugs 14

which are in the same longitudinal position along the length of the sandwich, whereas the second, fourth, and so on layers have plates interconnected by lugs longitudinally spaced between the other lugs as shown at 16.

With a further reference to Figure 1, it can be seen that the grids are all adjacent what may be described as a median line 20 extending between the two lines of grids with the positive plate grids on one side of the median line and the negative grids on the other side. The lugs 14 extend across the median line.

It is to be noted that an 'array' of grids (or plates after application of active material) as shown in Figure 1, has one grid (or plate) in each cell of a multi-cell battery and all the grids (or plates) in the array are in a single plane. It may also be noted that in the grid array of Figure 1, the only connection between plates 11 in one line is by way of the temporary cast links 15 which are removed after stacking and before electrolytic forming. The same applies to the plate 12 in the other line.

It will be appreciated that in the completed battery, after the links 15 and separator material have been cut through, as described below, there will be a line of sandwiches generally as shown in Figure 2, and each sandwich will be built up from grids which (except in the end sandwich) are one half of a double-grid pair consisting of one positive grid in one sandwich, and one negative grid, in a sandwich on the other side of the line of sandwiches. The arrangement of the interconnecting lugs connects the individual cells each consisting of one sandwich in series.

Figure 1 shows that each interconnecting lug 14 is separated into two by a central grap 46 extending transversely of the line of production, and that is formed when the grid is first cast, and is for ease in separating an individual battery element from the line, because separation can be by a pair of cuts, as indicated at 47 in Figure 1, one through each half of the lug 14, but one adjacent a negative grid, and one adjacent a positive grid.

The continuous casting machine produces a continuous length of the grid strip of Figure 1 which is pasted with negative and positive active material by a conventional pasting machine but with marking of the spaces between adjacent grids when the links 15 cross to save active material.

Then the pasted double-line strip is cut to length in dependence on the desired voltage of the batteries being made by severing at four links 15 and two cuts 47 as marked at 'X' to produce one plate array.

A number of arrays are stacked by hand with wo lines of elongate separator strip material between adjacent arrays as described above, one line on each side of the median line 20. The elongate strip of grids will have sufficient strength by virtue of the lugs 14 which have not been cut and the interconnecting links 15 between the plates in each side.

A vertical line of half lugs 48 (Figure 2) left at each end of the element is used in the formation of a tapered terminal post 57 for the battery, which is conveniently cast around the vertical line of lugs, in such a way that the thickness of the cast terminal at the take-off end is equivalent to the thickness of the intercell connecting lugs 14 between cells in the battery element; the terminal post will be as close as possible to the inner faces of the plates, so that the resistivity of the conducting path between cells is the same throughout the battery.

Then the links 15 and separator material between adjacent plates 11 and between adjacent plates 12, are cut - preferably while the plates are clamped in their sandwiches - and the battery element is filled with electrolyte and inserted in a container 51 (Figure 3) having integral partitions 43 extending in from the sides of the contains for nearly half the width of the container to insulate the cells in one line from their neighbours in the same line.

Filling is completed if necessary, external connections 59 are connected to the terminal posts 57 and the battery is electrolytically formed.

The battery is of the dry recombination type with no free electrolyte and it has been found that it is not necessary to provide sealing between cells in the gap between two lines of sandwiches because the surface tension generated by the separator material is so strong that adjacent surfaces are dry.

That berry makes very economical use of lead, because all the lead used during casting is included in the finished battery except for the lead forming the interconnecting links 15 and the lead in the grids can be used most efficiently, because the grids are designed primarily for current conducting properties and not for strength or rigidity requirements.

The battery is built up from a large number of fairly small plates forming the individual cells so that each plate can operate most efficiently, and there is a saving in the use of lead and active material for a given battery capacity.

CLAIMS

1. An elongate grid array for forming multi-cell batteries comprising two lines of grids, one line on each side of a hypothetical median line extending along the length of the grid, the grids being formed as bipolar pairs comprising an integral arrangement of a grid in one line, a grid in the other line, and an interconnecting lug extending across the median line.

2. A grid array as claimed in Claim 1 in which the grids in one line are staggered in relation to those in the other line in the direction of the median line, whereby a grid in one line is opposite a space between grids in the other line.

3. A grid array as claimed in Claim 1 or Claim 2 in which the grids in one line are different from those in the other line.

4. A grid array as claimed in Claim 3 in which the grids in one line are suitable for negative battery plates, and the grids in the other line are suitable for positive battery plates.

5. A grid array as claimed in Claim 4 in which the mesh components forming the grids are closer spaced in the positive grid line, than in the negative grid line.

6. A grid array as claimed in any preceding claim in which in the line of positive grids, current bars radiate from the interconnecting lugs.

7. A grid array as claimed in any preceding claim in which in each line each grid is connected with its neighbouring grids in that line by temporary links.

8. A grid array as claimed in any preceding claim in which each lug is in two separated side-by-side portions.

9. A grid array as claimed in any preceding claim in the form of an integral casting.

10. An elongate grid array for forming multi-cell batteries constructed and arranged substantially as herein specifically described with reference to Figure 1 of the accompanying drawings.

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