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APPARATUS FOR PRODUCING PRINTED WIRING BY METAL VAPORIZATION

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FIG. 1

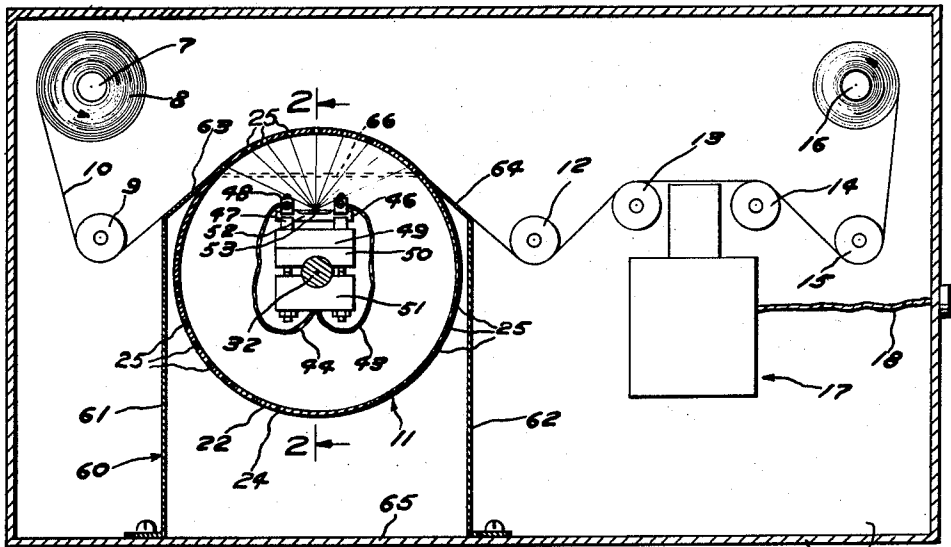


FIG. 2

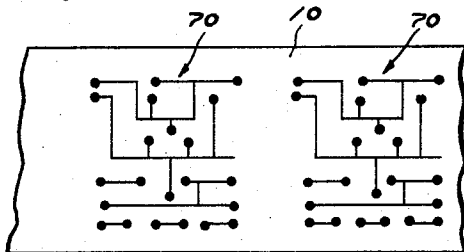
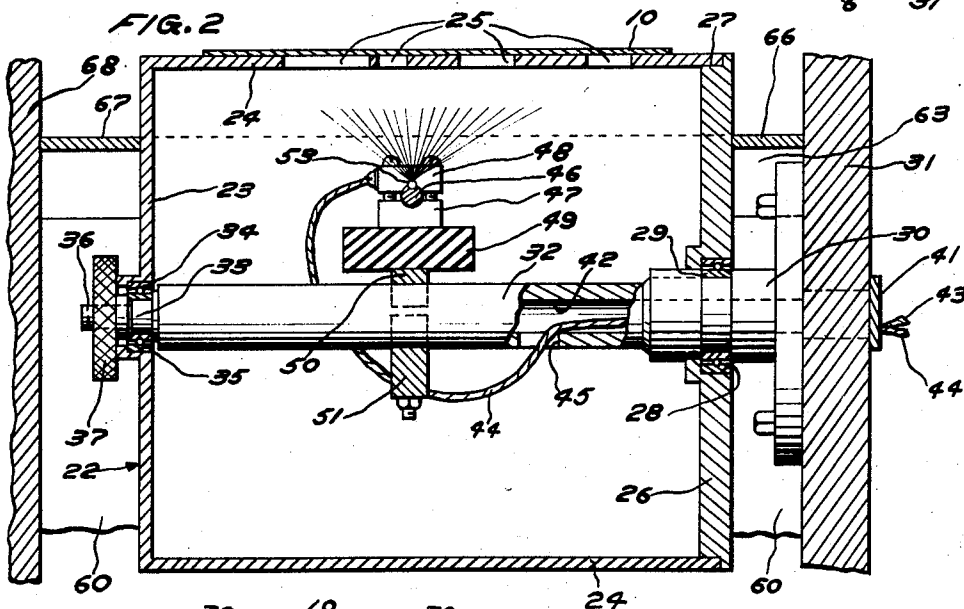


FIG. 3

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APPARATUS FOR PRODUCING PRINTED WIRING BY METAL VAPORIZATION

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4 Claims. (Cl. 118—49)

This invention relates to printed wiring and more particularly to apparatus for rapidly producing printed wiring for electrical apparatus.

It is an object of the present invention to provide apparatus for rapidly producing printed wiring.

Another object is to provide apparatus for economically and expeditiously producing such products by metal vaporization.

The objects may be achieved by utilizing an apparatus which may include means for continuously advancing a web of insulating material in a path which engages the web with and causes rotation of a continuously moving pattern-defining element. Vaporized metal is directed through the pattern-defining element by a metal vaporizer. The vaporizer, web advancing means and pattern-defining element are all enclosed in an evacuated chamber, whereby when the vaporized metal is directed through the pattern-defining element a pattern of metal will be applied to the web which conforms to the pattern of said element.

A clear understanding of the invention may be had by reference to the following detailed description, when considered with the accompanying drawing, in which:

Fig. 1 is an elevational view of an evacuated chamber with the front wall thereof removed;

Fig. 2 is an enlarged, fragmentary, transverse sectional view taken along the line 2—2 of Fig. 1 in the direction of the arrows, showing the details of the pattern-defining element, and

Fig. 3 is a fragmentary view of a web on which metal has been deposited in a pattern conforming to the pattern of the pattern-defining element.

Referring now to the drawing wherein like reference characters designate the same parts throughout the several views, there is illustrated an evacuated chamber 6, in which there is mounted an arbor 7 for supporting a supply 8 of insulating material in web form. The web of insulating material 10 withdrawn from the supply 8 passes under a guide roller 9 and then over a pattern-defining element, designated generally by the numeral 11. After passing over the pattern-defining element 11, the web passes under a guide roller 12, over guide rollers 13 and 14, under a guide roller 15 and thence to take up arbor 16. A vaporizer, designated generally by the numeral 17, is located adjacent to the traveling web 10 at a point between the guide rollers 13 and 14, and is supplied with heating current through cable 18 connected to a power source (not shown). The arbors 7 and 16, guide rollers 9, 12, 13, 14 and 15, and vaporizer 17 are mounted on a back wall 31 of the chamber 6. The arbor 16 is driven and the arbor 7 is retarded by suitable mechanisms (not shown) to advance the web 10 under tension.

The pattern-defining element 11 comprises a drum 22 having an outer end wall 23 permanently attached to a cylindrical wall 24. The cylindrical wall 24 has a series of cut outs 25 therethrough, which may be of any desired configuration to define a pattern. The outer end

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wall 23 is sealed to the cylindrical wall 24 to, in effect, form a cup-shaped body, which may be attached to an inner end wall 26. The cylindrical wall 24 is so proportioned that it will nest in an annular notch 27 formed adjacent to the periphery of the inner end wall 26. The inner end wall 26 has a central aperture 28 in which there is mounted an anti-friction bearing 29, whereby the inner wall is mounted for rotation on a hollow bearing member 30 suitably mounted upon the back wall 31 of the evacuated chamber 6. The bearing member 30 has fixed to it a stationary shaft 32, a reduced portion 33 of which carries an anti-friction bearing 34 that extends into a central aperture 35 in the outer end wall 23 of the drum 22. A still further reduced portion 36 of the shaft 32 is threaded to receive a knurled thumb knob 37 whereby the unitary structure comprising the end wall 23 and the cylindrical wall 24 may readily be mounted upon or removed from the inner end wall 26.

The shaft 32 has a central passage 42 formed throughout a part of its length. This passage 42 is formed to receive a pair of insulated conductors 43 and 44, which may be connected to any suitable power source. The conductors 43 and 44 extend through an air tight seal 41, into the passage 42 and out of the passage 42 through an aperture 45 to supply current to a carbon electrode 46. The carbon electrode 46 is mounted on suitable terminal blocks 47 and is clamped in place thereon by clamping plates 48. The terminal blocks 47 are mounted upon an insulator 49 which is in turn clamped onto the shaft 32 by suitably contoured clamp members 50 and 51. Formed in the carbon electrode 46 is a groove or pocket 52 in which there may be placed a pellet 53 of silver, which will be vaporized when the carbon electrode 46 has current supplied to it. This vapor will be directed upwardly and through the cut outs 25 in the cylindrical wall of the drum and onto the web 10 of insulating material passing over the drum.

In order to prevent the vaporized silver from passing out through apertures or cut outs 25 in the drum 22 which are not in engagement with the web of insulating material, a shield 60 is provided which encloses all of the drum 22 except that portion thereof in engagement with the web 10. The shield 60 comprises side plates 61 and 62 having inclined portions 63 and 64 which extend into tangential sliding contact with the outer surface of the cylindrical wall 24 of the drum 22. At their lower ends the side plates 61 and 62 are attached to the bottom 65 of the chamber 6 so that the bottom 65 of the chamber 6 also serves as the bottom of the shield 60. In addition to the side plates 61 and 62, the shield 60 includes top plates 66 and 67. Top plate 66 is fixed to the back wall 31 of the chamber 6 and slidably engages the outer surface of end wall 26 of the drum 22. Top plate 66 is also formed integrally with or otherwise sealed to the upper ends of inclined portions 63 and 64.

At the rear of the chamber 6 the side plates 61 and 62 are sealed to the back wall 31 which thus serves as the back wall of the shield 60. At the front of the chamber 6, top plate 67 is fixed to a removable front wall 68 of the chamber 6 and slidably engages the outer end wall 23 of drum 22. The top plate 67 also is removably sealed to the upper edge of inclined portions 63 and 64 in any suitable manner whereby, when the front wall 68 is removed, the top plate 67 will be removed with it to permit the end wall 23 and cylindrical wall 24 of the drum 22 to be removed from the evacuated chamber 6 as a unit. This permits the mounting of drums 22 having different arrangements of slots or cut outs 25 in them.

If the deposit of silver applied to the web of insulating material through the cut outs in the drum 22 is not heavy enough to conduct the currents to be applied to the cir-

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cuit for which the wiring is being prepared, the vaporizer 17 may be used. This vaporizer may be of the type known in the art of manufacturing condensers, which will heat zinc or other metals such as aluminum or cadmium to a temperature sufficiently high so that it will vaporize in the evacuated chamber. It is known that webs of insulating materials such as the web 10 which have a pattern of a very light coating of silver applied to them, when passed over a pool of molten zinc at a temperature such that the zinc will vaporize, will cause the zinc to adhere to the web 10 only in those areas which have been vaporized with silver. Thus, in the apparatus as shown in Fig. 1, suitable printed wiring will be applied on a very thin layer of insulating material which may be a paper base on which a coating of lacquer has been applied. In the event that relatively high currents are to be carried by the printed wiring, the web 10 with the silver and zinc deposited upon it in a pattern conforming to the pattern of the drum 22 may have a further and heavier layer of metal applied on the pattern by electrolytic deposition of suitable metals on the pattern.

In practising the invention a pellet 53 of silver is placed in the groove 52 of the electrode 46 and then the cup-shaped body comprising the outer end wall 23 and cylindrical wall 24 is mounted on the inner end wall 26. The unitary structure of the outer end wall 23 and cylindrical wall 24 is held in place by threading the thumb nut 37 onto the portion 36 of the shaft 32. If it is assumed that a large number of printed circuits such as that illustrated at 70 (Fig. 3) are to be printed, the cut outs 25 in the cylindrical wall 24 of the drum 22 will conform to the pattern 70. It will be noted from an inspection of Fig. 3 that the circuit paths are elongated and intersect. In order to product such circuit paths, the drum is provided with elongated (see Fig. 2) intersecting slots extending through the periphery thereof. Drums 22 having different patterns may be substituted for the one illustrated to provide circuit arrangements of any desired design.

After the drum 22 has been assembled and locked in place by the thumb nut 37, a supply of zinc having been put in the vaporizer 17, a supply of insulating material 8 in web form may be positioned on the arbor 7. The insulating material preferably comprises the web 10 made of paper on which there has been applied a coating of lacquer that serves to seal any porosity in the paper. The web 10 from the supply 3 is fed under guide roller 9 and up over inclined portion 63 of side plate 61 into engagement with a substantial portion of cylindrical wall 24 of drum 22. From the drum 22 the web 10 is directed over inclined portion 64 of side plate 62, under guide roller 12, over guide rollers 13 and 14 and under guide roller 15 to take up arbor 16. In passing over guide rollers 13 and 14 the web has a portion of it exposed to zinc vaporizer 17.

After the web has thus been placed in position the front wall 68 is sealed to the side walls, the top and bottom walls and the top plate 67 of shield 60 is simultaneously slid into sealing engagement with the upper edges of inclined portions 63 and 64. The chamber 6 is thus sealed and the shield 60 around the drum 22 is closed whereupon the chamber 6 is evacuated. As soon as chamber 6 is suitably evacuated, power is supplied to the vaporizer 17 through cable 18 and power is supplied to electrode 46 through conductors 43 and 44. As soon as the power supplied is connected to the vaporizer 17 and to the electrode 46, take up arbor 16 is actuated so that the web 10 will not be charred while the vaporizer 17 and electrode 46 are heating up to the point where they will vaporize the metals in them. Thus, the first portion of the web wound on take up arbor 16 will not have metal deposited on it but as soon as vapors are generated the metals will deposit on the web 10. The web 10 will turn the drum 22 and the pattern of cut outs 25 in the cylindrical wall 24 of drum 22 will control the pattern 70 of metals to be deposited.

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If a pattern of silver is sufficiently heavy the zinc vaporizer 17 need not be operated. Furthermore, if the pattern of silver and zinc is not heavy enough to carry the currents to be used in the circuit for which the wiring is being prepared, an additional metal coating may be electroplated on the zinc.

Although a specific apparatus for practising the invention has been described in detail, it will be understood that numerous modifications may be made without departing from the invention.

What is claimed is:

1. An apparatus for producing printed wiring having transversely extending metallic circuit paths comprising an evacuated chamber having therein an arbor for supporting a supply of insulating material in web form, a take-up arbor for withdrawing said web of insulating material from the supply thereof, a rotative drum having elongated slots in its cylindrical wall to define a predetermined pattern of elongated slots in said cylindrical wall, said pattern of elongated slots extending circumferentially and axially along the peripheral surface of the drum, means for guiding a web of insulating material from the supply arbor to the take-up arbor over the drum for engaging and rotating the drum, a metal vaporizer within said drum for directing vaporized metal through said elongated slots onto the surface of said web to form metallic circuit patterns extending longitudinally and transversely of the web, and a second vaporizer for vaporizing another metal adjacent to the path of said web for applying a coating of said second metal on the previously applied metallic pattern on the web.

2. An apparatus for producing printed wiring having elongated intersecting circuit paths comprising an evacuated chamber having therein an arbor for supporting a supply of insulating material in web form, a take-up arbor for withdrawing said web of insulating material from the supply thereof, a rotative, two-piece drum, a stationary shaft for supporting said drum, one piece of said drum comprising an inner wall member freely rotatable about said shaft and having an annular notch adjacent to its periphery and the other piece of said drum comprising an integrally formed outer wall freely rotatable about said shaft and a cylindrical wall, said cylindrical wall being provided with pattern-defining elongated intersecting slots and being formed to fit the annular notch on the periphery of the inner wall member, means for advancing the insulating material over the cylindrical wall to rotate the drum to successively present the intersecting slots to successive areas of the advancing insulating material, and a metal vaporizer mounted on said stationary shaft and within said drum for directing metallic vapor through said elongated slots to form elongated intersecting deposits on the web.

3. An apparatus for producing printed wiring having intersecting circuit paths, comprising an evacuated chamber having a hollow bearing member secured to a wall of said chamber, a rotative drum mounted on said bearing member and having a pattern of elongated intersecting slots extending through the periphery thereof, a shield mounted on the walls of said chamber and about the drum to longitudinally engage the drum along two spaced lines to expose a predetermined peripheral area to said evacuated chamber, a bracket mounted on said bearing at a point centrally located with respect to the ends of the drum for supporting metal to be vaporized, a heater mounted on said bracket for vaporizing the metal, conductors connected to said heater and extending through said hollow member for supplying current to said heater, and means for advancing and guiding a web into contact with the predetermined exposed area of the drum to thereby rotate the drum whereby a pattern of intersecting paths of metal is deposited on the web in conformance with the pattern of slots advanced through the predetermined exposed area by the rotating drum.

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4. An apparatus for producing printed wiring having intersecting circuit paths, comprising an evacuated chamber, an arbor rotatably mounted in said chamber for supporting a supply of insulating material in web form, a take-up arbor mounted in said chamber for withdrawing said web of insulating material from the supply thereof, a rotative drum mounted in said chamber having slots in its cylindrical wall to define predetermined patterns of intersecting openings in said cylindrical wall, each pattern of openings including circumferentially and axially extending intersecting slots, means for guiding a web of insulating material from the supply arbor to the take-up arbor over a predetermined portion of the drum for engaging and rotating the drum, a metal vaporizer within said drum for directing vaporized metal through said slots onto the surface of said web, and means to shield all of said drum except the predetermined portion engaged by the web from the remainder of the chamber for presenting each succeeding pattern of intersecting openings to

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successive portions of the advancing web whereby metal is deposited on the web to form intersecting circuit paths.

References Cited in the file of this patent

UNITED STATES PATENTS

746,786	Burdick	Dec. 15, 1903
1,551,850	Schmidmer et al.	Sept. 1, 1925
1,701,568	Hubl	Feb. 12, 1929
2,103,623	Kott	Dec. 28, 1937
2,382,432	McManus et al.	Aug. 14, 1945
2,426,494	Evans	Aug. 26, 1947
2,702,760	Barth	Feb. 22, 1955
2,750,921	Purdy	June 19, 1956

FOREIGN PATENTS

767,381	Germany	July 28, 1952
760,543	Germany	June 8, 1953
692,614	Great Britain	June 10, 1953