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PLATES ADAPTED FOR USE IN ELECTROLYTIC DEVICES

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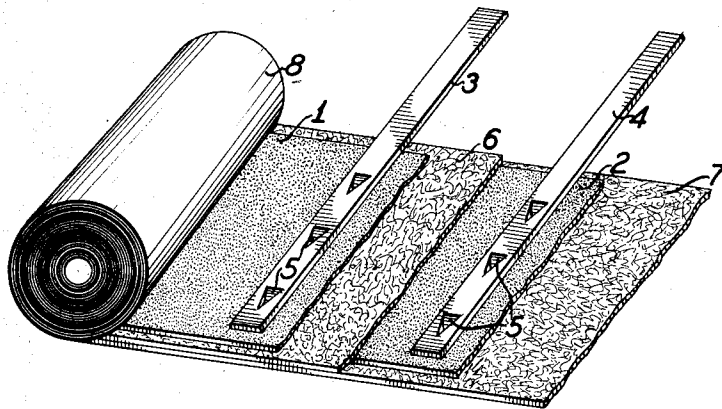


Fig. 1

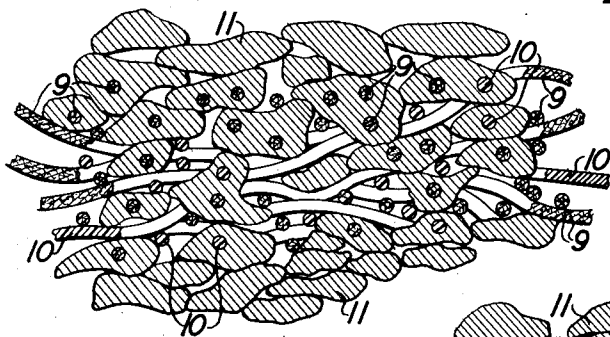


Fig. 2

Fig. 3

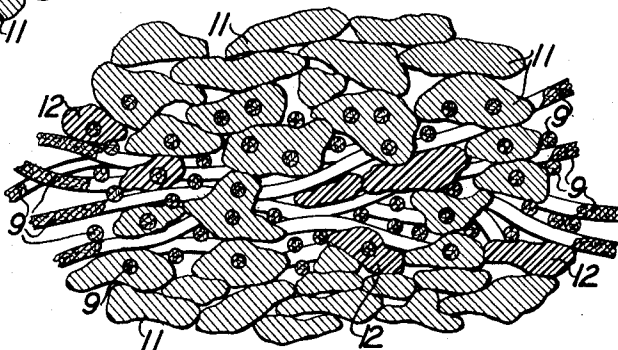
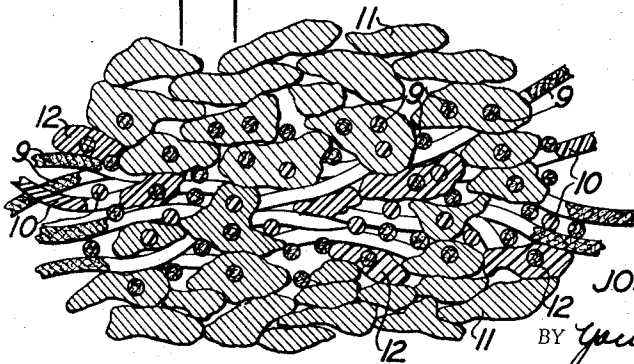


Fig. 4



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PLATES ADAPTED FOR USE IN
ELECTROLYTIC DEVICES

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Application September 13, 1951, Serial No. 246,444

9 Claims. (Cl. 154-46)

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This application is a continuation-in-part of my co-pending application Serial No. 25,785 filed May 7, 1948, now abandoned.

This invention relates to plates adapted for use in electrolytic devices such as, for example, electrolytic condensers.

Such plates are described in my U. S. Patent No. 2,104,018, issued January 4, 1938.

Electrolytic condensers of this type include electrodes comprising a layer of porous aluminum or other film forming metal. As commercially made, these electrodes have been fabricated by spray depositing molten film forming metal into and on one or more layers of woven gauze.

An object of my present invention is to produce an electrode having a base of material which can be manufactured much more inexpensively than gauze, and which is characterized by the fact that it has high tensile strength when wet.

In order to facilitate an understanding of the invention, reference is made to the accompanying drawings in which:

Figure 1 is a perspective view of an electrolytic condenser (partially unrolled) embodying an electrode constructed according to the present invention;

Figure 2 is a fragmentary magnified cross sectional view of a portion of an electrode according to the present invention;

Figure 3 is another fragmentary magnified cross sectional view of a portion of an electrode according to the present invention showing a modified form of construction;

Figure 4 is a further fragmentary magnified cross sectional view of a portion of an electrode according to the present invention showing another modified form of construction.

The material which I propose as a base for depositing spray deposited molten film forming metal is, according to my invention, a carded fabric comprising textile fibers, either natural and/or synthetic, in which the preponderance of the fibers extend lengthwise of the fabric in such a way that they are preferably bound together by thermoplastic and/or thermosetting particles or fibers at spaced intervals throughout.

The method of making the base material on which the film forming spray deposited metal is deposited according to my invention is to first make a layer of suitable fibers, such as of cotton and thermosetting synthetic fibers, which layer is in the form of a thin batt and thereafter subjecting this batt to calendering, as between heated rolls to at least partially coalesce the thermoplastic or thermosetting fibers so that a smooth porous soft inexpensive material is produced in the form of a continuous band, preferably not over .004" in thickness.

The above described batt prior to calendering

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may have thermoplastic or thermosetting particles distributed at spaced intervals therein as in addition to synthetic fibers, for example, by spraying cellulose acetate particles or urea formaldehyde resin particles therein prior to calendering and heat treatment thereof. Other suitable thermoplastic or thermosetting materials may be used. For example, nylon or cellulose acetate fibers and cotton fibers and urea formaldehyde particles may be incorporated in a batt and calendered under heat and pressure.

It is essential to use fibers and other thermoplastic materials which are non-contaminating in subsequent use in an electrolytic condenser when subjected to electrolysis.

It is essential that fibers and bonding agents used do not give off any chloride or sulphate ions and that they are free from metals and any other impurities which might react deleteriously in use with film forming electrolytes and film forming electrodes.

It is essential, according to my invention, that the bonded calendered batt have sufficient tensile strength to permit its being passed continuously in front of devices for spray depositing molten film forming metal without breaking up or igniting due to the temperatures or mechanical stress encountered and it must be closely formed enough so that the spray deposited metal does not pass through it in sufficient quantities to form a layer on the backing member over which it passes while it is being spray deposited. This backing member preferably comprises a fluid-cooled metallic surface, one of whose purposes is to conduct heat away from the above described base onto which a continuous layer of coherent conductive porous film forming particles is spray deposited. The calendered batts may be spray deposited in multiple layers, but if this is done, the spray deposited electrode should preferably not exceed .010" thickness.

According to my invention it is preferable that the preponderance of fibers be of a type which after heat calendering and/or heat treatment will retain their individual shape and it is desirable to use a small portion of bonding particles, or fibers such as on the order of from 1% to 40% by weight of coalescing fibers or particles.

The continuous tape which, according to my invention, is used as a base for spray depositing film forming electrodes thereon also is characterized by the fact that after calendering it is soft and porous and the molten metal when spray deposited thereon is preferably projected at such velocity that it penetrates into the fibers of the calendered batt so that the molten metal particles lend additional strength, especially wet strength, to a resultant electrode material. This is due to the fact that the molten metal particles interlock with the textile fibers.

It is essential that electrodes made according to my invention be continuous and they are generally made at least several hundred feet in length without interruption and it is essential that they have a wet strength beyond the wet strength of ordinary unwoven porous wet laid fibrous layer base electrodes in order to admit of their being passed continuously through hot electrolyte for formation of dielectric films thereon and for withstanding the tensions usually encountered in helically winding these electrodes with spacers into electrolytic condensers. The electrolyte in which these electrode tapes are film formed are usually kept near the boiling point of water and it is helpful in avoiding interruptions in the process that the electrode tape material have good tensile strength as well as high porosity to avoid breaking and so that commercial formation apparatus can be used in conjunction with the article of my invention and so that conventional winding apparatus and impregnation apparatus can be used therewith.

Calendered batts substantially free of chlorides and sulphates and having a preponderance of longitudinal textile fibers made according to my invention can also be used advantageously as separators in electrolytic condensers and have excellent electrolyte permeability and electrolyte retention characteristics.

As shown in Figure 1, the condenser comprises a pair of electrodes 1 and 2 having terminals 3 and 4 respectively secured thereto by tongues 5. Electrodes 1 and 2 are separated by separators or spacers 6 and 7. In use the assemblage of electrodes 1 and 2 and spacers 6 and 7 may be rolled together into a rolled unit 8 as illustrated.

The electrodes, as shown in Fig. 2, are formed of batts of textile fibers 9 having fibers 10 of thermo-bonding material such as thermo-plastic or thermo-setting material intermingled therewith. This figure also illustrates the electrolytically active metallic particles 11 deposited on and embedded within the mass of fibers and coalesced therewith. It will be noted that said metallic particles 11 are bonded together at spaced points on their surfaces and to the fibers 9 and 10 of the batt.

Figure 3 illustrates an electrode of modified form differing from that shown in Fig. 2 in that all of the fibers 9 are of textile material. This electrode differs from that of Fig. 2 also in that particles 12 of thermobonding material are intermingled with the fibers 9 and serve to bond said fibers together. Particles of metal 11 are associated with the batt in the same manner as in Fig. 2.

A still further modified form of the electrode is shown in Fig. 4. In this instance, the batt is formed of fibers 9 of textile material and fibers 10 of thermo-bonding material. Intermingled with the fibers 9 and 10 are particles 12 of thermobonding material bonding the fibers together. Particles of metal 11 are associated with the batt in the same manner as in Fig. 2.

Electrodes made according to my invention are porous throughout and may have one or more layers of spray deposited material applied thereto continuously by passing the calendered batts properly spaced before molten metal atomising equipment. They have great longitudinal strength and are inexpensive due to the fact that weaving and twisting is unnecessary. It is possible to make these calendered batts by using only natural textile fibers with thermobonding particles distributed at spaced intervals there-

through, or thermo-bonding fibers may be intermingled with the natural fibers so that the thermo-bonding particles coalesce and bond the natural fibers into a smooth permeable soft thin layer not over .004" thick after calendering and prior to spraying with molten metal particles. Unbleached cotton carded and dry laid into a batt having thermo-bonding material intermingled therein is a suitable material and preferable to bleached cotton because it does not necessitate the removal of contaminating bleaching reagents therefrom prior to use in making my invention. Calendering can be done in two or more stages, if preferred with the deposition of molten metal particles between stages if preferred, according to my invention, and the deposited molten metal particles may be used solely as bonding particles if preferred.

In addition to making batts as described herein of a calendered thickness up to .004 of an inch, it has been found that in some instances, it is preferable to make the batts of textile fibers bonded by thermoplastic material according to either of the several procedures hereinbefore described, but differing therefrom in that the calendered thickness of the batt may range up to about .006 to .008 of an inch. Such batts are particularly useful when it is desired to form electrodes having porous coating layers of electrolytically active metallic particles deposited on both sides of the batt and embedded within the mass of the batt to such an extent that the coating applied on one side of the batt is electrically conductively connected with the coating applied on the other side of the batt through the embedded particles.

Electrodes made according to my invention are so flexible that whereas ordinary spray deposited layers will crack on being folded at 180°, or at least become appreciably less conductive thereupon, electrodes made according to my invention can be folded upon themselves at approximately 180° without adversely affecting the electrical conductivity thereof appreciably. This makes it possible and practicable to slit and/or cut and fold along the edge a terminal connection of the same material of which the electrode is composed.

The thickness of the batt may be greater than the thickness specified according to my invention for making electrodes spray deposited on and from both faces of the batt strip material, the limitation on thickness and porosity of the batt being that these characteristics be such that the spray deposited particles penetrate into the body of the strip and substantially all the way through, and that these particles be bonded to each other in electrical conductive relationship and cohere to each other to form a unitary conductive body.

I find that I can get an increase in capacity by making electrodes according to my invention of at least 10% increase per unit of area over that of prior commercial practice and I find that for a given thickness of electrode and for a given cross section area thereof longitudinally I secure an increase in tensile strength of at least 20% over any fibrous wet laid materials.

I claim:

1. An electrode for an electrolytic device comprising a calendered band of textile fibers disposed primarily longitudinally thereof, a plurality of elements of thermo-bonding material intermingled with said textile fibers and bonding said textile fibers and forming a unitary porous

mass, and electrolytically active metallic particles deposited on and embedded within said mass and coalesced therewith, said metallic particles being bonded together at spaced points on their surface and bonded to and interlocked with the fibers of said band to form a conductive porous flexible electrode structure permeable to electrolyte.

2. An electrode for an electrolytic device comprising a calendered band of textile fibers disposed primarily longitudinally thereof, thermo-bonding plastic fibers intermingled with said textile fibers and bonding said textile fibers and forming a unitary porous mass, and electrolytically active metallic particles deposited on and embedded within said mass and coalesced therewith, said metallic particles being bonded together at spaced points on their surface and bonded to and interlocked with the fibers of said band to form a conductive porous flexible electrode structure permeable to electrolyte.

3. An electrode for an electrolytic device comprising a calendered band of unbleached cotton fibers disposed primarily longitudinally thereof, a plurality of elements of thermo-bonding material intermingled with said textile fibers and bonding said textile fibers and forming a unitary porous mass, and electrolytically active metallic particles deposited on and embedded within said mass and coalesced therewith, said metallic particles being bonded together at spaced points on their surface and bonded to and interlocked with the fibers of said band to form a conductive porous flexible electrode structure permeable to electrolyte.

4. An electrode for an electrolytic device comprising a band of textile fibers disposed primarily longitudinally thereof, a plurality of synthetic plastic fibers mingled substantially throughout said band, plastic particles heterogeneously intermingled with said band, said plastic fibers and particles bonding said textile and forming a unitary porous mass, and electrolytically active metallic particles deposited on and embedded within said mass and coalesced therewith, said metallic particles being bonded together at spaced points on their surface and bonded to and interlocked with the fibers of said band to form a conductive porous flexible electrode structure permeable to electrolyte.

5. An electrode for an electrolytic device comprising a calendered band of textile fibers disposed primarily longitudinally thereof, a plurality of elements of thermo-bonding material intermingled with said textile fibers and bonding said textile fibers and forming a unitary porous mass, and electrolytically active metallic particles deposited on and embedded within said mass and coalesced therewith, said metallic particles being bonded together at spaced points on their surface and bonded to and interlocked with the fibers of said band to form a conductive porous flexible electrode structure permeable to electrolyte, the content of thermo-bonding material ranging from 1 to 40%.

6. An electrode-forming tape for an electrolytic device comprising an elongated band of textile fibers with the fibers disposed preponderantly longitudinally of the band, and electrolytically active metallic particles deposited on and embedded within said mass and coalesced therewith, said metallic particles being bonded to-

gether at spaced points on their surface and bonded to and interlocked with the fibers of said band to form a conductive porous flexible electrode structure permeable to electrolyte.

7. An electrode for an electrolytic device comprising a calendered band of textile fibers disposed primarily longitudinally thereof, a plurality of elements of thermo-bonding material intermingled with said textile fibers and bonding said textile fibers and forming a unitary porous mass and electrolytically active metallic particles deposited on both sides of the band and embedded within the mass of said band and coalesced therewith, said metallic particles on each side of the band being bonded together at spaced points on their surfaces and bonded to and interlocked with the fibers of said band to form a conductive porous flexible electrode structure permeable to electrolyte, and some of the metallic particles of the layer on one side of the band penetrating into the band and electrically conductively connecting the layer on one side of the band with the layer on the other side of the band.

8. An electrode for an electrolytic device comprising a calendered band of textile fibers disposed primarily longitudinally thereof, and electrolytically active metallic particles deposited on both sides of the band and embedded within the mass of said band and coalesced therewith, said metallic particles on each side of the band being bonded together at spaced points on their surfaces and bonded to and interlocked with the fibers of said band to form a conductive porous flexible electrode structure permeable to electrolyte.

9. An electrode for an electrolytic device comprising a calendered band of textile fibers disposed primarily longitudinally thereof, thermo-bonding plastic fibers intermingled with said textile fibers and bonding said textile fibers and forming a unitary porous mass having a predetermined calendered thickness and electrolytically active metallic particles deposited on both sides of the band and embedded within the mass of said band and coalesced therewith, said metallic particles on each side of the band being bonded together at spaced points on their surfaces and bonded to and interlocked with the fibers of said band to form a conductive porous flexible electrode structure permeable to electrolyte, and some of the metallic particles of the layer on one side of the band penetrating into the band and electrically conductively connecting the layer on one side of the band with the layer on the other side of the band.

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