July 24, 1973 V. S. ALBERTO 3,748,181

GALVANIC CELL HAVING IMPROVED CONSTRUCTION

Filed July 21, 1971 2 Sheets-Sheet 1

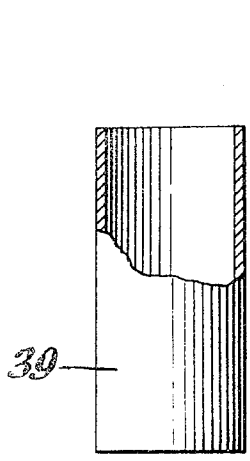

Fig. 1

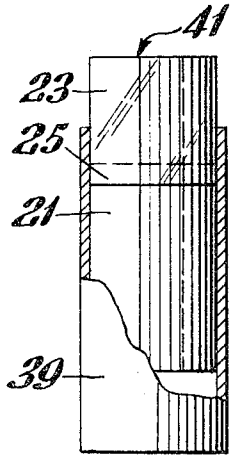

Fig. 2

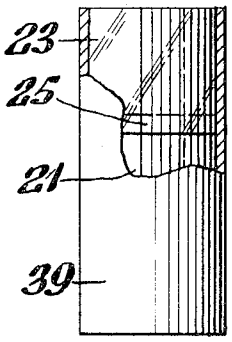

Fig. 3

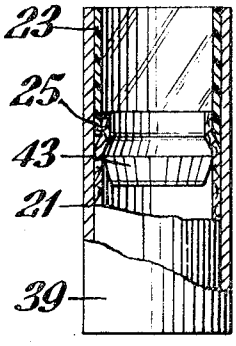

Fig. 4

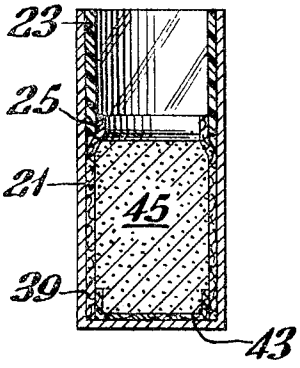

Fig. 5

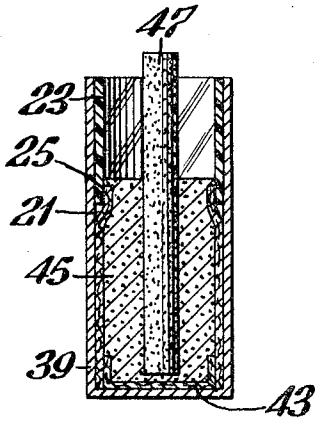

Fig. 6

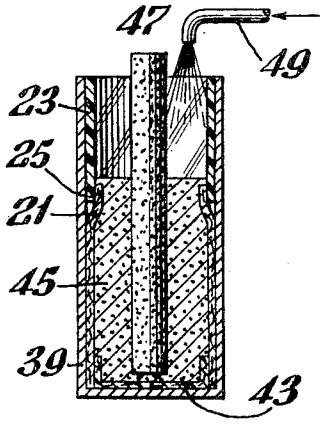

Fig. 7

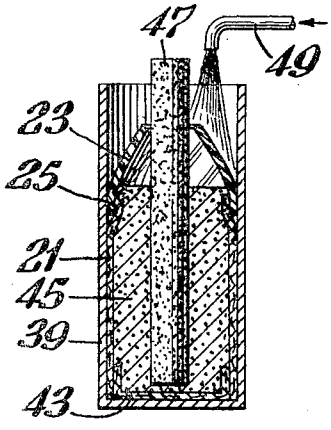

Fig. 8

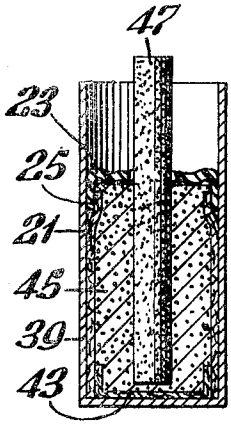

Fig. 9

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GALVANIC CELL HAVING IMPROVED CONSTRUCTION

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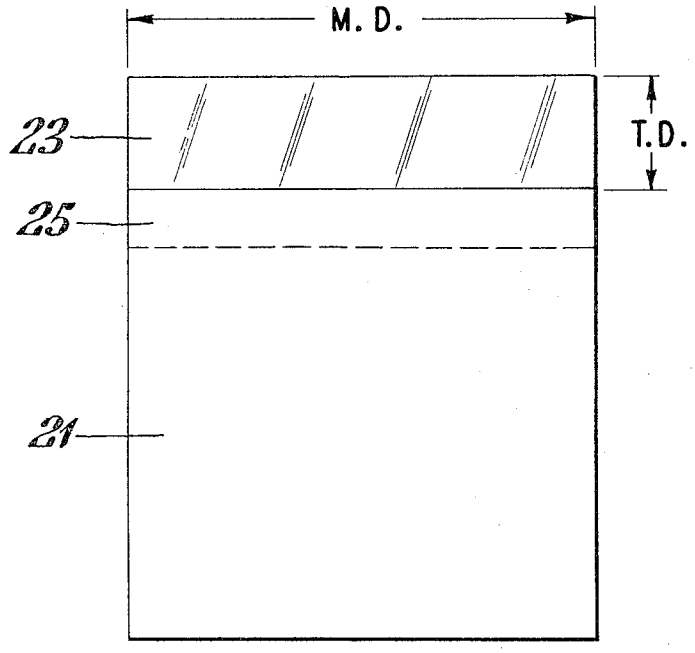

Fig. 10

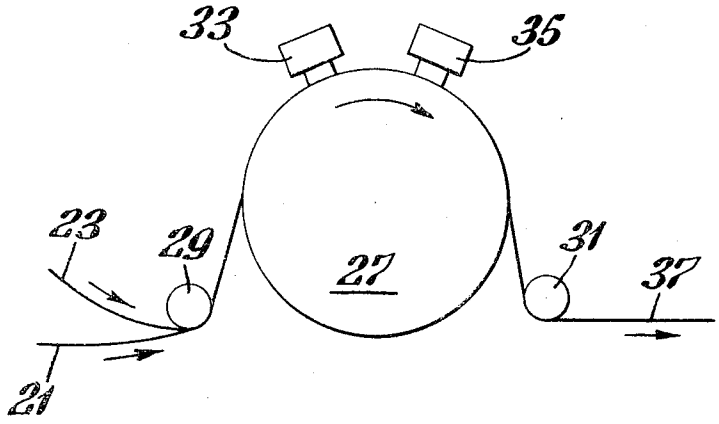

Fig. 11

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GALVANIC CELL HAVING IMPROVED CONSTRUCTION

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Int. Cl. H01m 21/00
U.S. Cl. 136—107 7 Claims

ABSTRACT OF THE DISCLOSURE

A galvanic cell is disclosed. The cell comprises a metal can having a wall with an inner surface, a top, and a bottom, depolarizing mix partially filling said can such that there is a space between the top of the mix and the top of the can, a current collecting rod in said depolarizing mix in contact therewith and extending outwardly therefrom to at least the top of said can, a paper liner separating said depolarizing mix from said can, and a strip of plastic film attached to the top of said paper liner, the film being shrunk away from the inner surface of the wall of the can. In the preparation of the cell, the strip of plastic film that is attached to the top of the paper liner acts as a shield or apron to protect the can from being smeared with depolarizing mix as the mix is being inserted in the can. The plastic film is then heat shrunk away from the inner surface of the wall of the can. The galvanic cell of the invention has reduced tendency to lose moisture from the depolarizing mix and from the separator.

The invention relates to a galvanic cell having an improved construction.

In U.S. Pat. 2,962,844, Orlando et al., one method for the production of paper-lined galvanic cells is proposed. Referring especially to FIGS. 40 through 50 of this patent, various steps in one process for producing paper-lined cells is shown. In accordance with this prior art process, a rolled up cylinder of paper is first inserted in a metal can. The cylinder extends from the bottom of the can to the top. Thereafter, a bottom liner in the form of a cup is inserted in the can. The depolarizing mix is then added to the can. The depolarizing mix fills the can only part way. Thereafter, the top edge of the paper liner is folded down in order to make room for the closure disc which is to be inserted in the top of the can as a seal. The current collecting rod is then inserted in the depolarizing mix, and the closure disc is positioned in the top of the can. The reason that the paper liner initially extends all the way to the top of the can, even though it is subsequently folded down, is to act as a shield for the can while the depolarizing mix is being added. If it were not for this shield, the depolarizing mix would smear the can in some cases, and cause either low voltage or perforation of the can. The folding down of the upper portion of the paper liner is not a satisfactory operation on a commercial scale. It must be done mechanically, and it is difficult to do this on a mass production basis, especially with smaller sized cans such as those being employed to make N, A, AA, and other small sized galvanic cells. Therefore, as a practical matter, in the commercial production of small sized galvanic cells, the paper liner does not extend to the top of the can when it is first inserted, in order to avoid the need for folding the paper down. As a result, there is a significant percentage of cells that are rejected because the depolarizer mix smears the inside of the can.

A disadvantage that inheres in the use of paper liners, regardless of whether or not the upper portion is folded down, is that the paper extending above the top of the depolarizer mix acts as a wick to carry moisture out of

both the separator and the depolarizer mix and into the air space above the mix. Some of this moisture is lost during venting of the cell, with the result that the separator and the mix have a tendency to dry out. A dry separator is disadvantageous because it causes an increase in internal resistance and lessened electrolytic contact with the anode. A dry mix is disadvantageous because it lowers the amount of electrical energy that the cell can deliver. One further problem is that small amounts of oxygen from the air can enter the cell during venting. The paper liner from which moisture has been lost, and which extends up into the air space, can provide a pathway through which oxygen can diffuse and thereby contact the inner surface of the anode. This can cause corrosion.

The present invention provides a means for substantially eliminating the risk of depolarizer mix smearing of the can during cell production, and at the same time, a means for producing a cell having less of a tendency to lose moisture from the separator and depolarizer mix, and less of a tendency to permit oxygen from the air to contact the anode, thereby improving the shelf life of cells made in accordance with the invention.

It is an object of the present invention to provide a means for the preparation of paper lined galvanic cells wherein fewer rejects are made.

It is another object of the invention to provide galvanic cells having a lessened tendency to lose moisture.

It is a further object of the invention to provide a galvanic cell having a reduced tendency to permit oxygen to contact the anode.

These and other objects and advantages of the invention will be apparent from the following description, taken in conjunction with the drawings, wherein:

FIG. 1 is a cut away elevation, partly in section, of a metal battery can that can be employed to produce the galvanic cells of the invention;

FIG. 2 is a cut away elevation, partly in section, showing a paper liner having a plastic strip on the top being inserted in the battery can of FIG. 1;

FIG. 3 is a cut away elevation, partly in section, of a metal battery can having the liner in place;

FIG. 4 is a cut away elevation, partly in section, showing the bottom cup or washer being inserted in the lined battery can of FIG. 3;

FIG. 5 is a side elevation, in cross section, of a lined battery can to which the depolarizing mix has been added;

FIG. 6 is a side elevation in cross section showing a lined battery can containing depolarizing mix after the current collecting rod has been inserted in the mix;

FIGS. 7 and 8 show various stages in the heat shrinking operation wherein the strip of plastic film is heat shrunk away from the inner surface of the wall of the can;

FIG. 9 shows the cell after the plastic film has been heat shrunk away from the inner surface of the wall of the can;

FIG. 10 shows a paper battery separator having a strip of plastic film attached at the top; and

FIG. 11 is a side elevational, partly schematic view of an apparatus that can be used for heat sealing a strip of plastic film to a strip of battery separator paper.

Briefly, the galvanic cell of the invention comprises a metal can having at least one wall, a top, and a bottom, depolarizing mix partially filling the can such that there is a space between the top of the mix and the top of the can, a current collecting rod in said depolarizing mix in contact therewith and extending outwardly therefrom to at least the top of said can, a paper liner separating said depolarizing mix from said can, and a strip of plastic film attached to the top of said piper liner, with the film being shrunk away from the inner surface of the wall of the can.

In FIG. 10 a separator suitable for use in the invention is shown. The separator includes a generally rectangular piece of paper **21** having a strip of heat shrinkable plastic film **23** attached to the entire top edge of said paper **21**. The width of the seam **25**, or area of film/paper overlap, is not critical. For instance, seam widths of from about one-sixteenth to about three-sixteenths of an inch are acceptable. Any conventional type of battery separator paper can be employed in the invention, including kraft paper, alpha-cellulose paper, and other porous, pinhole free paper. The paper is usually unsized, and may be coated on at least one side with materials such as methyl cellulose to improve the electrolytic contact with the inner surface of the wall of the can.

The heat shrinkable plastic film **23** that is attached to the top of the paper **21** can be any type of heat shrinkable plastic film that is impervious to the depolarizing mix. Such plastic films that can be used include polyethylene, polypropylene, polystyrene, polyvinyl chloride, polyvinylidene chloride/vinyl chloride copolymer, and polyester, which are well known in the art. The thickness of the film will normally be from about one-half to about three mils.

The plastic film **23** can be attached to the paper **21** by any convenient method such as by heat sealing or by the use of adhesives. (If coated paper is used, the plastic film can be bonded to either the coated or the uncoated side of the paper.) In FIG. 11 an apparatus that can conveniently be used for heat sealing a strip of plastic to a strip of separator paper is shown. The apparatus includes a steel rotatable drum **27**, guide rollers **29** and **31**, and heaters **33** and **35**. In operation, the advancing strips of paper **21** and plastic **23** film approach the steel drum **27** by passing under the feed guide roller **29**. The paper **21** and plastic **23** strips are overlapped slightly, with the plastic **23** being on the side next to the steel drum **27** so that the heaters **33** and **35** will come into direct contact only with the paper **21**. The heaters **33** and **35** are only as wide as the width of overlap, and their bottom surfaces are curved to match the curvature of the surface of the drum **27**. After the paper/film strip **37** has passed around the steel drum **27** and under the two heaters **33** and **35**, it passes under the takeoff guide roller **31** to a take up roll (not shown).

In one specific example of a paper/plastic film heat sealing operation, the paper employed was polyacrylamide coated alpha-cellulose paper 4 mils thick. The plastic film was 3-mil polyvinyl chloride film that was both heat sealable and heat shrinkable. The radius of the steel drum was 6 3/16 inches, and the heaters were 1/8-inch wide by 2 inches long (length was measured in a straight line from front edge to back edge, and not along the curved bottom or contact edge), and were made from aluminum. The paper and plastic strips were advanced at a speed of 45 feet per minute. The first heater **33** pressed down on the paper/film overlap with a force of 5.4 pounds and was at a temperature of about 750° C. The second heater **35** pressed on the overlap with a force of 5.8 pounds and was at a temperature of about 650° C.

Because the film that is being heat sealed to the paper is also heat shrinkable, it may be desired to provide means for cooling during the heat sealing operation in order to eliminate the possibility of any significant amount of shrinkage occurring in the film at this stage of the operation. Means for accomplishing this purpose will be apparent to those of ordinary skill in the art. For instance, the support surface opposite the hot surface may be cooled.

FIGS. 1 thru 9 show various stages in the construction of a galvanic cell in accordance with the principles of the invention. In FIG. 1, a metal battery can **39** (e.g., a magnesium or zinc can) suitable for use in the invention is shown. (While for purposes of illustration, a round can is shown, other shaped cans such as square cans can be used in the invention.) In FIG. 2, a liner, shown generally as **41**, is shown being inserted into the metal can **39**. The liner **41** is simply the flat liner shown in FIG. 10, that has been rolled up into a cylinder. The paper **21** portion of the liner **41** is inserted first, leaving the plastic film portion **23** at the top. In FIG. 3, the linear **41** fully inserted in the can **39** is shown. In FIG. 3, it is seen that the height of the liner **41** is the same as the inside depth of the metal can **39**. However, if desired, the liner **41** can extend a short distance outside of the can **39**. In the drawings (FIGS. 4–9) the plastic film **23** is shown on the outside of the paper **21**, that is, at the seam **25** the plastic film **23** contacts the can **39**. If desired, this can be reversed and the paper **21** can be on the outside.

The method for inserting the liner **41** into the can **39** is not critical. This operation can be performed manually by rolling up the liner into a cylinder and inserting it in the can. One method that has been devised for commercial operation is described in an application by Donald R. Trask, entitled "Apparatus for Forming a Cylinder," assigned to the same assignee as this application, and being filed concurrently herewith.

In FIG. 4, the insertion of a conventional bottom paper liner **43** into a can **39** already lined with a liner **41** of this invention is shown. The insertion of said bottom liner **43** is entirely conventional in the art. (In FIGS. 4–9, the thicknesses of the paper **21** and plastic film **23** are exaggerated for purposes of illustration.) In FIG. 5, the lined can is shown after the depolarizing mix **45** has been added. The addition of the depolarizing mix **45** is conventional in the art, and can be done by the method described in the aforementioned U.S. Pat. No. 2,962,844, as well as the patent to M. Orlando, U.S. Pat. No. 3,198,221.

In the next step of the construction of the cell of the invention, the current collecting rod **47** is inserted in the depolarizing mix **45**. This operation is done by any standard procedure, such as that shown in Orlando et al., U.S. Pat. No. 2,962,844. In FIG. 6, the raw cell after the current collecting rod **47** has been inserted in the depolarizing mix **45** is shown. After the insertion of the current collecting rod **47**, the height of the mix **45** in the can **39** is established. In general it is preferred that the top edge of the paper **21** be at a level that is approximately at or slightly below the level of the top surface of the mix **45**.

Of course, the depolarizer mix and current collecting rod could be inserted as a preformed bobbin, if desired.

In the next step in the process for producing the galvanic cells of the invention, the portion of the plastic film **23** that extends above the surface of the mix **45** is heat shrunk away from the inner surface of the wall of the can **39** in order to make room for the subsequent insertion of a closure disc or other sealing means. The heat shrinking can be done by exposing the open top of the raw cell to a hot air gun **49**, as is shown in FIGS. 7 and 8.

As a specific example of a heat shrinking operation, the plastic films in AA sized cells having liners made in accordance with the invention were heat shrunk. The plastic film employed was 3-mil polyvinyl chloride film that was heat shrinkable in both directions. A "Master FHT–1" flameless heat torch (purchased from Master Applicance Corporation, Racine, Wis. 53403) was employed to provide the heat. It had a nozzle shaped similarly to that shown in FIGS. 7 and 8, with an opening 1/8-inch in diameter. The opening in the nozzle was positioned 13/16-inch above the top of the can. At an air exit temperature of 980° F., and an air pressure of 2 p.s.i., 0.24 second residence time under the nozzle was sufficient to effect the desired heat shrink operation.

FIG. 9 shows the raw cell after the plastic film **23** has been shrunk away from the inside wall of the can **39**.

The remaining operations in the preparation of the cell are conventional in the art. For instance, a closure disc (not shown) is added to seal off the top of the can **37**, as is shown in Orlando et al., U.S. Pat. No. 2,962,844.

The galvanic cells of the invention have wide utility as

batteries for flashlights, portable radios, and other battery operated articles.

What is claimed is:

1. A galvanic cell comprising:

(a) a metal can having at least one wall having an inner surface, a top, and a bottom;

(b) depolarizing mix partially filling said can such that there is a space between the top surface of said depolarizing mix and the top of said can;

(c) a current collecting rod in said depolarizing mix, in contact therewith, and extending outwardly therefrom through said space to at least the top of said can;

(d) a paper liner having a top edge, said paper liner separating said depolarizing mix from said can; and

(e) a strip of plastic film attached to the entire top edge of said paper liner, said plastic film being shrunk away from the inner surface of said well.

2. The galvanic cell of claim 1 wherein said metal can is magnesium.

3. The galvanic cell of claim 1 wherein said metal can is zinc.

4. The galvanic cell of claim 1 wherein said plastic film is polyethylene.

5. The galvanic cell of claim 1 wherein said plastic film is polyvinyl chloride.

6. The galvanic cell of claim 1 wherein said top edge of said paper liner is at a level slightly below the said top surface of said depolarizing mix.

7. The galvanic cell of claim 1 wherein said top edge of said paper liner is at a level about the same as said top surface of said depolarizing mix.

References Cited

UNITED STATES PATENTS

1,331,762	2/1920	Hazelett	136—131
2,942,057	6/1960	Huber et al.	136—145
2,962,844	12/1960	Orlando et al.	136—175 X
3,573,106	3/1971	Johnson et al.	136—131
3,597,276	8/1971	Jammet	136—132

ANTHONY SKAPARS, Primary Examiner

U.S. Cl. X.R.

136—131