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SELECTIVELY DEMETALIZING CONDENSER PAPER

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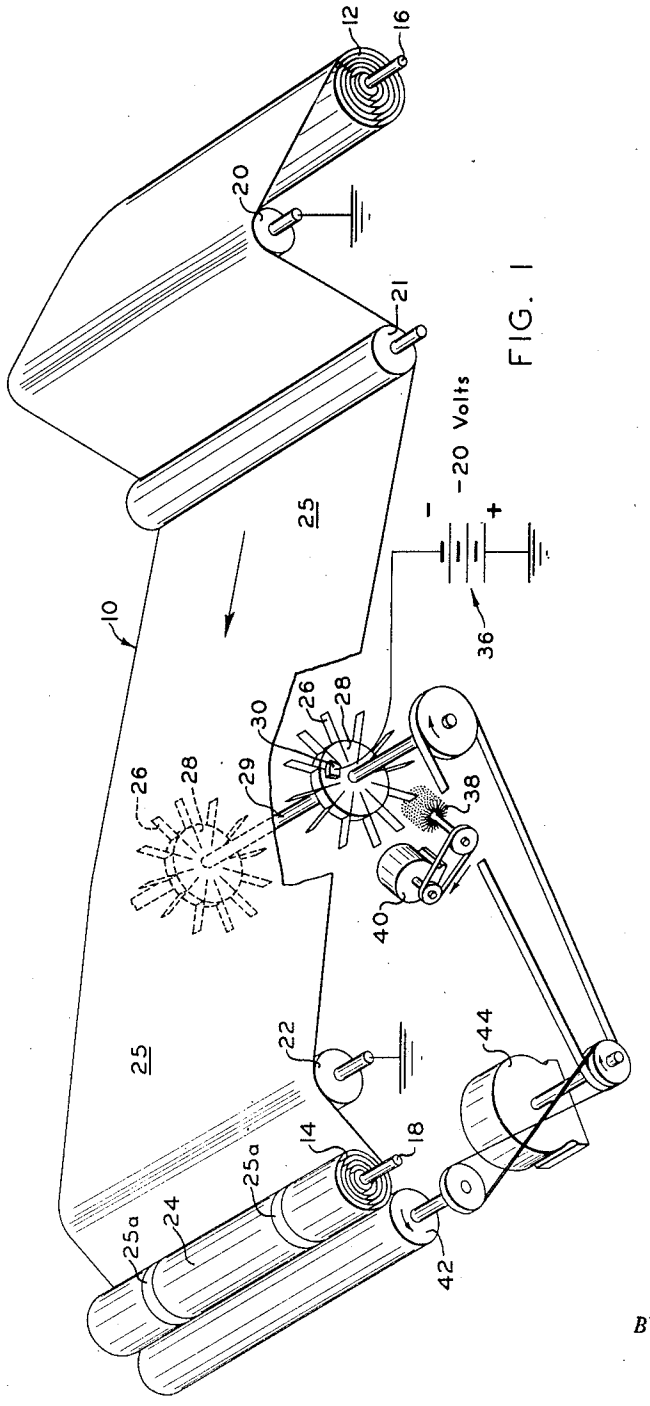


FIG. 1

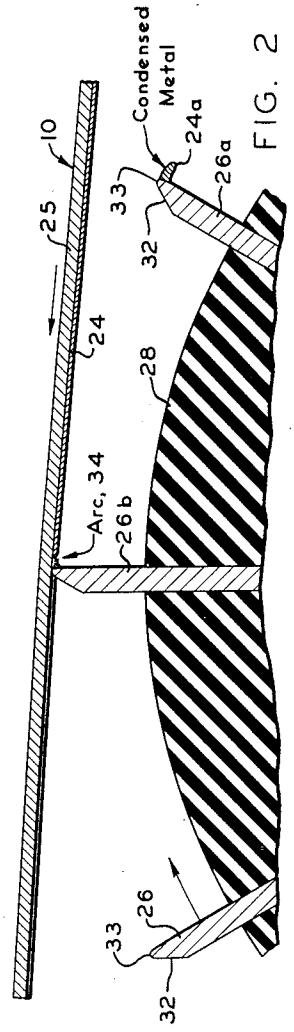


FIG. 2

INVENTORS
Glenn L. Mellen
Vincent C. Hall Jr.

BY Oliver W. Hayes
ATTORNEY

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SELECTIVELY DEMETALIZING CONDENSER PAPER

Glenn L. Mellen, Framingham Center, and Vincent C. Hall, Jr., West Roxbury, Mass., assignors to National Research Corporation, Cambridge, Mass., a corporation of Massachusetts

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This invention relates to the formation of a metal-free stripe on a web of metal-coated, nonconducting sheet material, and is particularly useful in the manufacture of electrical condensers.

In the fabrication of electrical condensers from strips of metal-coated, nonconducting sheet material, such as paper having thereon a vacuum deposited zinc coating, the metalized strips are interleaved. These strips are ordinarily slit from a wide web of the metal-coated paper, the strips being free of the metal coating in a band along one edge thereof. While the metal-free bands can be produced as an incident to the deposition of the metal coating on the paper, it is more practical to apply the metal as an unbroken film and to subsequently form the metal-free bands by removal of appropriate portions of the metal coating. The metal-removing operation is customarily carried out before the metalized paper is slit to produce the condenser strips.

A principal object of the present invention is to provide an improved apparatus for removing predetermined stripes of such a metal coating from a web of the nonconducting sheet material.

Another object of the invention is to provide apparatus of the above type which is adapted to accomplish the clean removal of all metal in the area to be striped, this removal being accomplished at a high rate of speed of sheet travel without danger of tearing of the sheet material.

Still another object of the invention is to provide a process for forming metal-free stripes on metal-coated sheet material, which is particularly advantageous with respect to cleanness of the stripe and freedom from any remaining metal particles in the striped area.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the apparatus possessing the construction, combination of elements and arrangement of parts, and the process involving the several steps and the relation and the order of one or more of such steps with respect to each of the others which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings wherein:

Fig. 1 is a perspective view illustrating in a diagrammatic fashion the preferred embodiment of the present invention; and

Fig. 2 is an enlarged, diagrammatic, sectional view of a portion of the apparatus of Fig. 1.

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In the present invention the apparatus comprises a means for advancing a web of a metal-coated, nonconducting sheet material, this means preferably advancing the web at a continuous high rate of speed. The apparatus also includes an electrical contact positioned so as to engage the metal face of the web to maintain this metal face at a predetermined electrical potential. This electrical contact conveniently comprises, in a preferred form, one or more of the feed rolls which are arranged to guide the web along a predetermined path during advancement. The means for removing the band of metal coating preferably comprises a plurality of electrodes which are successively positionable adjacent the metal coating as the metal-coated web is advanced. Each of these electrodes has a width, extending across the advancing web, which is on the order of the width desired for the metal-free stripe. The apparatus includes a means for moving the electrodes successively into and out of engagement with the web, and a means for maintaining a sufficient potential difference between one of the electrodes, in contact with the web, and the metal face of the web to create an arc between the metal coating and the electrode, this arc serving to vaporize the metal coat in the area to be striped.

In a preferred form of the invention, the means for maintaining the potential difference is so arranged that the potential difference, between the metal coating and a particular electrode in contact with the web, is removed prior to the time that the electrode is moved out of engagement with the web so as to prevent a drawing out of the arc with consequent irregularity of vaporization.

This sheet is preferably advanced at a rate of approximately 200 feet per minute, and each electrode is in arcing contact with the metal coating for about one foot. It is also preferable that each electrode be maintained at the potential difference required for arcing, up until the time that the next succeeding electrode has been brought into engagement with the web and has also been brought to this potential difference. The electrodes are preferably mounted on a common support, such as a wheel, the electrodes being insulated from each other and being preferably uniformly arcuately spaced from each other on the wheel.

Referring now to Figs. 1 and 2, the various features are shown in schematic form in one representative embodiment of the invention. In these figures the web of metal-coated sheet material is indicated at 10 as being fed from one roll 12 thereof to a wind-up roll 14 thereof, these two rolls being supported on suitable axles 16

and 18 respectively. For guiding the web in its path of travel, there are provided guide rolls 20, 21 and 22, it being seen that guide rolls 20 and 22 engage the metal-coated surface 24 of the web, while the roll 21 engages the upper surface 25 of the web. Positioned between the two guide rolls 21 and 22 is the means for removing the metal coating 24 from a predetermined area 25a of the web. This means comprises a plurality of electrodes 26. The outer end of each electrode 26 has a width substantially equal to the desired width for the metal-free stripe, these electrodes being preferably mounted on a rotary support, such as a wheel 28. Two electrode wheels 26, 28 are shown as being mounted on a common shaft 29. The wheel 28 is preferably formed of an insulating material and carries the electrodes 26 uniformly arcuately spaced around the circumference thereof. Near the center of wheel 28 the various electrodes 26 are exposed so as to provide a commutator which is engaged by a commutator brush 30 for successively energizing the various electrodes. In a preferred arrangement, the commutator brush 30 has an arcuate length slightly greater than the arcuate spacing of the electrodes, so that two of the electrodes may be simultaneously energized.

As seen best in Fig. 2, each of the electrodes 26 preferably includes a knife edge 32 for concentrating the arc 34 created, as described hereinafter, between the electrode 26 and the metal coating 24. This knife edge is slightly rounded, as at 33, to prevent tearing of the web 10 as this web moves in a direction opposite to the movement of the electrode.

As can be seen best from Fig. 1, the electrode wheel 26, 28 is so positioned with respect to the straight line path between rolls 21 and 22 that the electrodes 26 deviate the web 10 only slightly from this straight line path. This feature of the invention is particularly advantageous in preventing tearing of the relatively fragile web 10.

For applying a potential difference between one of the electrodes 26 and the metal coating 24, there is provided a source of electrical energy, preferably a low impedance source such as a battery 36, the positive side of the battery being preferably grounded, and the negative side of the battery being preferably connected to the commutator brush 30. For completing the electrical circuit to the metal surface 24, the rolls 20 and 22 are also preferably grounded. This arrangement is particularly convenient since it allows most of the elements of the apparatus to be at ground potential while the electrodes and the commutator brush 30 are at a potential of about minus 20 volts.

The means for removing metal deposited on the electrode 26, as the result of arc vaporization of the metal, preferably comprises a brush 38 driven by a motor 40, the brush being preferably positioned near the bottom part of the path of travel of the electrodes. This brush 38 is preferably mounted so that its axis is at 45° to the plane of rotation of the electrodes.

The means for advancing the web through the apparatus preferably comprises a roll 42, driven by motor 44, roll 42 engaging the outer surface of the web roll 14. The axle 18, supporting roll 14, is preferably provided with a floating mounting so as to permit axle 18 to move away from the axis of roll 42 as the radius of web roll 14 increases. The electrode wheel 28 is also preferably driven, through a suitable connection, by means of motor 44.

In the operation of the device illustrated in Figs. 1 and 2, the roll 12 of the web of metal-coated base material is suitably mounted in the apparatus and the web is fed past the rolls 20 and 21, over the electrode wheel 26, 28 and over roll 22. The end of the web is attached to the floating axle 18. The device is then put into operation by starting motor 44 to rotate the web roll 14. The web, as shown, travels from right to left while the electrode wheel 26, 28 rotates in a clockwise direction. Thus the electrodes, while in engagement with the web, are traveling in an opposite direction to the movement of the web. The wheel 28 is preferably rotated at such a speed that each electrode is in contact with slightly more than one foot of web length per rotation of the wheel. As the wheel 28 rotates, the electrodes are successively brought into contact with the web. As the first electrode (26a in Fig. 2) contacts the metal coating 24, which is at ground potential, an arc 34 is struck between the metal surface and the electrode. This arc serves to vaporize the thin metal coating which condenses on the electrode 26a slightly below the tip 33 thereof. This condensing metal, indicated at 24a, forms a shoe that extends from the face of the electrode and overlies the advancing metal coat. As the metal shoe 24a is built up, it acts as the source of the arc so that the arc moves farther and farther from the electrode. When about one foot of coated surface has passed electrode 26a, this electrode has meanwhile rotated so that the base thereof is no longer in contact with the commutator brush 30. Shortly thereafter, electrode 26a moves out of engagement with the web. Meanwhile the next succeeding electrode 26b has been rotated into contact with the web and its base has been contacted by the commutator brush 30 so that it is maintained at the minus 20 volts potential. When this next electrode 26b first contacts the web, there is no arcing since it contacts only the metal-free paper base 25 which is a nonconductor. When the preceding electrode 26a is de-energized, the arc is extinguished and the metal coat advances to the succeeding electrode 26b. When the metal coat touches this succeeding electrode 26b, the arc is struck and the metal stripe is removed from the advancing web as previously described.

In a preferred form of apparatus and process utilizing the invention, the metal-coated paper 10 comprises a thin condenser tissue 25 having thereon a zinc coating 24 deposited from vapor phase in a vacuum. Such a zinc coating has a thickness on the order of 1 micron or less, and is readily vaporized by the arc 34 generated between the electrode 26 and the metal coating 24. The electrodes 26 are preferably formed of brass, and the rolls 20, 22 are preferably also formed of a good conductor such as brass or copper.

For simplicity of illustration, the electrical connections to only one electrode wheel 26, 28 have been shown. It is preferred to have each of the electrode wheels 26, 28, which are mounted on the common rotating shaft 29, arranged so that corresponding electrodes are equally arcuately spaced around shaft 29, each of the corresponding electrodes being electrically connected to a corresponding contact extending between the various electrode wheels. This arrangement has the advantage that a single commutator brush 30 may be employed to energize the corresponding electrodes in the various electrode wheels.

Since certain changes may be made in the above apparatus and process without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description, or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Apparatus for continuously forming a metal-free stripe on a web of metal-coated, nonconducting sheet material by removing a band of said metal coating, said apparatus comprising means for continuously advancing the web, an electrical contact positioned to engage the metal face of the web, a plurality of electrodes successively positionable in contact with said metal coating, each said electrode being provided at its contacting end with a knife-blade edge having a width, extending across the advancing web, which is on the order of the width desired for the metal-free stripe, means comprising a rotary member supporting said electrodes for moving said electrodes successively into and out of engagement with said web, said rotary member being arranged to move said electrodes, while in contact with said web, longitudinally of said web in a direction opposite to the direction of advancement of said web, means for maintaining a sufficient potential difference between one of said electrodes in contact with the web and the metal face of the web to create an arc between said metal coating and said electrode, said last-named means being arranged to remove said potential difference prior to movement of said electrode out of engagement with said web, and means for removing from each said electrode metal evaporated by the arc which condenses on the electrode.

2. Apparatus for forming a metal-free stripe on a web of metal-coated, nonconducting sheet material by removing a band of said metal coating, said apparatus comprising means for advancing the web, an electrical contact positioned to engage the metal face of the web, a plurality of electrodes successively positionable adjacent said metal coating, each said electrode having a width, extending across the advancing web, which is on the order of the thickness desired for the metal-free stripe, a wheel, said electrodes being positioned around and extending from the periphery of said wheel, means for rotating said wheel so that said electrodes move, while in contact with said web, in a direction opposite to the direction of advancement of said web, and a commutator for successively energizing said electrodes as each said electrode moves through a predetermined arc of rotation, said commutator being arranged to de-energize each said electrode prior to movement of said electrode out of engagement with said web.

3. The apparatus of claim 2 wherein said arc of rotation is slightly greater than the arcuate spacing of said electrodes on said wheel.

4. Apparatus for forming a metal-free stripe on a web of metal-coated, nonconducting sheet material by removing a band of said metal coating, said apparatus comprising means for advancing the web, an electrical contact positioned to engage the metal face of the web, a plurality of electrodes successively positionable adjacent said metal coating, each said electrode having a width, extending across the advancing web, which is on the order of the width desired for the metal-free stripe, a wheel, said electrodes being positioned around and extending from the periphery of said wheel, means for rotating said wheel so that said electrodes move, while in contact with said web, in a direction opposite to the direction of advancement of said web, a commutator for successively energizing said electrodes as each said electrode moves through a predetermined arc of rotation, said commutator being arranged to de-energize each said electrode prior to movement of said electrode out of engagement with said web, and means for guiding said web along a predetermined straight line path, the axis of said wheel being spaced from said path by an amount only slightly less than the radius of the circle described by the ends of said electrodes, whereby said electrodes, upon contacting said web, deviate said web only slightly from said path.

5. The process of forming a metal-free stripe on a web of metal-coated, nonconducting sheet material which comprises advancing the web, providing a plurality of electrodes adjacent said advancing web, moving said electrodes successively into contact with the metal coating on the advancing web, moving each electrode, while in contact with the web, in a direction opposite to the direction of advancement of the web, applying a potential difference between said metal coating and each electrode during a portion of the time each said electrode is in contact with the web to create a metal-evaporating arc between said electrode and said coating, removing said potential difference, thereafter moving said electrode out of contact with said web, and removing from said electrode metal vaporized by said arc and deposited on said electrode.

6. The process of forming a metal-free stripe on a web of metal-coated, nonconducting sheet material which comprises advancing the web, providing a plurality of electrodes adjacent said advancing web, each said electrode having a knife-blade edge, moving said electrodes successively into contact with the metal coating on the advancing web, moving each electrode, while in contact with the web, in a direction opposite to the direction of advancement of the web, applying a potential difference between said metal coating and each electrode during a portion of the time each said electrode is in contact with the web to create a metal-evaporating arc between said knife-blade edge and said metal coating, condensing evaporated metal on that side of said knife-blade edge facing said advancing metal coating, maintaining said arc between said advancing metal coating and said condensed metal on said electrode, removing said potential difference, thereafter moving said electrode out of contact with said web, and removing from said electrode metal vaporized by said arc and deposited on said electrode.

7. The process of claim 6 wherein each said electrode is maintained in arcing contact with about one foot of length of said metal coating.

GLENN L. MELLEN.
VINCENT C. HALL, JR.

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