April 24, 1951 R. A. GROUSE 2,549,966

APPARATUS FOR THE MANUFACTURE OF METALIZED PAPER FOR ELECTRIC CONDENSERS

Filed June 26, 1946 3 Sheets-Sheet 1

Fig. 1.

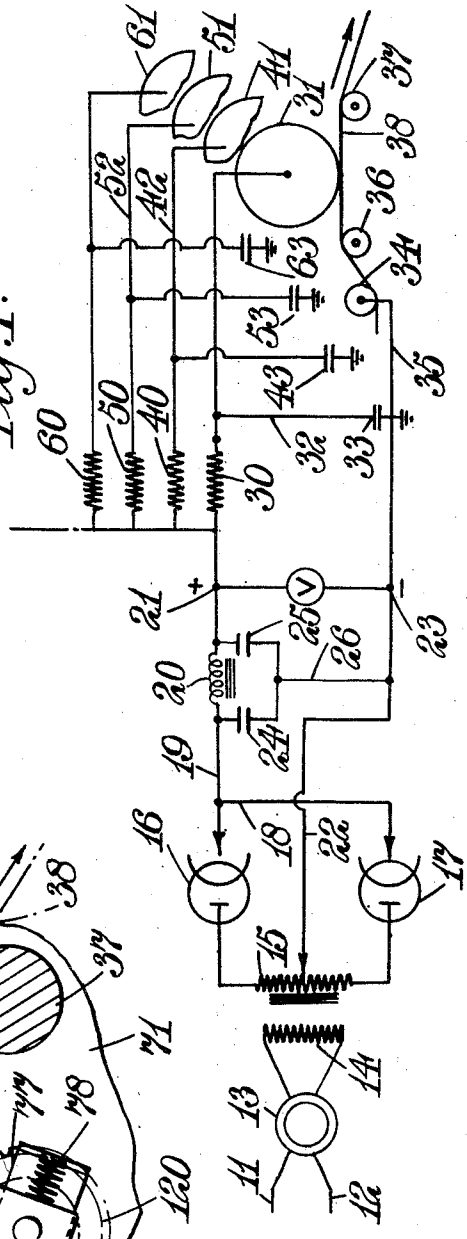

Fig. 4.

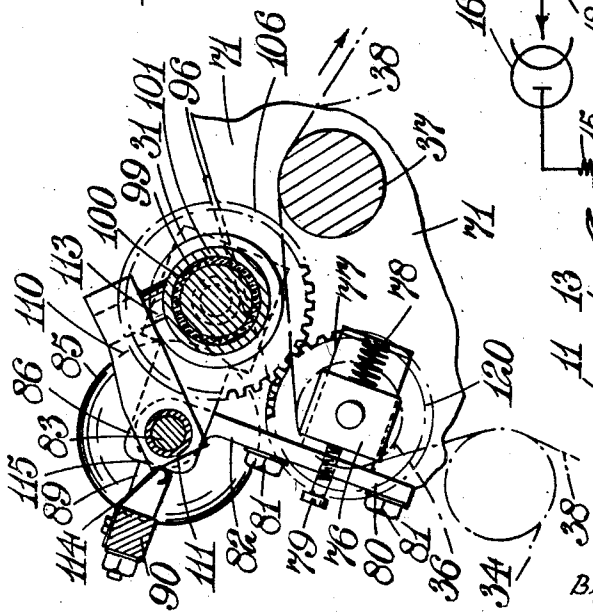

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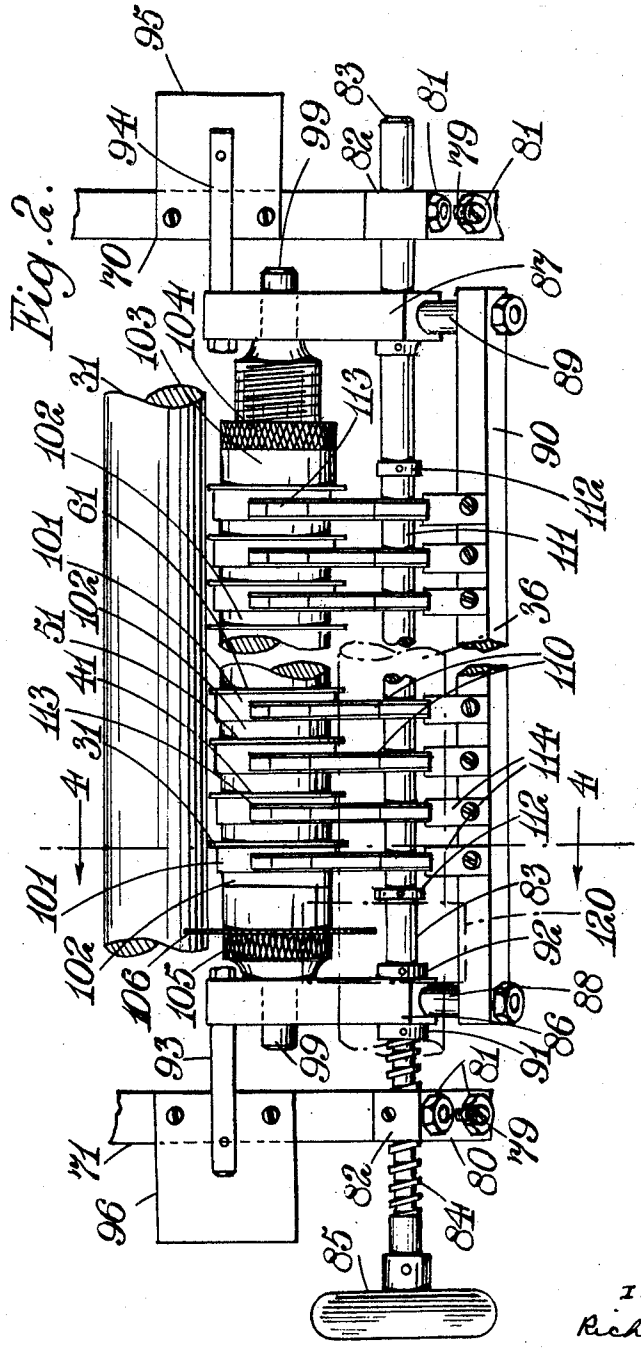
Fig. 2.



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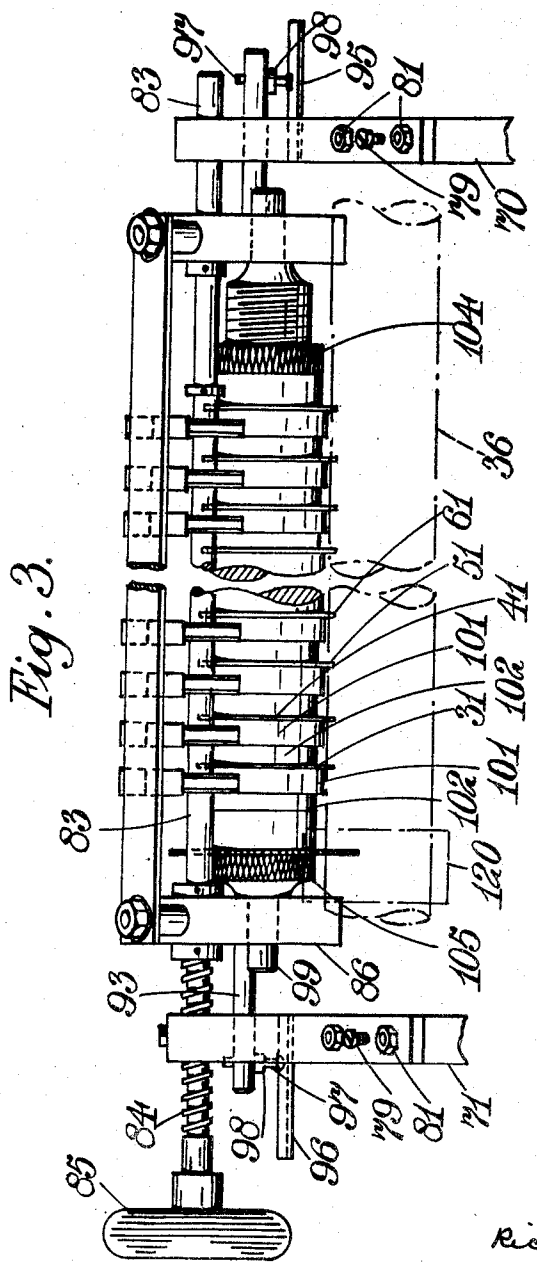
Filed June 26, 1946 3 Sheets-Sheet 3

Fig. 3.



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UNITED STATES PATENT OFFICE

2,549,966

APPARATUS FOR THE MANUFACTURE OF METALIZED PAPER FOR ELECTRIC CONDENSERS

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7 Claims. (Cl. 219—19)

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This invention comprises improvements in or relating to apparatus for the manufacture of metallised sheet dielectric for electric condensers. The invention has for its object to provide an improvement in the apparatus described in the specification of prior United States Patent No. 2,435,441.

The invention is applied to that type of apparatus which comprises in combination means to support a feed roll of metallised paper, a demetallising contact or contacts (preferably in the form of a rotatable disc or discs) supported so that the metallised face of the paper can be fed past and in contact with it or them as the band of paper passes from the feed roll, another conductor or other conductors, preferably in the form of a roller or rollers also engaged with the metallised face of the paper band and an electric supply circuit electrically connected through a current limiting resistance respectively with the demetallising contact or contacts and with the other conductor or conductors in such manner that there will be a potential difference between the demetallising contact or contacts and the metallised face of the paper. In such a case a demetallising discharge occurs between the contact and the metallised surface of the dielectric with which it is engaged.

The purpose of such a circuit is to ensure that immediately on engagement between the metallised surface and contact engaging it there shall be a momentary current discharge through the metallised surface sufficient to remove the metal by volatilisation for a given width on each side and a given distance ahead of the contact. The current thereafter will momentarily cease and the capacitor discharged during the momentary demetallising will become again recharged pending the arrival of the metallised surface again into engagement with the contact. Thereupon the next momentary discharge occurs followed by a recharging and this operation continues successively in rapid alternation as the metallised dielectric band is traversed past and in engagement with the demetallising contact. It is found that under these conditions the speed of demetallisation can be markedly increased compared with that obtainable without the said capacitor.

In practice the alternation above mentioned is so rapid that in appearance a continuous demetallising action occurs; but by selection of the respective values of the resistance and capacity a very accurate control of the demetallising effect is obtainable.

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Preferably there are provided a series of demetallising contacts insulated from the said conductor and from one another and engaging the same face of the dielectric as that engaged by the conductor, a direct current electric supply connected as to one pole to the said demetallising contacts through a series of current-limiting resistances in parallel with one another and in series with the demetallising contacts, and a series of branch circuits, one to each resistance, each containing a capacitance and each connected from a point of the circuit lying between its resistance and a demetallising contact on the one hand, and the other pole of the supply on the other hand. By cutting out any particular set or sets of resistances and capacities, demetallising in the area controlled by that particular contact will be eliminated and consequently the distance between the demetallised strips running along the paper can be varied by putting into or out of circuit any desired contact or set of contacts.

The accompanying drawings show by way of example one embodiment of the invention. In the drawings:

Figure 1 is a connection diagram,

Figure 2 is a plan of a portion of a machine showing the demetallising contacts,

Figure 3 is an elevation of the same, and

Figure 4 is a section upon the line 4—4 of Figure 2 looking in the direction of the arrows.

Referring to Figure 1, alternating electric current supply lines 11, 12 are connected through a variable auto-transformer 13 to the primary winding 14 of a transformer. The transformer has a secondary winding 15 the ends of which are connected to the plates of two rectifying valves 16, 17. The direct current output of the valves is connected by lines 18, 19 through a choke 20 to the positive terminal 21 of the direct current demetallising circuit. The mid-point of the transformer winding 15 is connected by a line 22 to the negative or earthed terminal 23 of the circuit. Two capacitors 24, 25 are connected across the terminals of the choke 20 and the mid point between the capacitors 24, 25 is connected by a line 26 to the earthed side of the circuit. The purpose of the choke and capacitors is to smooth the direct current output of the valves. From the positive terminal 21 a connection is taken through a current limiting resistance 30 to a demetallising roller 31. In parallel with the demetallising roller there is a connection 32 to a capacitor 33 the other terminal of which is connected to the earthed side of the circuit. Metal-

lised paper is fed with its metallised face upwards beneath a roller 34 which is connected to the earthed side of the supply circuit by a line 35, over a supporting roller 36 and past the demetallising roller 31 to another supporting roller 37, the paper being thence led away for further treatment.

It is found that if suitable values are given to the resistance 30 and capacitor 33 the demetallising roller 31 will, when brought in contact with the metallised face of the paper, start an intermittent electrical discharge which effectively demetallises the paper along the line which is touched by the demetallising roller 31 and that the speed of progress of the paper through the apparatus with effective demetallisation can be much higher than would be the case if the capacitor 33 were omitted, assuming that the resistance 30 is adjusted to the best value for cooperation with the capacitor and the demetallising roller. Another demetallising roller 41 is supplied through a line 42 and resistance 40, and is connected in parallel with a capacitor 43, the demetallising roller 41 pressing upon the paper along a line parallel to and spaced from that produced by the roller 31. Similarly along another line there is another demetallising roller 51 supplied by a line 52 from a resistance 50 and in parallel with a capacitor 53 and a fourth and other similar rollers 61 can be added, each associated with a resistance such as 60 and a capacitor such as 63, up to any desired practicable number.

In a specific instance paper having a thickness of eight microns and a metallised deposit of aluminium on one face thereof having a thickness of approximately 80 millimicrons was satisfactorily demetallised, using a direct current voltage between the terminals 21 and 23 of 500 volts, the resistances 30, 34, 50 and so on each having a value of 3,000 ohms and the capacitors 33, 43, 53 and so on each having a capacity of 0.003 microfarad. The speed of passage of the paper over the supporting rollers 36, 37 past the demetallising rollers was in this case 57 feet per minute, which is much higher than can be employed with the apparatus according to the aforesaid prior United States Patent No. 2,435,441 in which no condensers were embodied. In this instance the demetallising rollers 31, 41 and so on had a width at their edge of about $1/16''$.

Referring now to Figures 2, 3 and 4, these show the mechanical arrangement for the support of the demetallising rollers in relation to the paper. The apparatus is intended to be used as an addition to a machine in which a web of paper 38 after being fed past the demetallising rollers is led past a gang of slitting knives which cut it into strips along lines which extend through the middle of the demetallised bands produced and also through the middle of the unmetallised bands, so that each strip has a metallised surface which extends up to one edge but is separated from the other edge by a narrow unmetallised band of paper as described in the aforesaid Patent 2,435,441.

The various rollers over which the paper passes in the machine are supported in bearings in side frames 70, 71 and the rollers include the rollers 34, 36, 37 already referred to in connection with Figure 1. In Figures 2 and 4 the roller 36 is shown in chain lines only so as not to interfere with the view of other parts and the roller 37 in full lines. In Figure 3 the roller 37 has been omitted. The roller 36 has pivots at its ends which enter sliding bearing blocks 76 mounted in slots 77 in the side plates 70, 71, the blocks 76 being supported by springs 78 and held in position by adjusting screws 79. The slot 77 is closed over the top by a cap 80 held down by set screws 81 and the cap 80 is prolonged to form a bracket 82 which supports a spindle 83. At one side of the machine the spindle 83 is screwthreaded as shown at 84 and the bracket 82 receives the screwthread. Beyond the screwthread the spindle carries a hand wheel 85. This arrangement enables the spindle to be adjusted endwise relatively to the brackets 82. Upon the spindle 83 there is mounted a frame which consists of two pivoted arms 86, 87, free to turn upon the spindle and carrying posts 88, 89 which are firmly united by a cross bar 90. The frame is prevented from moving endwise on the spindle 83 by collars 91, 92 but it is free to cant about the spindle so that it can be rocked up from the position shown in the drawing into the position in which the arms 86, 87 are upright. At the ends of the arms 86, 87 are laterally projecting bars 93, 94 which overlie plates 95, 96 secured on the upper edge of the side members 70, 71 of the frame of the machine. Adjusting screws 97 pass through the bars 93 and are fastened in adjusted position by lock nuts 98. In the position shown in the drawing the heads of the screws 97 are upside down and rest upon the plates 95, 96. The plates 95, 96 are made large enough to ensure that in all positions of adjustment of the spindle 83 the heads of the screws 97 will be able to engage the plates 95, 96.

The arms 86, 87 afford bearings for the ends of a spindle 99 which carries the demetallising rollers 31, 41, 51, 61 and so forth. The spindle is surrounded by an insulating sleeve 100 over which the demetallising rollers 31 to 61 are threaded and also threaded on the insulating sleeve are slip rings 101 of metal which abut at one side against the demetallising rollers but are of smaller diameter. Between the other side of each slip ring and the next demetallising roller is an insulating ring 102. The assembly of demetallising rollers, slip rings and insulating rings is all pressed together by nuts 104, 105 screwed on the ends of the spindle 99 and at one end there is inserted on the spindle a gear wheel 106 by which the spindle may be driven. The nuts 104, 105 are made with knurled outer surfaces so that they can readily be loosened by the operator when desired and by substituting different insulating spacers 102 of different width from those shown in the drawing the spacing between the demetallising rollers 31, 41 and so on can be varied to suit the work in hand.

Upon the spindle 83 there are mounted a number of brush rocker arms 110 which are free to rotate about the spindle and are spaced from one another by spacing sleeves 111 threaded on the spindle and held in place at the ends by collars 112. Each rocker arm carries a brush 113 to bear upon one of the slip rings 101 and the rocker arms are yieldingly urged towards the slip rings by springs 114 secured by screws to the bar 90. The springs 114 bear on a corner 115 of the rear end of the brush rockers 110 and if desired any brush rocker can be lifted out of contact with its slip ring and rotated rearwardly through 90°, in which case the corner 115 will snap past the spring 114 and the rocker will in that case be held up out of contact with the slip ring. Thus the operator can rapidly select which of the demetallising rollers 31, 41 and so on shall be connected to the electric supply by the brush rockers

in the manner just described. The bar **90** is made of insulating material and the electrical connections to each brush rocker are carried to it through the springs **114**. Conveniently the condensers **43**, **53**, **63** and the resistances **30**, **40**, **50** and so on already referred to can also be mounted on the insulating bar **90** and thus a convenient and compact assembly of these parts is provided. The resistances and condensers are not however shown in the drawing. It should be explained that the spacing sleeves **111** are likewise made of insulating material and the brush rockers **110** have insulating bushings which insulate them from the spindle **83**.

The roller **36** is provided with a gear wheel **120** to mesh with the gear wheel **106** on the spindle **99** so that the demetallising rollers may be driven at a suitable speed corresponding to the speed of the roller **36**. If the frame comprising the side levers **86** on which the demetallising rollers are carried is lifted by the operator the gear wheel **106** will automatically be unmeshed from the gear wheel **120** but it will drop into mesh again when the frame is returned to the position shown in the drawing. The path of the paper **38** is shown in Figure 4 of the drawing, the metallised surface coming in contact with the roller **34** and thence passing over the roller **36** and under the rollers **31**, **41** and so forth and away over the roller **37**. The screws **97** are adjusted so that the demetallising rollers just touch the surface of the paper with requisite pressure and the gear wheel **106** meshes satisfactorily with the gear wheel **120**. Further adjustment is provided by the screws **79**. In operation the operator usually has to lift the demetallising rollers away from the paper momentarily in order to permit the condensers **33**, **43** and so forth to become charged. On allowing the frame **86**, **87** to return so that the demetallising rollers touch the paper demetallisation will immediately commence and will proceed as hereinbefore described.

The reason why the demetallising rollers are mounted on a rocking frame so that they can collectively be lifted off the paper is that if they are in contact with the metallised surface of the paper before the current is turned on the condenser is short-circuited by the metallised surface of the paper and cannot become charged. The current passed by the resistance alone under these conditions, when it is of the high value stated above as an example, is not sufficient by itself, without aid from the condenser, to start the discharge which effects demetallisation. On the other hand if (as in the case of the said prior patent) no condenser is provided or reliance is placed only on the natural capacity of the leads, the resistance would have to be less than in the case of the present invention and then the discharge would extend further from the discs and so produce a less exact and smooth line of demetallisation on the paper.

It will be appreciated that the actual figures of resistance and capacity in any particular case will depend on the thickness of the metallised layer and the speed of passage of the papers. The above figures are given for the case of paper which has been metallised by deposition from vapour form in vacuo which produces a layer of aluminium of a thickness of about 80 to 90 millimicrons. A simple practical trial in any other particular case will serve to determine the best values of resistance and capacity but the present invention will not operate satisfactorily on metal layers of great thickness, such as metal foil.

I claim:

1. Apparatus for the production of sheet dielectric partially metallised on one face, comprising in combination a dielectric feed-roll, means to guide dielectric from the feed-roll in a predetermined path, a conductor which engages one face of the dielectric in said path, a demetallising contact insulated from the conductor and engaging the same face of the dielectric as that engaged by the conductor, a direct current electric supply connected as to one pole to the said conductor and as to the other pole to the demetallising contact through a current limiting resistance, a branch circuit from the line connecting the demetallising contact and the resistance to the other pole of the circuit, said branch containing a capacitance, the value of the resistance being adequate to extinguish a demetallising discharge between the demetallising contact and the dielectric promptly after its initiation and the capacitance being adequate to store sufficient energy to start a fresh discharge upon contact being resumed between the demetallising contact and a metallised surface on the dielectric.

2. Apparatus for the production of sheet dielectric partially metallised on one face, comprising in combination a dielectric feed-roll, means to guide dielectric from the feed-roll in a predetermined path, a conductor which engages one face of the dielectric in said path, a series of demetallising contacts insulated from the said conductor and from one another and engaging the same face of the dielectric as that engaged by the conductor, a direct current electric supply connected as to one pole to the said demetallising contacts through a series of current-limiting resistances in parallel with one another and in series with the demetallising contacts, a series of branch circuits, one to each resistance, each containing a capacitance and each connected from a point of the circuit lying between its resistance and a demetallising contact on the one hand, and the other pole of the supply on the other hand, the value of each resistance being sufficient to extinguish a demetallising discharge between a demetallising contact and the dielectric promptly after its initiation and the value of each capacitance being adequate to store sufficient energy to start a fresh discharge upon the corresponding demetallising contact resuming contact with the metallised surface of the dielectric.

3. Apparatus as claimed in claim 2 wherein means are provided for collectively lifting the demetallising contacts from the metallised surface of the paper for the purpose described.

4. Apparatus as claimed in claim 2 wherein the demetallising contacts consist of a series of narrow-faced rollers insulated from one another and mounted on a spindle common to them all, each roller being associated with a slip ring for the supply of current and wherein a number of contact brushes bear upon the slip rings and serve to supply demetallising current thereto.

5. Apparatus as claimed in claim 2 wherein the demetallising contacts consist of a series of narrow-faced rollers insulated from one another and mounted on a spindle common to them all, each roller associated with a slip ring for the supply of current, wherein a number of contact brushes bear upon the slip rings and serve to supply demetallising current thereto, and wherein means are provided for permitting any one or

more of the contact brushes to be lifted from its slip ring for the purpose described.

6. Apparatus as claimed in claim 2 wherein the demetallising contacts consist of a series of narrow-faced rollers insulated from one another and mounted on a spindle common to them all, each roller being associated with a slip ring for the supply of current and wherein a number of contact brushes bear upon the slip rings and serve to supply demetallising current thereto and a rocking frame on which is mounted the spindle which carries the demetallising rollers, which frame carries also the brushes so that the frame and brushes can be swung away from the paper which is to be demetallised whenever desired.

7. Apparatus as claimed in claim 2 wherein the demetallising contacts consist of a series of narrow-faced rollers insulated from one another and mounted on a spindle common to them all, each roller being associated with a slip ring for the supply of current and wherein a number of contact brushes bear upon the slip rings and serve to supply demetallising current thereto, a rocking frame on which is mounted the spindle which carries the demetallising rollers, which frame carries also the brushes so that the frame and brushes can be swung away from the paper which is to be demetallised whenever desired and adjustable means for urging the rocking frame in the direction to cause the demetallising rollers to press on the paper.

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