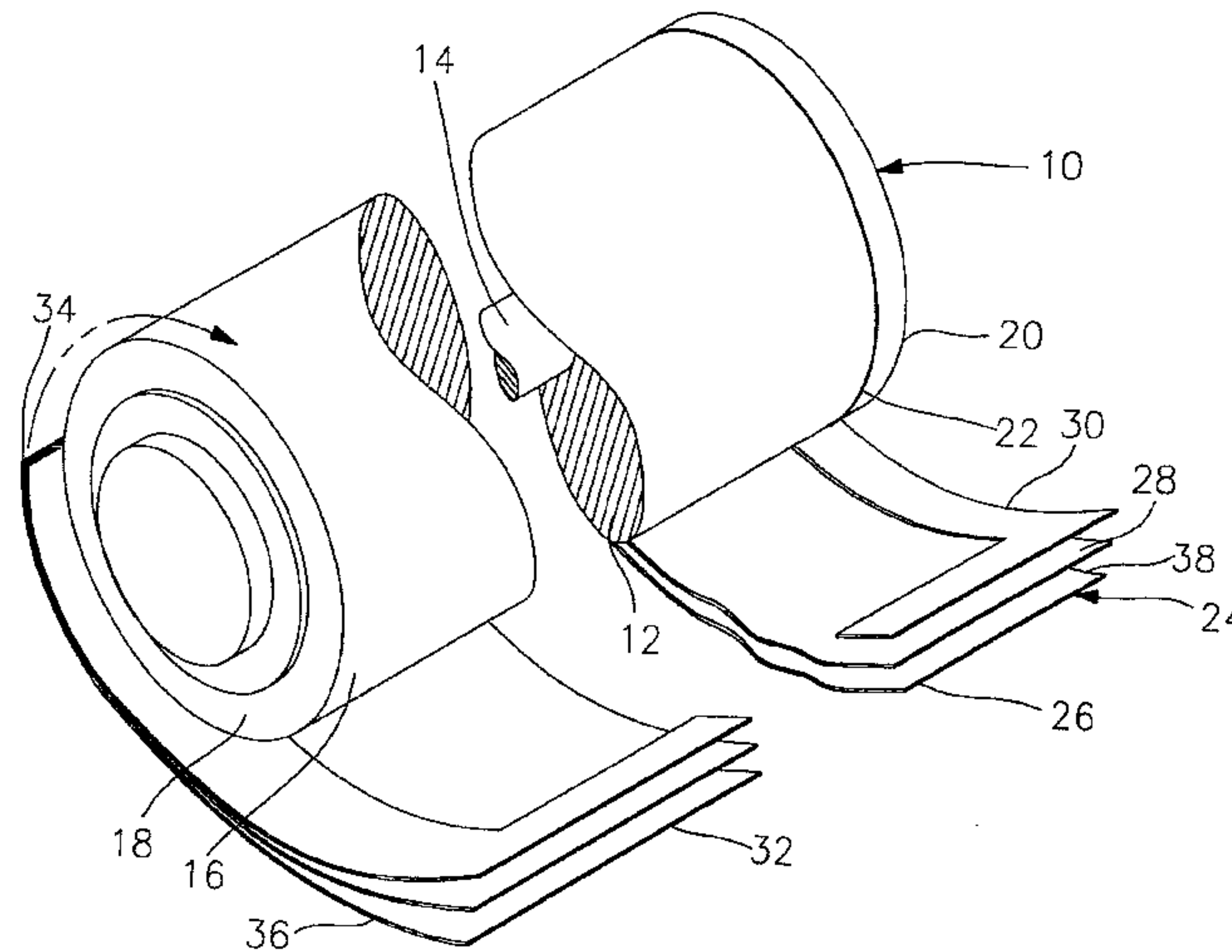




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 (54) Title: SINGLE PLY PSA LABELS FOR BATTERY APPLICATIONS



(57) Abrégé/Abstract:

There is provided single ply labels for labelling dry cell batteries having elongate peripheral case (16) defining an axis and opposed ends enclosing a direct current, electrical energy providing core (12). The label is formed of a transparent, self supporting, substantially monoaxially oriented, heat shrinkable polymer film backing (26) having an outer surface and an inner surface, a width sufficient for the backing to embrace the battery case and provide, at opposed ends, first (32) and second (34) edges which extend parallel to the axis of the battery and meet in at least abutting relationship, and a length for extending beyond the opposed ends of the battery and lap over onto the opposed third (36) and fourth (38) ends of the battery. An alkali resistant, electrically non-conductive, opaque pigmented layer (28) is applied to the inner surface of and supported by the backing. An electrically non-conductive, pressure-sensitive adhesive layer (30) is applied over the pigmented layer at least along the first (32) and second edges (34). The pressure-sensitive adhesive has sufficient peel adhesion to prevent lifting of an applied label from the case of the battery and sufficient shear strength to prevent relative movement of adhered first edges on heat shrinkage of an adhesively applied backing about the battery case (16).



## SINGLE PLY PSA LABELS FOR BATTERY APPLICATIONS

### Background of the Invention

5           Dry cell batteries are the most popular portable sources of electrical energy. They include flashlight, tool, toy, appliance batteries, and the like. Dry cell batteries come in a variety of configurations and voltage outputs and may be single or multiple use batteries. The most popular sizes are the "AA," "AAA," "C," "D" and "9 volt" batteries. The AA, AAA, C and D size batteries, along with some other configurations utilize at least one drawn metal cylindrical casing providing and serving as the positive end pole and an end serving as the negative pole. The positive pole is separated from a negative pole by an insulator.

10           In early batteries, graphics used to present battery information to the consumer were applied on the battery case. Graphics were next presented on metallized paper coverings for the case of the battery. The latter has now been largely supplanted by labels which are based on the use of multiple layers or plies of polymeric shrink films, with the most popular polymeric material being polyvinyl chloride. The multilayer constructions employed have been what is termed in the art "triplex" and "duplex" constructions with triplex being the most common.

15           With reference to the drawing captioned "Prior Art," the triplex construction consists of a composite laminate of a first heat shrinkable, self-supporting, polymeric polymer film layer (2) on which there is applied a layer of a metal (4) normally formed by vapor deposition onto which there is added a second self-supporting, heat shrinkable, polymeric film layer (2'), a graphics layer (6) and a top protective layer of another self-supporting, heat shrinkable polymeric film layer (2"). A pressure-sensitive adhesive layer (8) is applied to the undersurface of film layer (2).

20           In the duplex construction, the first intermediate heat shrinkable polymer layer (2') is eliminated to provide a laminate of a first heat shrinkable polymer film layer (2) onto which there is provided a metallized layer (4), pigmented layer (6), and the heat shrinkable polymer layer (2"). Again heat shrinkable polymer film layer (2) is undercoated with the pressure-sensitive adhesive layer (8). In either constructions where a bond is weak, particularly between a self-supporting, heat shrinkable polymer layer and a layer of metal, it has been common to utilize a layer of adhesive to enhance the strength of the bond. Multilayer adhesive label constructions are described for instance in U.S. Patents 4,801,514, 4,911,994, 5,032,477, 5,262,251 and 5,312,712, to Will et al.

25           Attempts have been made to move the layer of metal from between layers of self-supporting heat shrinkable polymeric film to between a heat shrinkable polymer film layer and the layer of a pressure-sensitive adhesive. One such construction, not involving

the use of shrink polymeric films, is described in U.S. Patent 5,292,566 to Sharklett, III. A significant limitation of this construction, however, is that the bond of the metal to the polymeric layer is weak and the layer of metal has been susceptible to cracking by on-line impact forces used to impart lot and date code information to the label. Segments of the broken layer of metal has been known to penetrate the relatively soft pressure-sensitive adhesive layer and short circuit the battery causing dissipation of electrical energy.

Another approach which has been commercially tried has been to substitute a UV cured varnish for the top layer of heat shrinkable polymeric film (2"). This construction is described in U.S. Patent 5,190,609 to Lin et al. These labels have found only limited acceptance, as the coating has proven to be a weak link exhibiting poor abrasion resistance and resistance to changes in environmental conditions.

Multiple layer constructions also present problems of matching the shrink characteristics of the several polymeric films so that no slip occurs between adjacent heat shrinkable polymeric film layers on heat shrinkage. If not, distortion of graphics, puckering and possible delamination can occur. The duplex construction has also exhibited problems of liftoff of the label from the battery case as well as poor environmental aging.

It would be desirable to provide a pressure-sensitive adhesive single ply construction for wrapping the casing of a battery. A single ply construction would be cheaper than multiple layer label constructions now employed.

A single ply battery label to be functional has to have a service life in excess of 5 years without exhibiting losses due to the environmental stress, including cyclic exposure to temperatures in excess of 150<sup>0</sup>F and humidities approaching 100%. More significantly a single ply label must properly withstand the rigors of manufacture without benefit of the presence of other plies whose characteristics can be used to add to or modify the characteristics of a single ply to account for manufacturing and environmental stresses.

In consequence, providing an effective single ply label remains an ongoing quest in the art, despite cost and production advantages as well as an advantage in that a single ply label construction maximizes functional battery volume by reducing the thickness of the label, thereby allowing the battery manufacturer to pack more energy

into a total battery construction of fixed external dimensions.

### **Summary of the Invention**

There is provided in accordance with the instant invention single ply labels for dry cell batteries which provide a peripheral shell and opposed ends enclosing a direct current electrical energy providing core. The label is formed of an at least partially transparent, self-supporting substantially monoaxially oriented, heat shrinkable polymeric film facestock or backing having a width and length. The width of the backing provides at its ends first and second opposed longitudinal edges and is sufficient for the backing to embrace the case of the battery so that the first and second edges meet in at least abutting relation. The length of the backing is sufficient for the backing to extend beyond the length of the battery case and provides at its ends first and second opposed peripheral edges adapted, when wrapped about a battery case, to extend beyond the length of the battery case. An opaque alkali resistant, electrically non-conductive pigmented layer covering any visual indicia printed on the undersurface of the backing is also printed on the undersurface of and supported by the backing. An electrically non-conductive pressure-sensitive adhesive layer extends at least along the length of the first and second edges of the backing, preferably about the periphery of the backing and extending sufficiently inward from the several opposed edges of the backing to ensure adhesive contact with the peripheral case of the battery at least at each opposed end of the battery. It is preferred that the pressure-sensitive adhesive extend over the entire pigmented layer. The pressure-sensitive adhesive has sufficient shear or cohesive strength to prevent heat shrinkage of the backing at least about the periphery of the battery and a sufficient peel adhesion to prevent lifting of the label from the case of the battery along the length of the battery.

Accordingly, the present invention provides a single ply label for labelling a dry cell battery, said battery having an elongate peripheral case extending along the battery length and defining an axis and opposed ends intersecting the axis and enclosing, with the case, a direct current, electrical energy providing core, said label formed of:

- (a) an at least partially transparent, self supporting, substantially

monoaxially oriented, heat shrinkable polymer film backing having an outer surface and an inner surface for facing the battery case, a width providing at opposed end thereof, first and second edges for extending parallel to the axis of the battery, and a length for extending beyond the opposed ends of battery and providing at opposed ends thereof third and fourth edges for extending normal to the axis of the battery, the width of the backing being sufficient for the backing to embrace the peripheral case of the battery and for the first and second edges to meet in at least abutting relationship, and the length of the backing being sufficient for the third and fourth opposed edges to lap over the opposed ends of the battery on heat shrinkage of the backing; said backing having a heat shrinkage predominately in the direction of width of the backing and in an amount up to about 60% in the direction of the width of the backing;

(b) an opaque pigmented layer comprised of an alkali resistant, electrically non-conductive ink applied to the inner surface of and supported by the backing, said layer exhibiting no perceptible change upon exposure to the action of 7.2N KOH for 24 hours; and

(c) an electrically non-conductive pressure-sensitive adhesive layer applied to and extending over the pigmented layer at least along the first and second edges, said pressure-sensitive adhesive having sufficient peel strength to substantially prevent lifting of an applied label from the case of the battery, and sufficient shear strength, to substantially prevent movement of an adhesively applied first edge of the backing to the case relative to an adhesively applied second edge of the backing on heat shrinkage of an adhesively applied backing.

In a further aspect, the present invention provides a labelled dry-cell battery having an elongate peripheral case defining an axis and opposed ends intersecting the axis and enclosing, with the case, a direct electrical energy providing core, said label formed of:

(a) an at least partially transparent heat shrunk, self supporting, monoaxially oriented, polymer film backing having an outer surface and inner surface facing the battery case, a width terminating in opposed first and second edges extending parallel to the axis and a length terminating in opposed third and fourth edges extending normal to the axis, said first and second edges secured by a pressure-sensitive adhesive

to the case of the battery and in at least substantially abutting relationship, each of said first and second edges substantially prevented from movement relative to the other on heat shrinkage of the backing about the battery case, said third and fourth opposed edges lapping onto and heat shrunk against the opposed ends of the battery, said  
5 backing having a heat shrinkage predominantly in the direction of the width of the backing an in an amount up to about 60% in the direction of the width of the backing prior to heat shrinkage;

(b) an opaque pigmented layer comprised of an alkali resistant, electrically non-conductive ink applied to the inner surface of and supported by the backing, said  
10 layer exhibiting no perceptible change upon exposure to the action of 7.2N KOH for 24 hours; and

(c) an electrically non-conductive pressure-sensitive adhesive layer adhering the label to the battery case and applied to and extending over the pigmented layer at least along the first and second edges and extending sufficiently inward of the first and  
15 second edges to adhere to the battery case and having a peel adhesion sufficient to substantially prevent lifting of the first and second edges from the case of the battery and a shear strength sufficient to substantially prevent movement of the first edge of the backing relative to the second edge of the backing on heat shrinkage of the backing.

20 in a still further aspect, the present invention provides a method of manufacture of a labelled battery which comprises:

(a) providing a dry cell battery, said battery having an elongate peripheral case extending along the battery length and defining an axis and opposed positive and negative pole ends intersecting the axis and enclosing, with the case, a direct current,  
25 electrical energy providing core;

(b) providing on a web having release surface at least one label formed of an at least partially transparent, self supporting, substantially monoaxially oriented, heat shrinkable polymer film backing having an outer surface and an inner surface for facing the battery case, a width, providing, at opposed ends thereof, first and second  
30 edges for extending parallel to the axis of the battery, and a length for extending beyond the opposed ends of battery and providing at opposed ends thereof third and fourth edges for extending normal to the axis of the battery, the width of the backing

being sufficient for the backing to embrace the peripheral case of the battery and for the first and second edges to meet in at least abutting relationship, and the length of the backing being sufficient for the third and fourth opposed edges to lap over the opposed ends of the battery on heat shrinkage of the backing; said backing having a  
5 shrinkage predominantly

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in the direction of width of backing of up to and in an amount to about 60% in the direction of the width of the backing;

(i) an opaque pigmented layer comprised of an alkali resistant,  
10 electrically non-conductive ink applied to the inner surface of and supported by the backing, said layer exhibiting no perceptible change upon exposure to the action of 7.2N KOH for 24 hours; and

(ii) an electrically non-conductive pressure-sensitive adhesive layer applied to and extending over the pigmented layer at least along the first and second  
15 edges, said pressure-sensitive adhesive having sufficient peel strength to substantially prevent lifting of an applied label from the case of battery and sufficient shear strength sufficient to substantially prevent movement of an adhesively applied first edge of the backing to the case relative to an adhesively applied second edge of the backing to the case on heat shrinkage of an adhesively applied backing;

(c) dispersing said label from said web for attachment to said peripheral  
20 case of said battery;

(d) causing said label to adhere to and wrap around said peripheral case and said first and second edges to meet in abutting or overlapping relation with said third and fourth edges extending over opposed ends of the battery forming overlapping  
25 extensions;

(e) causing by application of heat, heat shrinkage of said polymer film and said overlapping extension to wrap over the positive and negative poles of the battery.

The label is applied to the outer surface of the case of the battery and attaches to the case by contact of the pressure-sensitive adhesive. The label is then wrapped  
30 around the battery case with first and second edges at least abutting third and fourth edges protruded beyond the battery case. The protruding ends of the label are caused by action of heat on the heat shrinkable film to shrink to wrap over the opposed ends

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of the battery.

The pigmented layer is for purposes of this invention considered to be alkali resistant if impervious to the action of 7.2N KOH for 24 hours in an immersion test and electrically resistant if resistance is greater than about 560 megohms (560 x 10<sup>6</sup> ohms).

The presently preferred adhesive is a solvent based acrylic, pressure-sensitive adhesive. Emulsion or hot melt pressure-sensitive adhesives may also be effectively employed. It is presently preferred that the pressure-sensitive adhesive provide a peel strength or peel adhesion of at least about 2 Pli (pounds per inch), preferably about 2 to about 5 Pli, a shear strength of at least 4,000 mins., preferably from about 4,000 to about 10,000 mins. and a loop tack of at least about 2 Pli, preferably about 20 to about 4 Pli.

The preferred backing has a coefficient of shrinkage in the peripheral or circumferential direction of up to about 60%, preferably about 20% to about 60%, more preferably about 40-50%. Shrinkage is along the width of the backing, i.e., modrine direction. The presently preferred backing is a transparent, monoaxially oriented polyvinyl chloride film about 2 mils. thick.

1 **Brief Description of the Drawings**

That portion of the drawings captioned "Prior Art" illustrates triplex and duplex label constructions which represent current adhesive battery label constructions.

5 FIG. 1 illustrates a prospective view of the detail of the layers of the single ply label of the instant invention along with the relationship of the label to the battery case.

FIG. 1-A shows the same construction as FIG. 1 except where the adhesive layer extends around the periphery of both the label.

FIG. 2 shows the single ply label of the instant invention wrapped about the circumference of the battery in abutting relationship.

10 FIG. 3 illustrates heat shrinkage of protruding ends of label over opposed ends of the battery by the application of heat.

FIG. 4 illustrates one means for labeling batteries using the single ply labels of the instant invention.

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1 **Detailed Description**

In accordance with the instant invention, there is provided single ply labels for dry cell batteries and batteries clad with such labels.

5 Batteries to be clad with the single ply labels of the instant inventions include cylindrical "AA" "AAA" and "C" and "D" size batteries. Labels used for such batteries exceed battery length and enable label ends, when shrunk, to fold over and onto opposed ends of a battery. Labels of the instant invention may also be employed for any other dry cell battery construction which does not require the electrical considerations of cylindrical AA, AAA, C and D size batteries. Other such battery configurations include but are not  
10 limited to the popular 9-volt batteries.

With reference now to FIGS. 1, 1-A, 2 and 3, a typical cylindrical dry cell battery 10 consists of an electrical energy providing core 12 preferably formed an alkaline material and electrode 14. Both are cased by cylindrical shell 16 providing a positive pole end cap terminal 18 and negative pole end cap terminal 20. The positive pole is electrically  
15 connected to the core 12 and the negative pole is electrically connected to the electrode 14. Case 16 is electrically insulated from end cap 20 by an annular insulator 22 of a suitably non-conductive material. Portions of positive and negative end cap poles 18 and 20 are in contact within the single ply battery label 24 of the instant invention.

As depicted in FIG. 1 and 1-A, the single ply battery label 24 consists of three  
20 principal layers: a self-supporting, heat shrinkable layer 26; a supported alkali resistant pigmented layer 28, which is electrically non-conductive at least in regions where it extends over battery segments 16 and 20 of the battery case; and, a supported, pressure-sensitive adhesive layer 30, which is electrically non-conductive, at least where it extends over  
25 elements 16 and 20 of the battery case. Pressure-sensitive adhesive layer 30 must extend along first and second edges 32 and 34 shown to be parallel to the axis of the battery. Edges 32 and 34 are to abut and may overlap. Adhesive is provided to ensure some pressure-sensitive adhesive at each of the four edges contacts the battery case. Desirably, as shown in FIG. 1-A, the pressure-sensitive adhesive extends about the periphery of label 24, i.e., provides first and second edges 32 and 34 and third and fourth edges 36 and 38.  
30 More typically, as shown in FIG. 1, the pressure-sensitive adhesive layer 30 extends over the entire surface of layer 26. The pressure-sensitive adhesive layer 30 is at least electrically non-conductive where it contacts elements 18 and 20 to prevent drainage from the positive pole to the negative pole of the battery. Pigmented layer 28 and the heat shrinkable polymer facestock or backing 26 are also electrically non-conductive where they are in electrical  
35 contact with both poles of the battery 10. The non-conductive pigmented layer which eliminates prior fragile vacuum deposited metal layers is critical to the use of a single layer support.

1 Another key to the ability to provide a single ply battery label is the proper choice  
of facestock with production parameters in mind. There must be achieved with a single self-  
supporting layer, namely, the facestock on which the graphics are underprinted and over such  
5 underprinted graphics the adhesive is applied, a net construction which must perform as are  
equivalent of multiple layers which have been employed in the past. In the past, in  
employing multiple self-supporting layers, one layer could complement another or modify  
or enhance certain property in order to tailor the label to the vigors of manufacture. In the  
present invention, a single layer must provide function of multiple layers and still minimize  
10 label thickness. This cannot be achieved at the sacrifice of production. For, if going to  
single layer significantly increases production cost the increase of production cost will  
overcome the advantage of the single layer. In addition, the single support film must be  
thermally shrinkable and yet be sufficiently inelastic to withstand distortion at repeated  
registrations at various printing sites where a plurality of colors used to form informational  
as well as esthetic graphics are printed. For such operation, some 6 to 10 or more colors  
15 will be added to a film. The film must not adversely stretch or else there will be shifts in  
registration impeding print clarity which will be commercially unacceptable. At the same  
time, the film must have some degree of shrinkage in the machine direction to enable the  
ends of the applied labels to fold over the end of the battery on application of heat without  
distortion of the graphics on the film. If there is excessive drawback or shrinkage, the film  
20 could lift at the seams exposing adhesive which would be a source to collect dirt, another  
unacceptable result. In addition, improper shrinkage of the seams could result in lift which  
leads to undesirable cosmetic appearance. With these goals in mind and the production rates  
of up to 800 batteries per minute for "AA" size and 600 or more batteries per minute for  
"AAA" batteries in labeling machines, the following specifications have been arrived for the  
25 self-supporting layer of the label construction.

Facestock or backing 26 is for the single ply construction is a monoaxially oriented  
polymer film, which is oriented substantially only in the direction normal to the axis of the  
battery, i.e. along the backing width and about its periphery. Shrinkage in that direction,  
i.e., in the machine direction or in the direction from first edge 32 to second edge 34 may,  
30 depending on production rate, be up to about 60% generally from about 20 to about 60%,  
and preferably range from about 40 to about 50%, most preferably from about 40 to about  
45% for smaller batteries and 40 to 50% for larger batteries.

Residual shrink-back in storage should be not more than about 10%, preferably less  
than 8%, more preferably less than about 3%.

35 Some shrinkage may also occur in the axial direction normal thereto. Shrinkage in  
one direction to a direction normal thereto is from -2 to +5%, preferably 0-3%, even more  
preferably about 0-1%. A negative shrinkage means elongation.

1 The presently preferred mechanical properties of the film are tinsel strength of about 15  
Kpsi in the machine direction, an elongation of 77% in the machine direction and elastic  
modules of 400 Kpsi in the machine direction all according to ASTM D882-91 (Test Method  
A).

5 A presently preferred heat shrinkable film layer 26 is preferably about 2 mils. thick  
and a substantially monoaxially oriented polyvinyl chloride film having a manufactured by  
American Mirrex Corp. of New Castle, Delaware.

10 Presently preferred films are machine direction monoaxially oriented polyvinyl  
chloride films having a thickness of from about 1 to about 3 mils., preferably from about 2  
to about 3 mils., more preferably about 2 to about 2.5 mils.

In addition to polyvinyl chloride films other heat shrinkable films which may be used  
as the facestock include, but are not limited to, polyvinyl fluoride films, vinylidene fluoride  
films, polypropylene films and the like. Other films include polypropylene films described  
in U.S. Patent 5,190,609 to Lin et al. Facestock 26

15 serves as the self supported carrier for pigment layer 28 and pressure-sensitive adhesive layer  
30.

20 Between pigment layer 28 and film 26, there are contained other intelligent indicia  
formed of inks such as decorative graphics, bar codes, product information and the like.  
While surface conductivity and alkali resistance is not critical to such inks, they are  
preferably provided as inks which display resistance to attack by alkali (KOH) and preferably  
an electrical resistance at least equal with the electrical resistance of the pigmented layer 28  
and/or pressure-sensitive adhesive layer 30. This eliminates any consideration of minor flaws  
providing short circuit battery drainage where the elements of label, i.e., facestock,  
pigmented layer and pressure-sensitive adhesive layer are in electrical contact with both the  
25 positive and negative polar elements of a battery.

30 As to any layer of the label which contacts the opposed poles of a battery, it is  
required that such layer be essentially non-responsive to the action of alkali or be  
alkali-resistant. By "alkali-resistant" there is meant the absence of any perceptible change  
in appearance upon exposure to 7.2N KOH for about 24 hours. Any of the element 28 and  
30 which electrically contact positive and negative battery elements must also be electrically  
non-conductive. By "electrically non-conductive" there is meant a resistance greater than  
about 560 meg ohms ( $560 \times 10^6$  ohms). While only components of a layer which, by  
necessity, bridge positive and negative poles of a battery must be electrically non-conductive,  
it is, as stated above, preferred that all of layers 28 and 30 be electrically non-conductive.

35 Pigmented layer 28 is formed of alkali resistant inks in which the pigment is deposited  
from a carrier or vehicle to leave an alkali resistant, electrically non-conductive layer which  
is supported by backing 26 and which provide a coating which is opaque and forms a  
background for a label. Single color and multicolor, side by side or overlapping pigmented

1 layers may comprise layer 28. The indicia and background forming pigmented layer 28 are underprinted on the self-supporting, transparent layer 26.

5 Presently preferred alkali resistant electrically non-conductive inks are manufactured by Zeneca Specialty Inks, Dayton, New Jersey. Suitable are Zeneca NDX-1467, (copper), NSX-1442 (silver), NKX-2155 (black) and NWX1596A (white). Copper and silver color inks have a pearlescent formulation, which provides a metallic appearance and, replaces the conductive layer of metal found in the prior art label constructions. It is presently preferred that pigmented layer 28 be continuous over the back portion of the transparent film 26 of label 24. As indicated, however, it can be discontinuous or multilayered provided that the portion of the pigment layer 28 which is in electrical contact with the positive and negative poles 20 and 22 be electrically non-conductive in addition to being alkali resistant.

10 Pressure-sensitive adhesive layer 30 may, as shown in FIG. 1, extend over the entire surface of the film 28. It may also extend only along edges 32 and 34 or, as shown in FIG. 1-A, extend about the periphery of label and be of a width sufficient to ensure contact with the case of the periphery of the battery. The adhesive bond to the battery case should be sufficient to ensure that no shrinkage of the label will occur between zones of adhesive contact except where the label extends beyond the ends of the battery. With reference to FIGS. 2 and 3, on exposure to heat the extended ends shrink, fold over and are adhered by the pressure-sensitive adhesive to the opposed ends of the battery. In the event the pressure-sensitive layer 30 only runs along edges 32 and 34 forming seam 42, graphics must be designed to account for the manner in which layer 26 shrinks in the axial direction.

15 The pressure-sensitive adhesive may be applied from a solvent, emulsion or suspension or as a hot melt. The pressure-sensitive adhesive must have sufficient shear or cohesive strength to prevent excessive shrink-back of the label where adhered to the battery case upon the action of heat after placement of the label on a battery as the substrate; sufficient peel strength to prevent the facestock from lifting from the battery and sufficient tack or grab to enable adequate in flight attachment to the label to the battery case during the labeling operation.

20 The presently preferred pressure-sensitive adhesive is of a solvent based acrylic adhesive manufactured by Ashland Chemical Company, Columbus, Ohio, under the product designation 1860Z45 modified with an addition of an antioxidant. Another suitable solvent acrylic pressure-sensitive adhesive is Polytex™ 7000 manufactured by the Avery Chemical Division of Avery Dennison Corporation and described in U.S. Patent 4,812,541 to Mallya et al.

25 A suitable emulsion pressure-sensitive adhesive is that described in U.S. Patent 5,221,706 to Lin et al.

30 In order to have an overall balance of adhesive properties and to enable proper application and retention of label intact on the battery case, it is presently preferred that the adhesive have a peel strength or adhesivity of at least preferably about 2 Pli, more preferably

1 2 to about 5 Pli, width as determined by using PSTC #1 (Pressure-Sensitive Tape Counsel  
Test #1) run at 12 inches per minute peel rate after 20 minute dwell on a 2-mil polyester  
backing; a shear strength, a measure of cohesive strength, of at least 4,000, preferably about  
4,000 to about 10,000 minutes according to PSTC Test #7 using 2 mil polyester backing,  
5 which for a sample measuring 0.5 by 0.5" and a 500 gram weight, result is in a loading of  
2,000 grams per square inch test and a loop tack of at least about 2, preferably 2 to about  
4 Pli at a 12" per minute peel rate for a 1" wide loop on stainless steel.

FIG. 4 depicts one labeling operation. With reference thereto, labels 24 on web of  
release material 44 are caused to pass over a relatively sharp dispensing edge 46 and release  
10 from the web of release material 44, and adhere in flight and "grab" onto the surface of  
advancing battery 10. The battery 10 is rotated by roll 48 as it continues to advance, and  
label 24 is wrapped around the shell of the battery in abutting (FIG. 3), or slightly  
overlapping relation to form seam 42. The pressure-sensitive adhesive layer 30 contacts the  
cylindrical portion of the shell of the battery. The label is secured rigidly to the battery case  
15 and acts to resist label shrinkage about battery case and preferably along the length and width  
of the battery case on application of heat from source 50, normally an air knife. The  
adhesive also prevents distortion of any indicia contained between layers 26 and 28 due to  
heat shrinkage of the facestock 26. Elimination of adhesive from along edges 36 and 38 is  
feasible if the backing has low shrinkage in the direction of the battery axis.

20 With further reference to FIG. 2 and 3, once the labels have been rolled about and  
adhered to the cylindrical shell of battery 10, the ends 40 of the label extend beyond the  
cylindrical case of battery 10 and protrude beyond the positive pole 18 and the negative pole  
(not shown) of battery 10. As shown in FIG. 3, on application of heat, the label shrinks  
causing the label end to wrap over the positive and negative poles of the battery causing,  
25 when present, the pressure-sensitive adhesive to adhere the label to the battery case at the  
two ends. In the alternative, the shrinkage may be sufficient to hold the overlapping portions  
of the label against the surface of the ends of the battery. In the above embodiments,  
cohesive strength of the pressure-sensitive adhesive insures that label movement due to  
shrinkage along the cylindrical case does not occur and as a consequence, distortion of the  
30 indicia cannot occur nor in any instance there will not form an opening at seam 42 in  
consequence of circumferential shrinkage. In sum, the graphics remain intact while, upon  
shrinkage, the exposed ends are drawn by heat shrinkage to and adhered by the  
pressure-sensitive adhesive to the positive and negative poles of the battery completing, at  
low cost, battery labelling.

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## WHAT IS CLAIMED IS:

1. A single ply label for labelling a dry cell battery, said battery having an elongate peripheral case extending along the battery length and defining an axis and opposed ends intersecting the axis and enclosing, with the case, a direct current, electrical energy providing core, said label formed of:
- (a) an at least partially transparent, self supporting, substantially monoaxially oriented, heat shrinkable polymer film backing having an outer surface and an inner surface for facing the battery case, a width providing at opposed end thereof, first and second edges for extending parallel to the axis of the battery, and a length for extending beyond the opposed ends of battery and providing at opposed ends thereof third and fourth edges for extending normal to the axis of the battery, the width of the backing being sufficient for the backing to embrace the peripheral case of the battery and for the first and second edges to meet in at least abutting relationship, and the length of the backing being sufficient for the third and fourth opposed edges to lap over the opposed ends of the battery on heat shrinkage of the backing; said backing having a heat shrinkage predominately in the direction of width of the backing and in an amount up to about 60% in the direction of the width of the backing;
- (b) an opaque pigmented layer comprised of an alkali resistant, electrically non-conductive ink applied to the inner surface of and supported by the backing, said layer exhibiting no perceptible change upon exposure to the action of 7.2N KOH for 24 hours; and
- (c) an electrically non-conductive pressure-sensitive adhesive layer applied to and extending over the pigmented layer at least along the first and second edges, said pressure-sensitive adhesive having sufficient peel strength to substantially prevent lifting of an applied label from the case of the battery, and sufficient shear strength, to substantially prevent movement of an adhesively applied first edge of the backing to the case relative to an adhesively applied second edge of the backing on heat shrinkage of an adhesively applied backing.
2. A single ply label as claimed in claim 1 in which the backing has a shrinkage of about 40 to about 50% in the direction along the width of the backing.

3. A single ply label as claimed in claim 1 in which the backing has a shrinkage of about 40 to about 45% in the direction along the width of the backing.
4. A single ply label as claimed in claims 1, 2 or 3 in which the backing has formed of a monoaxially oriented polyvinyl chloride film and having a thickness  
5 of about 1 to about 3 mils.
5. A single ply label as claimed in claims 1, 2 or 3 in which the backing has formed of a monoaxially oriented polyvinyl chloride film and having a thickness of about 2 to about 2.5 mils.
6. A single ply label as claimed in any one of claims 1 to 5 in which the  
10 pressure-sensitive adhesive is an acrylic based adhesive having a peel strength of at least about 2 Pli, a shear strength of at least 4,000 minutes and a loop tack of at least about 2 Pli at a 12 inch per minute peel rate for a 1 inch loop on stainless steel.
7. A single ply label as claimed in any one of claims 1 to 5 in which the pressure-sensitive adhesive is an acrylic based adhesive having a peel strength of at  
15 least 2 to about 5 Pli and a shear strength of at least of about 4,000 to 10,000 minutes.
8. A single ply label as claimed in any one of claims 1 to 7 in which the pressure-sensitive adhesive additionally extends along the third and fourth edges of the backing.
9. A single ply label as claimed in any one of claims 1 to 8 in which  
20 substantially all of the pigmented layer is covered with the pressure-sensitive adhesive layer.
10. A single ply label for labelling a dry cell battery as claimed in any one of claims 1 to 9 in which said label comprises:
- (a) an at least partially transparent, self supporting, substantially  
25 monoaxially oriented, heat shrinkable polymer film backing having an outer surface

and an inner surface for facing the battery case, a thickness of about 1 to about 3 mils, a width providing at opposed ends thereof, first and second edges for extending parallel to the axis of the battery, and a length for extending beyond the length of the battery and providing at opposed ends thereof third and fourth edges for extending  
5 normal to the axis of the battery, the width of the backing being sufficient for the backing to embrace the peripheral shell of the battery and for the first and second edges to meet in at least abutting relationship about the peripheral case of the battery, and the length of the backing being sufficient for the third and fourth opposed edges to lap over the opposed ends of the battery on heat shrinkage of the backing, said  
10 backing having a heat shrinkage predominantly in the direction of the backing and in an amount of up to about 60% in the direction of the width of the backing;

(b) an opaque pigmented layer comprised of an alkali resistant, electrically non-conductive ink applied to the inner surface of and supported by the backing, said layer exhibiting no perceptible change upon exposure to the action of 7.2N KOH for  
15 24 hours; and

(c) an electrically non-conductive, acrylic based, pressure-sensitive adhesive layer extending over the pigmented layer at least along the first and second edges and having a peel strength of at least about 2 Pli and sufficient to prevent lifting of the applied label from the case of the battery and a shear strength of at least about 4,000  
20 minutes and sufficient to prevent movement of an adhesively applied first edge of the backing to the case relative to an adhesively applied second edge of the backing on heat shrinkage of an adhesively applied backing.

11. A single ply label as claimed in claim 10 in which the backing has formed of a monoaxially oriented polyvinyl chloride film and having a thickness of  
25 about 2 to about 2.5 mils and a shrinkage of about 40 to 45% in the direction of the width of the backing.

12. A labelled dry-cell battery having an elongate peripheral case defining an axis and opposed ends intersecting the axis and enclosing, with the case, a direct electrical energy providing core, said label formed of:

30 (a) an at least partially transparent heat shrunk, self supporting, monoaxially

oriented, polymer film backing having an outer surface and inner surface facing the battery case, a width terminating in opposed first and second edges extending parallel to the axis and a length terminating in opposed third and fourth edges extending normal to the axis, said first and second edges secured by a pressure-sensitive adhesive  
5 to the case of the battery and in at least substantially abutting relationship, each of said first and second edges substantially prevented from movement relative to the other on heat shrinkage of the backing about the battery case, said third and fourth opposed edges lapping onto and heat shrunk against the opposed ends of the battery, said backing having a heat shrinkage predominantly in the direction of the width of the  
10 backing an in an amount up to about 60% in the direction of the width of the backing prior to heat shrinkage;

(b) an opaque pigmented layer comprised of an alkali resistant, electrically non-conductive ink applied to the inner surface of and supported by the backing, said layer exhibiting no perceptible change upon exposure to the action of 7.2N KOH for  
15 24 hours; and

(c) an electrically non-conductive pressure-sensitive adhesive layer adhering the label to the battery case and applied to and extending over the pigmented layer at least along the first and second edges and extending sufficiently inward of the first and second edges to adhere to the battery case and having a peel adhesion sufficient to  
20 substantially prevent lifting of the first and second edges from the case of the battery and a shear strength sufficient to substantially prevent movement of the first edge of the backing relative to the second edge of the backing on heat shrinkage of the backing.

Received Event (Event Succeeded)

PCT/US 96/10769

Date:	9/11/97	Time:	8:37 PM
Pages:	20	Sender:	IPPA/US 11 SEP 1997
Fax Number:		Subject:	
Company:	SEP 11 '97 17:37 TO-917033053599 FROM-	Type:	Fax T-092 P.10/20 F-170

1           13.    A battery as claimed in claim 12 in which the monoaxially oriented backing is, prior to shrinkage, up to about 60% shrinkable in the direction along the width of the backing.

5           14.    A battery as claimed in claim 12 in which the monoaxially oriented backing is prior to shrinkage about 40 to about 50% shrinkable in the direction along the width of the backing.

10           15.    A battery as claimed in claims 12, 13 or 14 in which the backing is formed of a monoaxially oriented polyvinyl chloride film and having a thickness of about 1 to about 3 mils.

15           16.    A battery as claimed in any one of claims 12 to 15 in which the backing is formed of a monoaxially oriented polyvinyl chloride film and having a thickness of about 2 to about 2.5 mils and has a shrinkage of about 40 to about 45% in the direction along the width of the backing.

20           17.    A battery as claimed in any one of claims 12 to 16 in which the pressure-sensitive adhesive has a peel strength of at least about 2 Pli, a shear strength of at least about 4,000 minutes and a loop tack of at least about 2 Pli at a 12 inch per minute peel rate for a 1 inch loop on stainless steel.

25           18.    A battery as claimed in any one of claims 12 to 17 in which the pressure-sensitive adhesive is an acrylic adhesive having a peel strength of at least 2 to about 5 Pli and a shear strength of about 4,000 to 10,000 minutes.

30           19.    A battery as claimed in any one of claims 12 to 18 in which the pressure-sensitive adhesive additionally extends along the third and fourth edges of the battery and at least adhesively secures said backing at said third and fourth edges to the opposed ends of the battery.

35           20.    A battery as claimed in any one of claims 12 to 19 in which the pressure-sensitive adhesive layer covers substantially all of the pigmented layer and in which the backing, at least at said third and fourth edges, is adhesively secured to the opposed ends of the battery.

            21.    A battery as claimed in any one of claims 12 to 20 in which the pressure-sensitive adhesive layer covers substantially all of the pigmented layer.

            22.    A battery as claimed in any one of claims 12 to 21 in which the label is formed of:

## Received Event (Event Succeeded)

Date: 9/11/97 Time: 8:37 P  
 Pages: 20 Sender: IPEAUS 11 SEP 1997  
 Fax Number: Subject:  
 Company: SEP 11 '97 17:38 TO-917033053599 FROM- Type: Fax T-092 P.11/20 F-170

- 1 (a) an at least partially transparent, self supporting, substantially monoaxially oriented, heat shrinkable polymer film backing having an outer surface and an inner surface facing the battery case, a thickness of about 1 to about 3 mills, a width terminating, at opposite ends, in first and second edges extending parallel to the axis, and a length terminating at  
 5 opposed ends, in third and fourth edges normal to the axis of the battery, said label embracing the peripheral case of the battery with the first and second edges meeting in at least abutting relationship and adhered by a pressure-sensitive adhesive to the case of the battery, the third and fourth opposed edges overlapping onto and heat shrunk against the opposed ends of the battery, said backing having a heat shrinkage of up to about 60% in the direction of the width  
 10 of the backing prior to shrinkage of the backing, said backing having a heat shrinkage predominantly in the direction of the width of the backing and in an amount up to about 60% in the direction of the width of the backing prior to heat shrinkage;
- (b) an opaque pigmented layer comprised of an alkali resistant, electrically non-conductive ink applied to the inner surface of and supported by the backing, said layer  
 15 exhibiting no perceptible change upon exposure to the action of 7.2N KOH for 24 hours; and
- (c) an electrically non-conductive, acrylic based, pressure-sensitive adhesive layer adhering the label to the battery case and extending over the pigmented layer at least  
 20 along the first and second edges sufficient to enable adhering the label at about the first and second edges to the case of the battery, said pressure-sensitive adhesive having a peel strength of at least about 2 Pli and sufficient to substantially prevent lifting of the applied label from the case of the battery and a shear strength of at least about 4,000 minutes and, sufficient to substantially prevent movement of the first edge of the backing relative to the second edge of the backing on heat shrinkage of the backing.
- 25 23. A method of manufacture of a labeled battery which comprises:
- (a) providing a dry cell battery, said battery having an elongate peripheral case extending along the battery length and defining an axis and opposed positive and negative pole ends intersecting the axis and enclosing, with the case, a direct current, electrical energy providing core:
- 30 (b) providing on a web having release surface at least one label formed of an at least partially transparent, self supporting, substantially monoaxially oriented, heat shrinkable polymer film backing having an outer surface and an inner surface for facing the battery case, a width, providing, at opposed ends thereof, first and second edges for extending parallel to the axis of the battery, and a length for extending beyond the opposed ends of  
 35 battery and providing at opposed ends thereof third and fourth edges for extending normal to the axis of the battery, the width of the backing being sufficient for the backing to embrace the peripheral case of the battery and for the first and second edges to meet in at least abutting relationship, and the length of the backing being sufficient for the third and fourth opposed

edges to lap over the opposed ends of the battery on heat shrinkage of the backing; said backing having a shrinkage predominantly in the direction of width of backing of up to and in an amount to about 60% in the direction of the width of the backing;

5 (i) an opaque pigmented layer comprised of an alkali resistant, electrically non-conductive ink applied to the inner surface of and supported by the backing, said layer exhibiting no perceptible change upon exposure to the action of 7.2N KOH for 24 hours; and

10 (ii) an electrically non-conductive pressure-sensitive adhesive layer applied to and extending over the pigmented layer at least along the first and second edges, said pressure-sensitive adhesive having sufficient peel strength to substantially prevent lifting of an applied label from the case of battery and sufficient shear strength sufficient to substantially prevent movement of an adhesively applied first edge of the backing to the case relative to an adhesively applied second edge of the backing to the case on heat shrinkage of an adhesively applied backing;

15 (c) dispersing said label from said web for attachment to said peripheral case of said battery;

(d) causing said label to adhere to and wrap around said peripheral case and said first and second edges to meet in abutting or overlapping relation with said third and fourth edges extending over opposed ends of the battery forming overlapping  
20 extensions;

(e) causing by application of heat, heat shrinkage of said polymer film and said overlapping extension to wrap over the positive and negative poles of the battery.

24. A method as claimed in claim 23 in which said pressure-sensitive adhesive extends to said third and fourth surfaces and the overlapping extensions  
25 provide on shrinkage become adhesively bonded to the positive and negative poles.

25. A method as claimed in claims 23 and 24 in which the label is dispensed by passing the label over a relatively sharp edge.

26. A method as claimed in claim 25 in which the dispensed label adheres

in flight by said first or second edge to said battery case and wrapped around said battery case by rotating of the battery case about said axis.

27. A method as claimed in any one of claims 23 to 26 in which the heat provided to shrink the label is from an air knife.

5 28. A method as claimed in any one of claims 23 to 27 in which the backing has a shrinkage of about 40 to about 50% in the direction along the width of the backing.

10 29. A method as claimed in any one of claims 23 to 27 in which the backing has a shrinkage of about 40 to about 45% in the direction along the width of the backing.

30. A method as claimed in any one of claims 23 to 29 in which the backing has formed of a monoaxially oriented polyvinyl chloride film and having a thickness of about 1 to about 3 mils.

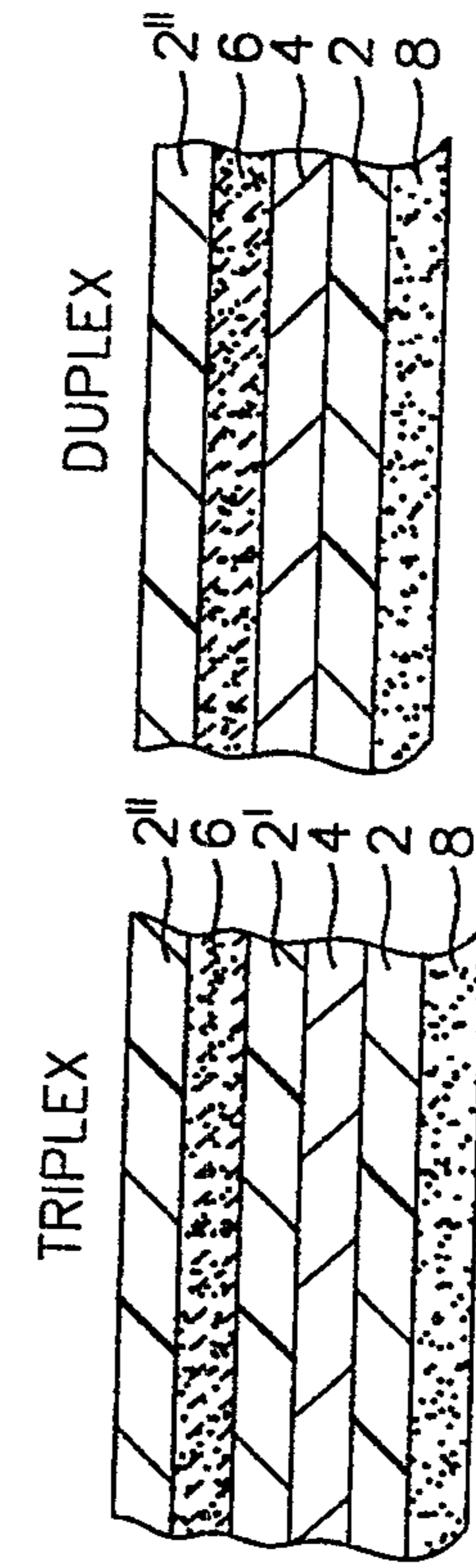
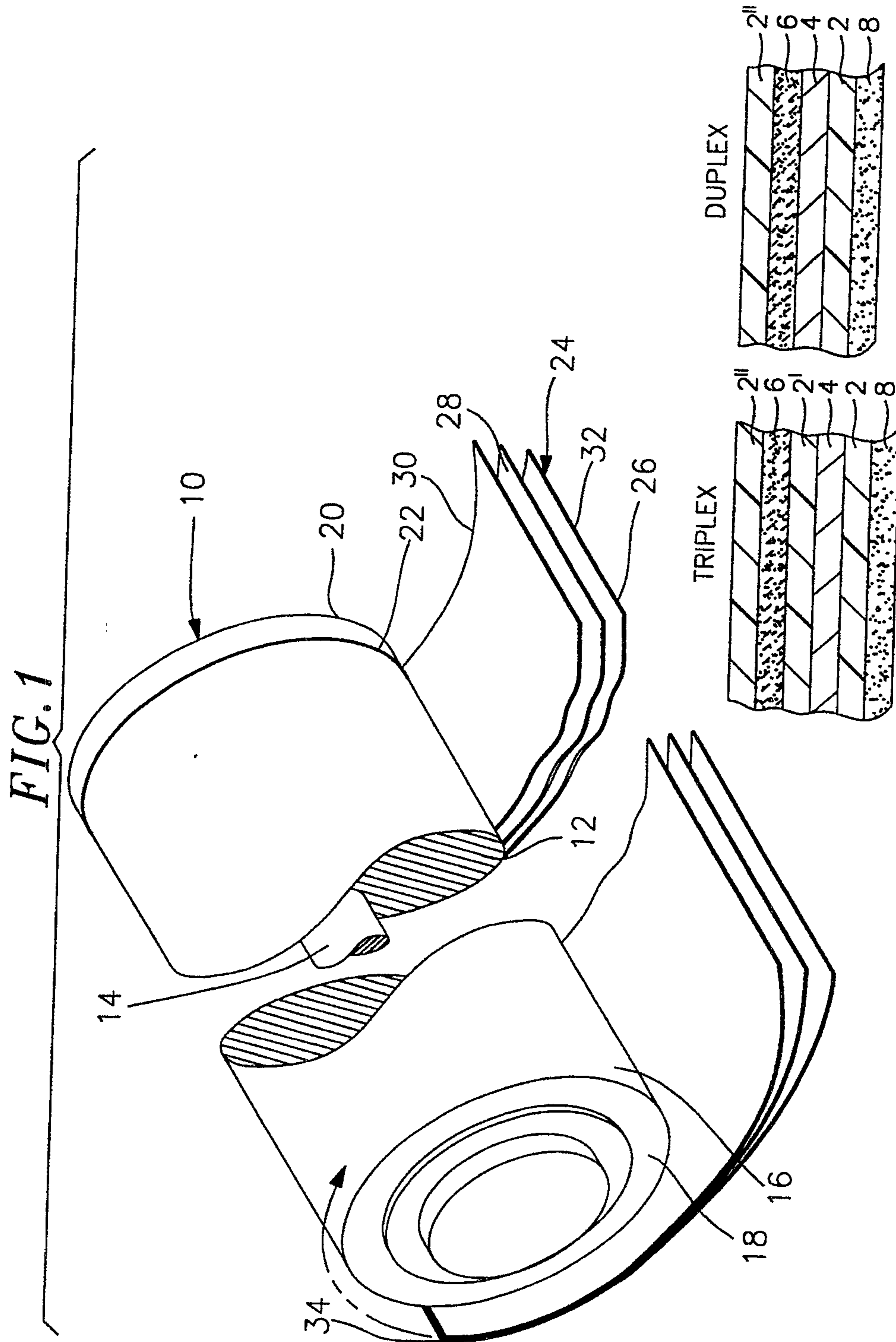
15 31. A method as claimed in any one of claims 23 to 29 in which the backing has formed of a monoaxially oriented polyvinyl chloride film and having a thickness of about 2 to about 2.5 mils.

20 32. A method as claimed in any one of claims 23 to 31 in which the pressure-sensitive adhesive is an acrylic based adhesive having a peel strength of at least about 2 Pli and a shear strength of at least 4,000 minutes and a loop tack of at least about 2 PLI at a 12 inch per minute peel rate for a 1 inch loop on stainless steel.

33. A method as claimed in any one of claims 23 to 31 in which the pressure-sensitive adhesive is an acrylic based adhesive having a peel strength of at least 2 to about 5 Pli and a shear strength of at least of about 4,000 to 10,000 minutes.

34. A method as claimed in any one of claims 23 to 33 in which substantially all of the pigmented layer is covered with the pressure-sensitive adhesive layer.

35. A labelled dry-cell battery having a single ply label, said battery being  
5 formed by the method of any one of claims 23 to 34.



PRIOR ART

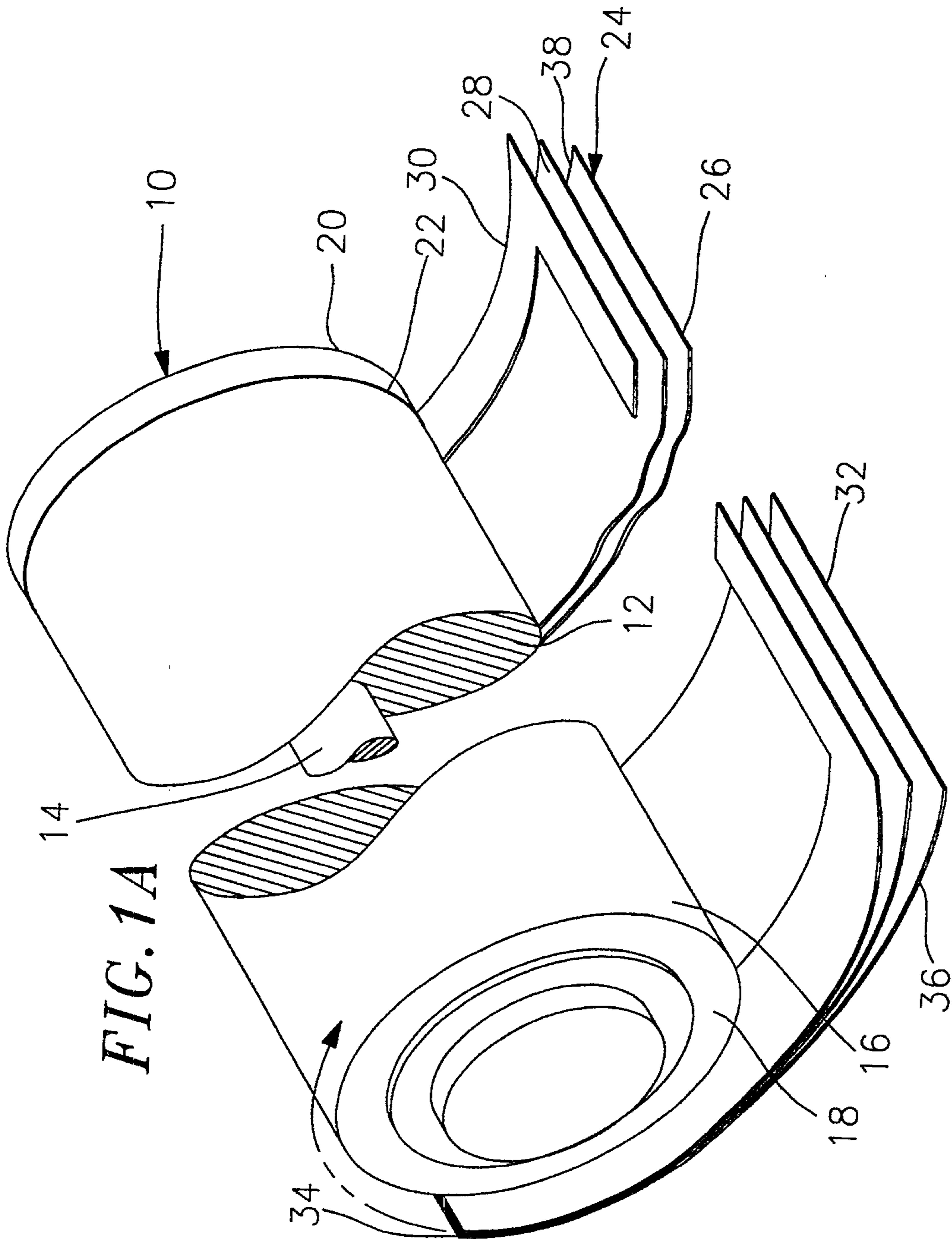


FIG. 2

