

Feb. 3, 1948.

R. A. GROUSE

2,435,441

PROCESS FOR DEMETALLIZING METALLIZED PAPER

Filed Oct. 20, 1943

3 Sheets-Sheet 1

Fig.1.

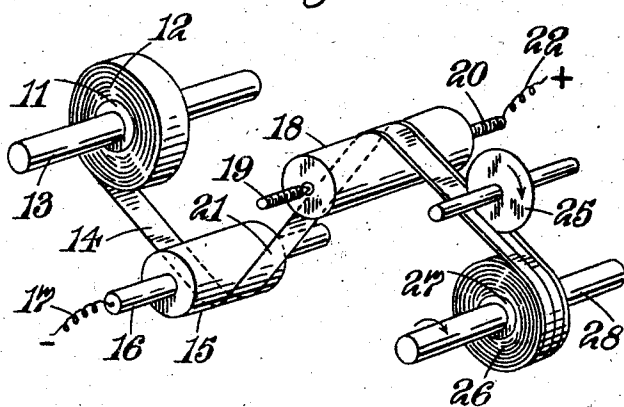
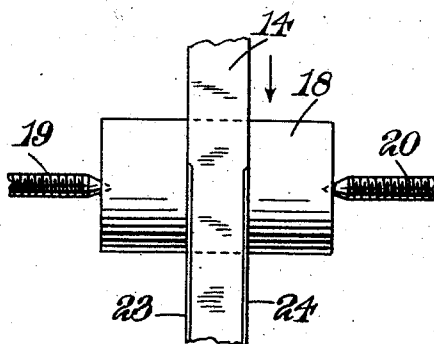


Fig. 2.



INVENTOR

Richard Alfred Hrouse

By Watson, Cole, Grindle & Watson
Attorneys

Feb. 3, 1948.

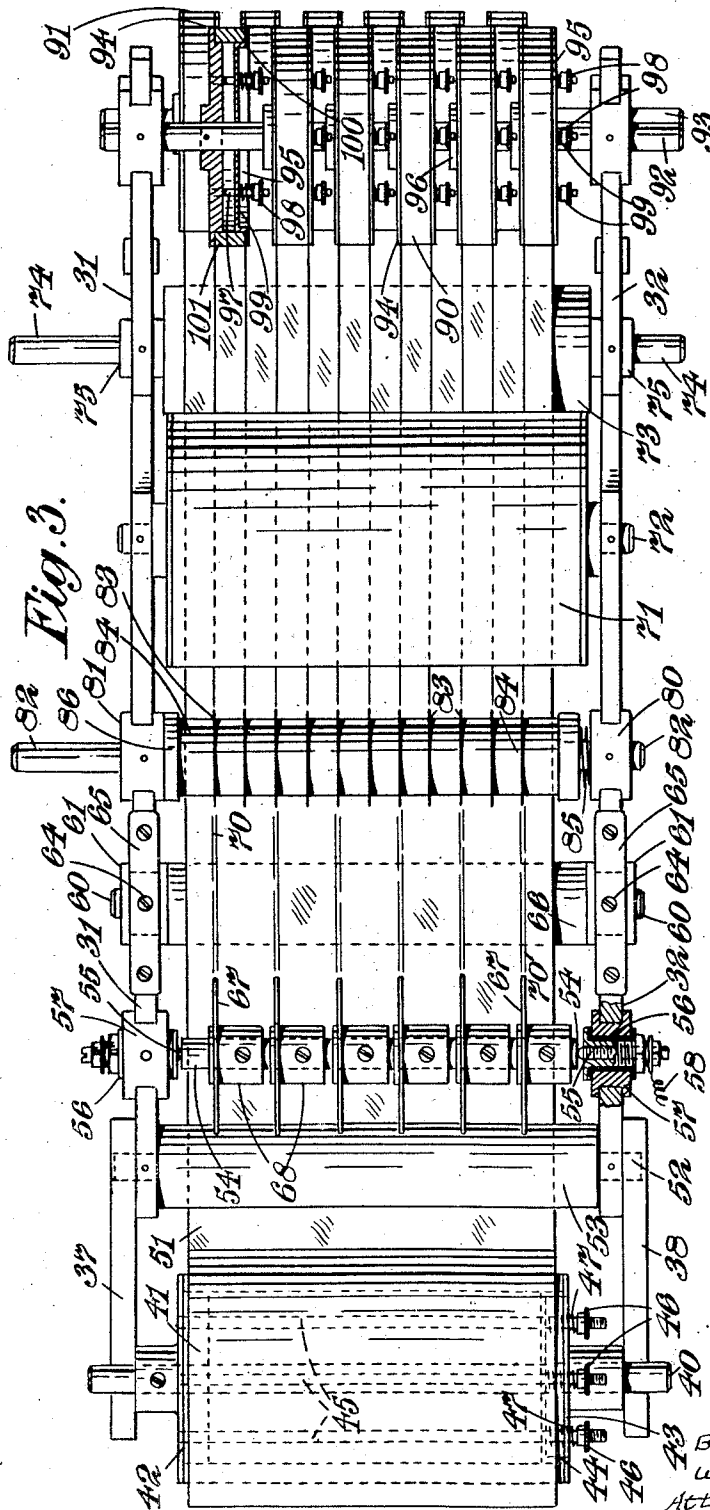
R. A. GROUSE

2,435,441

PROCESS FOR DEMETALLIZING METALLIZED PAPER

Filed Oct. 20, 1943

3 Sheets-Sheet 2



INVENTOR

Richard Alfred Grouse

B3

Watson, Colo, Grindle

Attorneys. T Watson

Feb. 3, 1948.

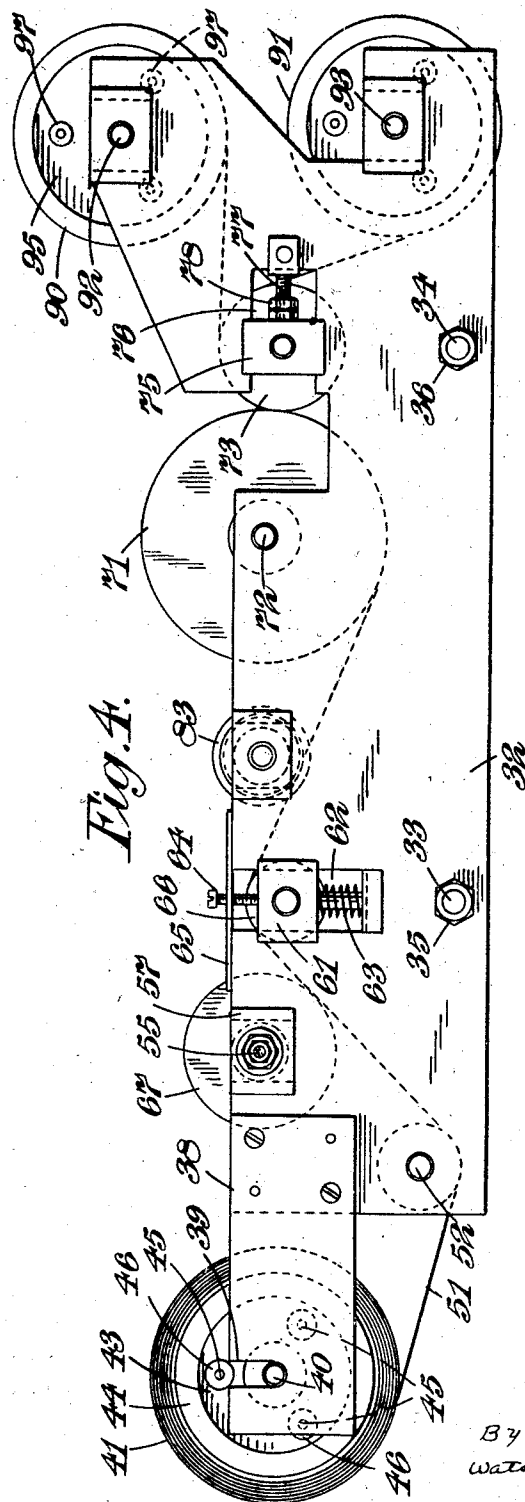
R. A. GROUSE

2,435,441

PROCESS FOR DEMETALLIZING METALLIZED PAPER

Filed Oct. 20, 1943

3 Sheets-Sheet 3



INVENTOR
Richard Alfred Grouse
By
Watson, Cole, Shindler & Watson
Attorneys

UNITED STATES PATENT OFFICE

2,435,441

PROCESS FOR DEMETALLIZING
METALLIZED PAPER

Richard Alfred Grouse, London, England, assign-
or to A. H. Hunt Limited, London, England, a
company of Great Britain

Application October 20, 1943, Serial No. 507,042
In Great Britain October 23, 1942

4 Claims. (Cl. 117-102)

1

This invention comprises improvements in or relating to processes for the treatment of metallized paper and the manufacture of electric condensers therefrom.

In metallized paper condensers the paper constitutes the dielectric and the metallized surface constitutes an electrode of the condenser; two strips of metallized paper can be wound together to constitute a condenser providing at least one margin on each of the strips is free of metal. It is necessary that the margin should be free of metal in order to ensure that there is no flash over or short circuit from one electrode to the other and the higher the voltage at which the condenser is to be used the wider must the margin be. However, in the interests of compactness the margin should be kept at a minimum value which is suitable for the working voltage at which the condenser is intended to be employed; this, of course, implies that the flash-over voltage will be substantially in excess of the working voltage, but not so much as to waste space by requiring an undue margin. For example, in the case of a condenser to work at 150 volts it is sufficient if the flash-over voltage is as much as 300 volts. For this purpose a margin no more than $\frac{1}{64}$ of an inch wide would be sufficient; but a margin of this degree of narrowness is difficult to provide by the ordinary means. Normally when the metal is deposited on the paper, the paper is masked in such a way as to leave the desired edge margin, but the masking cannot produce an extremely narrow edge margin.

It is an object of the present invention to provide metallized paper which is suitable for use in the manufacture of electric condensers and in which the unmetallized margins or bands are produced without masking the paper in the original operation of producing the metallized surface. Although in such condensers the provision of an unmetallized edge margin is the primary consideration, it sometimes occurs that it is desirable to employ paper in which there is an unmetallized band along the surface of the paper and not only along the margin. Moreover, in intermediate stages of manufacture of condensers, as for example described in patent applications Nos. 493,824 and 493,173, use may be made of metallized paper rolls having unmetallized bands which are slit along the unmetallized bands so as to produce strips of paper with unmetallized margins, and it is an object of this invention to produce such paper.

It is a further object of the invention to provide metallized paper electric condensers in which

2

the unmetallized portions of the paper employed are reduced to the narrowest satisfactory dimensions.

The invention comprises a process for producing metallized paper with an unmetallized strip portion or portions thereon characterised by first metallizing the paper and thereafter removing the metal from the strip or strips which it is desired should be unmetallized by bringing the material into contact with, and moving it past, an electrified conductor while maintaining the metallized area of the paper of opposite polarity to the conductor so that current from the conductor burns off the metal along the said strip.

In one form of the process the conductor is applied to the unmetallized side of the paper along one or both edges thereof so that the strip or strips from which the metal is removed consist of one or both edge margins of the paper close to the conductor. If both edge margins are thus demetallized and the paper is of the width of two of the strips eventually desired for the condenser, it can thereafter be slit so as to produce two strips each having along one edge an unmetallized margin and along the other edge having the metallized surface extending up to the edge. Such strips are of particular service in winding electric condensers because the edge which has not been demetallized is convenient for the making of electrical connection to a terminal, for example as described in patent application No. 493,173.

In another form of the process the conductor may consist of a narrow member of a width suitable to produce the desired unmetallized strip, applied to the paper on the metallized surface thereof. The paper in such a case may be a web of a width great enough to comprise the width of several unmetallized strips parallel to one another, and several conductors may be applied to the metallized surface simultaneously so as to produce such unmetallized strips.

The conductor or conductors may consist of a rotatable roller or rollers around which the paper is passed.

The process works best when the metallized surface is exceedingly thin and preferably the metallized paper employed is paper on which the metallized surface has been produced by condensation of metallic vapour thereon in vacuo as an extremely thin conducting layer, for example by the process described in U. S. patent specifications Nos. 2,100,045 and 2,153,786.

The invention includes a process of manufacture of electric condensers consisting in taking metallized paper, producing a demetallized strip

or strips thereon by means of steps as above described and thereafter winding two or more strips of such paper together into an electric condenser.

The invention further comprises apparatus for demetallising strips of metallised paper in which there is provided in combination means to support a feed-roll of metallised paper, a set of narrow demetallising rollers supported so that the metallised face of the paper can be fed past and in contact with them from the feed roll, means for connecting the set of demetallising rollers to the electric supply so that their potential is opposite to that of the metallised face of the paper and means to receive paper from the demetallising roller and rewind it.

A gang of slitting knives may be set to cut the paper, before it is re-wound, along the centres of the demetallised strips and also along lines extending along the metallised bands between the strips. In this way strips are obtained which are demetallised along one edge and along the other edge are metallised right up to the edge of the paper.

The following is a description, by way of example, of certain forms of apparatus and of the process as carried out therein.

Referring to the accompanying drawings,

Figure 1 is a diagrammatic perspective view of one form of apparatus;

Figure 2 is a detail illustrating the demetallisation of the edge margins of the paper shown in the diagram Figure 1;

Figure 3 is a plan of an alternative apparatus;

Figure 4 is a side elevation of the same.

Referring to Figure 1, 11 is a core on which is wound a feed roll 12 of paper which has been metallised on one face with an extremely thin conducting layer of aluminium or copper. The roll 12 on its core 11 is mounted on a shaft 13 which is supported in bearings not shown in the drawing. The paper is so wound on the roll 12 that the metallised face is the inner face 14 of the paper as it comes off the roll. From the roll 12 the paper is fed past a metallic roll 15 mounted on a suitably supported shaft 16 so that the roll 15 is in electrical contact with the metallised surface of the paper. The roll 15 is connected to the negative or earth terminal of an electric supply as indicated by the wire 17. Beyond the roll 15 the paper passes upwardly and over the upper surface of another electrical conducting roller 18 which is supported between insulated point bearings 19, 20. The insulated supports for the point bearings are not shown in the drawings and may be of any construction desired, the object being to enable the roller 18, which forms a conductor in contact with the unmetallised surface 21 of the paper, to be maintained (by a connection 22 to the positive terminal of an electric supply) at a substantial potential difference from that of the metallised surface of the paper which is connected to the roll 15.

The potential difference applied is at least as high as that which the condenser will eventually be called upon to bear under working conditions and preferably considerably higher so as to provide a margin of safety. For example, if the condenser is intended to work under a potential difference of 200 volts, the potential applied to the roller 18 may be of the order of 500 volts. The paper strip on the roll 12 is metallised right up to its edges, and owing to the thinness of the paper the result is that at the edges, as the strip reaches the conductor 18, there is a flash-over of current from the con-

ductor to the metallised surface of the paper. This flash-over burns back the metallised surface on the paper along the margin during the passage of the paper around the roll 18, producing two demetallised edge margins 23, 24 as shown in Figure 2. If the metallisation on the paper is sufficiently thin this burning back of the edge margins will take place without appreciably carbonising the paper itself. Thus, a demetallised edge margin of the minimum width which will withstand the potential difference applied, is automatically produced along each edge of the paper.

At the same time, any faults which may exist in the dielectric itself are automatically burned out, that is to say, the metallised surface is burned away around the fault during the passage of the paper over the conductor 18 in the manner described in patent application No. 493,173.

From the conducting roller 18, the paper strip, with its two demetallised edge margins is led past a rotating cutting knife 25 so as to be slit into two strips, each having one demetallised margin and one edge along which the metallised surface extends up to the edge. The strips are wound into a roll 26, on a core 27 mounted on a suitably driven shaft 28.

Thereafter the two rolls so produced can be used for winding into an electrical condenser in the manner described in the aforesaid application No. 493,173.

By the above process an edge margin can be produced which is extremely narrow, and, even for high voltages, as great as the paper is able to stand up to as a dielectric, may be less than $\frac{3}{64}$ of an inch.

Referring now to Figures 3 and 4, the apparatus shown comprises two side plates 31, 32 which extend parallel to one another and in conjunction with suitable spacing members 33, 34 and nuts 35, 36 constitute the frame of the apparatus. On the side plates 31, 32 at one end there are secured brackets 37, 38 having slots 39 to receive a spindle 40 which carries a feed roll 41 of metallised paper. The feed roll 41 is wound on a cardboard tube which is supported from the spindle 40 by means of flanged discs 42, 43. The flanged discs have a cylindrical portion which fits inside the cardboard tube and a flange 44 which abuts upon its ends. The two discs are drawn together by means of three bolts 45 which are equidistantly spaced around the spindle 40 and by knurl-headed nuts 46 upon the bolts. The knurl-headed nuts do not engage the disc 43 directly, but interposed between the nuts and the disc are springs 47. Thus the roll 41 is frictionally held with respect to the spindle 40 and the tension which can be applied to the paper web 51 from the roll 41 is limited to the force transmissible through the frictional connection. This tends to avoid tearing the paper web, which is very thin, being of the order of thickness of about one-half a thousandth of an inch. The thickness of the metallised layer upon the paper is considerably less, being less than one-fiftieth of a thousandth of an inch and the metallised layer is wound so as to face inwards on the roll and is, therefore, uppermost on the web 51 as it comes away from the roll.

Between the plates 31, 32 there is mounted at the end nearest the roll 41, a spindle 52 carrying a roller 53. This roller is made of conducting material, for example, brass, and is in electrical

connection with the frame of the machine, which is connected to earth. This ensures that the metallised surface of the paper is at earth potential.

Somewhat above and to the right of the spindle 52 there is another spindle 54 which is supported between point bearings provided by screws 55 mounted in an insulating bushing 56 in removable blocks 57 in the side plates 31, 32. The screws 55 are electrically connected, for example by means of a wire 58, to the positive or unearthed terminal of an electric supply having a voltage of between 500 and 600 volts, direct current. Beyond the spindle 54 and also supported between the side plates 31, 32 there is another spindle 60 supported in bearing bushes 61, each of which works in a vertical slot 62 in the side plate in which it is mounted. The bearing blocks 61 are supported on springs 63 so that they tend to rise and the amount of the rise is limited by means of an adjusting screw 64 in a cap plate 65. The spindle 60 carries a roller 66 over which the paper web 51 passes. By adjusting the screws 64, the exact path of the paper web may be adjusted within fine limits.

Upon the spindle 54 there are mounted a number of narrow disc-like conductors 67 by means of hubs 68 which fit the spindle 54. The diameter of the conducting discs 67 is such that they just touch the paper passing from the roller 53 to the roller 66 in the course of its path, and the adjustment provided by the screws 64 is intended to ensure that the discs 67 can engage the paper properly but without producing undue pressure upon it.

The width of the conductors 67 is made to correspond with the width of strips which it is desired should be demetallised upon the paper web 51, and the spacing of the discs corresponds to the desired spacing between the demetallised strips. It is found that as soon as the metallised surface of the paper touches the conductors 67 the flow of current at the point of contact is sufficient to burn off and volatilise the metallised surface of the paper, the width so demetallised being only slightly greater than the width of the operative edges of the discs 67. Consequently the paper, as it comes away from the discs 67, presents a metallised surface which is subdivided by unmetallised bands, shown in the drawing by chain lines 70.

Beyond the spring-supported roller 66 the paper web is caused to move downwardly beneath a large feed roller 71 supported on a spindle 72. The paper web passes beneath the feed roller 71 into a nip provided by a second feed roller 73 which is carried on a shaft 74 mounted in bearing blocks 75. The bearing blocks 75 work in horizontal slots 76 in the side plates 31, 32, and they are adjustable along the slots by means of a screw 77 provided with adjusting nuts 78. Thus the roller 73 can be pressed firmly against the roller 71 and grip the paper web securely. The shaft 74 is extended so as to provide a mounting for a driving pulley (not shown in the drawing) and by this means the paper is drawn through the machine at a suitable speed.

In the stretch of the web which extends from the roller 66 to the underside of the roller 71, a slitting operation is performed upon the paper. To this end there is mounted in bearings 80, 81 a driven shaft 82 (carrying a pulley, not shown). Upon the shaft 82 there is a gang of circular slitting knives 83 which are spaced apart by cylindrical spacing members 84. The knives 83 are so spaced as to slit the paper down the centre of

each of the demetallised strips 70 and also down the centre of each of the metallised areas between the strips. In order to ensure that no lateral movement of the slitting knives takes place the gang of knives is urged by a spring 85 toward the side plate 31. The spring 85 is located between the bearing block 80 in the side plate 32 and the end member of the spacing members 84. At the other end of the gang of knives a thrust washer 86 is caused, by the pressure of the spring 85, to bear on the bearing block 81. It will be appreciated that it is important that no lateral movement of the knives should occur as they rotate, otherwise the paper web may become torn. It will also be observed that the screws 55 which support the spindle 54 of the demetallising conductors 67 provide a means of adjustment so that the conductor 57 may be set exactly in line with the slitting knives 83. Furthermore, the mounting of the feed roll 41 on the spindle 40 is such that the feed roll is automatically held always in the same position relatively to the spindle, and, therefore, if the spindle 40 is lifted out and a fresh roll of paper substituted when the roll in use has become exhausted, the new roll will automatically come into the same position relatively to the demetallising conductors 67 and the slitting knives 83 as was the case with the previous roll. In this way exact repetition of results is maintained.

It will, therefore, be seen that the paper web 51, by the time it has passed the slitting knives 83, consists of a number of separate strips of paper, each of which is metallised up to one edge and demetallised along its other edge, the demetallised margin being equal to half the width of the demetallised strips 70. After passing the feed roller 73 the strips are separated from one another. Half of them have demetallised margins along their right-hand edges and the other half have demetallised margins along their left-hand edges. The former are led on to an upper series of re-winding rolls 90 and the latter on to a lower series of re-winding rolls 91. The rolls 90 are mounted on a driven spindle 92 and the rolls 91 on a driven spindle 93. These spindles project beyond the side plate 32 sufficiently to carry driving pulleys, and they are driven from a driving pulley (not shown) on the spindle 74. The fragility of the paper strips makes it necessary that the force applied to wind them on to the rolls 90 and 91 should be strictly limited. To this end each of the rolls 90 and 91 is supported between two discs 94, 95. The disc 94 has a hub 96 by which it is mounted on the spindle (92 or 93 as the case may be) and the disc 95 is supported from the disc 94 by means of three equidistantly spaced bolts 97 carrying knurled nuts 98 between which and the disc 95 there are interposed springs 99. The cores of the re-winding rolls 90 consist of short cylindrical lengths 101 of cardboard tube or other suitable material which are gripped between the discs 94, 95 and are centred by inwardly projecting flanges 100 on these discs. Therefore, the driving force which can be applied to the cores of the re-winding rolls is limited to the force afforded by the frictional grip and this can be adjusted so as to be as light as desired by means of the nuts 98. In order to attach the ends of the paper strips 71 to the cores 101 it is sufficient to stick them in place with a dab of petroleum jelly or like material.

Once a web of paper has been passed through the various parts of this apparatus and its ends appropriately attached to the re-winding rolls 90, 91, the rest of the paper can be quickly and

automatically demetallized along the strip 70, cut by the cutting knives 85, and re-wound as a series of alternate right-handed and left-handed strips without necessitating undue attention on the part of the operator. From the rolls 90 and 91 the paper can then subsequently be re-wound into a condenser as described, for example, in patent application No. 493,173.

It will be appreciated that if for any purpose the strips of paper are required to be produced with demetallized bands running down their centre or in other positions removed from the edges, this can be arranged with apparatus of the kind illustrated in Figures 3 and 4 by appropriately spacing the discs 87 and omitting the appropriate knives from the gang on the spindle 82. Of course, the re-winding rolls 90, 91 need to be arranged so as to be of appropriate breadth to receive the strips thus produced.

I claim:

1. The method of demetallizing a selected area of that surface of a strip of very thin paper upon which there has been previously deposited an extremely thin layer of metal, which comprises continuously maintaining in direct contact with the exposed surface of such metal layer two spaced electrical conductors of opposite polarity one of which makes direct electrical contact with a relatively small area of said surface and the other of which makes direct electrical contact with a larger area of that surface, passing sufficient current through said conductors and metal layer to cause the density of the current passing directly between the conductor of smaller contacting area and the metal layer to be sufficiently high to cause volatilization of the metal directly contacted by said last mentioned conductor, and, while maintaining the current flow, continuously advancing the strip so as to continuously bring fresh areas thereof into contact with said conductors, the speed of advancement being such that volatilization of the metal at the point of contact between the strip and the conductor of smaller strip conducting area proceeds uninterruptedly and an unbroken elongated demetallized area is created.

2. The method of demetallizing a selected area of that surface of a strip of very thin paper upon which there has been previously deposited an extremely thin layer of metal, such metal layer being approximately .00004 inch in thickness but having satisfactory conducting properties, which comprises continuously maintaining in direct contact with the exposed surface of such metal layer two spaced electrical conductors of opposite polarity one of which makes direct electrical contact with a relatively small area of said surface and the other of which makes direct electrical contact with a larger area of that surface, passing sufficient current through said conductors and metal layer to cause the density of the current passing directly between the conductor of smaller contacting area and the metal layer to be sufficiently high to cause volatilization of the metal directly contacted by said last mentioned conductor, and, while maintaining the current flow, continuously advancing the strip so as to continuously bring fresh areas thereof into contact with said conductors, the speed of advancement being such that volatilization of the metal at the point of contact between the strip and the conductor of smaller strip conducting area proceeds

uninterruptedly and an unbroken elongated demetallized area is created.

3. The method of demetallizing a selected area of that surface of a strip of very thin paper upon which there has been previously deposited an extremely thin layer of aluminum, which comprises continuously maintaining in direct contact with the exposed surface of such aluminum layer two spaced electrical conductors of opposite polarity one of which makes direct electrical contact with a relatively small area of said surface and the other of which makes direct electrical contact with a larger area of that surface, passing sufficient current through said conductors and aluminum layer to cause the density of the current passing directly between the conductor of smaller contacting area and the aluminum layer to be sufficiently high to cause volatilization of the aluminum directly contacted by said last mentioned conductor, and, while maintaining the current flow, continuously advancing the strip so as to continuously bring fresh areas thereof into contact with said conductors, the speed of advancement being such that volatilization of the aluminum at the point of contact between the strip and the conductor of smaller strip conducting area proceeds uninterruptedly and an unbroken elongated demetallized area is created.

4. The method of demetallizing a selected area of that surface of a strip of very thin paper upon which there has been previously deposited an extremely thin layer of aluminum, such aluminum layer being approximately .00004 inch in thickness but having satisfactory conducting properties, which comprises continuously maintaining in direct contact with the exposed surface of such aluminum layer two spaced electrical conductors of opposite polarity one of which makes direct electrical contact with a relatively small area of said surface and the other of which makes direct electrical contact with a larger area of that surface, passing sufficient current through said conductors and aluminum layer to cause the density of the current passing directly between the conductor of smaller contacting area and the aluminum layer to be sufficiently high to cause volatilization of the aluminum directly contacted by said last mentioned conductor and, while maintaining the current flow, continuously advancing the strip so as to continuously bring fresh areas thereof into contact with said conductors, the speed of advancement being such that volatilization of the aluminum at the point of contact between the strip and the conductor of smaller strip conducting area proceeds uninterruptedly and an unbroken elongated demetallized area is created.

RICHARD ALFRED GROUSE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
758,923	Knowlton	May 3, 1904
920,970	Mansbridge	May 11, 1909
1,154,301	Fogarty	Sept. 21, 1915
1,276,731	Crowell	Aug. 27, 1918
1,909,079	Steerup	May 16, 1933
2,248,057	Bond	July 8, 1941
2,310,071	Frisch	Feb. 2, 1943