

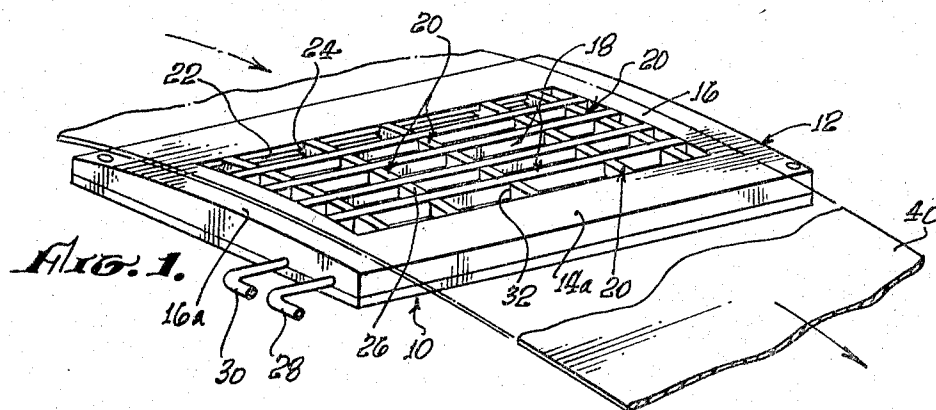
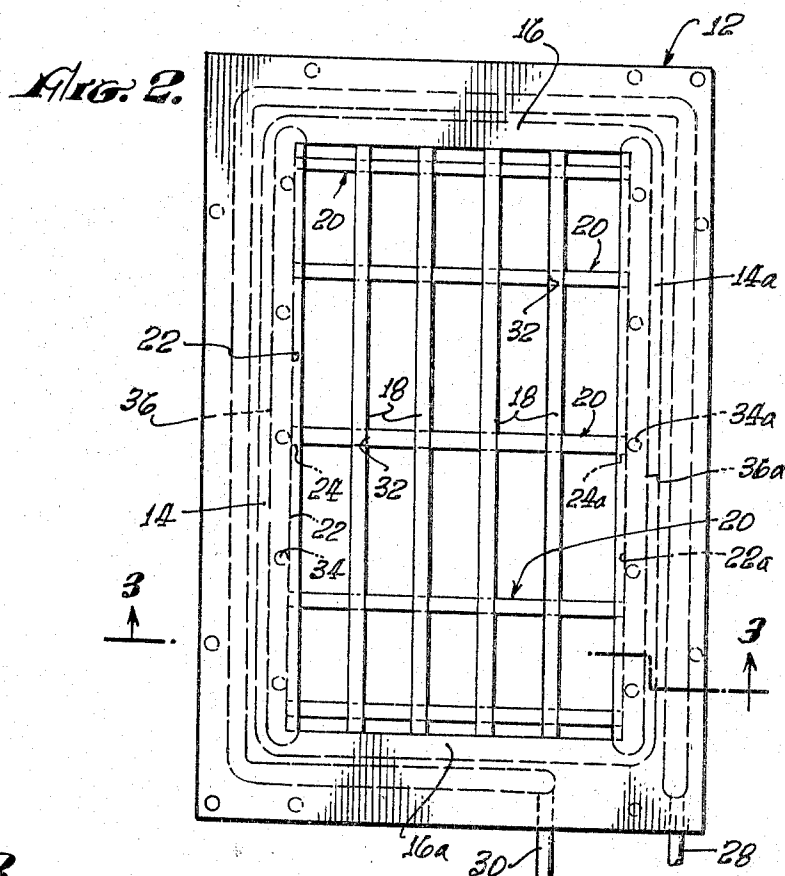
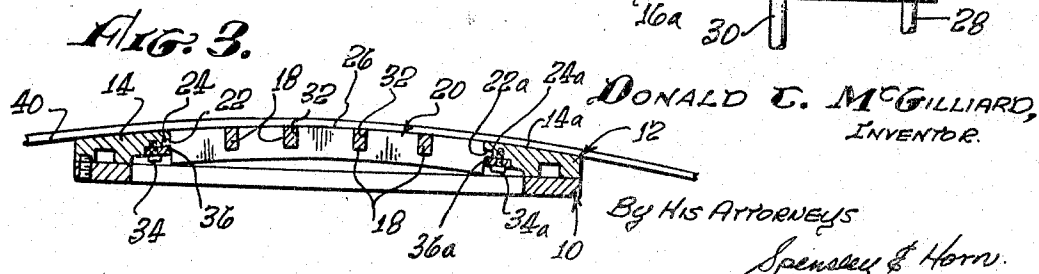
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ADJUSTABLE MASK

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ADJUSTABLE MASK

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2 Claims. (Cl. 118—504)

This invention relates to a means for masking portions of a surface from metalizing material being applied to other portions of the surface. More particularly, this invention relates to an adjustable masking device for masking surfaces from metalizing vapor.

The metalizing of the surfaces of various materials is conventionally accomplished by the use of masking devices such as those having cut out areas and shielding areas of fixed construction, which expose only predetermined portions of a surface to metalizing vapors. Masking devices are particularly useful in the manufacture of capacitors where a rapidly moving sheet of dielectric material has continuous metalized bands deposited thereon. In the present capacitor manufacturing process, a masking device is placed immediately above a metal evaporator, e.g., silver. A continuous sheet of dielectric material is passed over the masking device at a predetermined velocity while making intimate contact with the top surface of the mask. Silver vapor rising out of the evaporator passes through openings in the mask and is deposited on the surface of the rapidly moving dielectric material, thus, forming a metalized band. The width of the deposited metalized band is determined by the dimensions of the openings in the masking device.

There are several disadvantages inherent in the conventional methods of metalizing a surface. Usually the masking device employed is of a fixed construction having openings machined therein which correspond to the desired metalized band width. If, however, a different band width is desired, a new mask having openings of the desired width must be constructed. The design and construction of new masks as required is both a time consuming and expensive process. Another disadvantage of the one piece conventional masks is caused by a so-called shadowing effect. The metalizing vapor rises from the evaporator, passes through openings in the mask and is deposited on the substrate surface to be metalized; however, areas of the surface immediately adjacent to the shielding sections of the mask do not receive sufficient contact with the metalizing vapors because of a blocking effect caused by the thickness dimension of the shielding member. Thus, it is observed that the extreme outer edges of the band to be metalized have received very little if any metal vapor. This phenomenon is evidenced by an area of insufficient metalizing (the so-called shadow) extending along the substrate material surface parallel to the shielding sections and to the direction of movement of the dielectric material. It is impossible to determine the precise dimensions of the shadow in advance for each individual mask design and it is, therefore, impossible to construct the mask to make allowances for the shadow effect. Therefore, situations arise in which a mask which has been designed to produce a metalized band of a predetermined width dimension produces metalized bands of a different smaller dimension because of the shadow effect. This necessitates the design and manufacture of a new mask which is both a time consuming and expensive process.

It is accordingly an object of this invention to provide a mask with which metalized patterns of various shapes can be deposited on a substrate material.

It is another object of this invention to provide a mask with which metalized bands of various widths can be deposited on a substrate material.

Still another object of this invention is to provide a mask having adjustable shielding sections through which metal-

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ized bands of varying widths can be deposited, and which band widths can be easily adjusted.

It is yet another object of this invention to provide a mask having adjustable shielding sections and having rigid cross members to support a sheet of dielectric material upon which metalized bands of various widths can be deposited.

As an aid to the understanding of this invention a brief description of the presently preferred embodiment follows in summary form. The mask comprises a frame having sides and at least two shielding members. The shielding members are capable of being disposed across the frame in the horizontal plane and are adapted to adjustably engage the sides of the frame. The shielding members are capable of being adjustably longitudinally positioned to any desired position within the frame. The mask has at least two support members which are adapted to intersect the shielding members. The support members are capable of being disposed within the frame in the horizontal plane in a direction normal to the direction in which the shielding members are disposed thereby forming a grid within the frame. In operation, the frame is placed upon a metal evaporator. Metal vapor from the evaporator rises through the openings in the frame. The width of the openings in the frame can be adjusted by sliding the shielding members closer together or further apart as necessary. A sheet of material to be metalized is passed across the frame in a direction parallel to the longitudinal axis of the shielding members while maintaining intimate contact with both the shielding members and support members. The weight of the substrate material is partially supported by the shielding members and partially by the intersecting support members. Thus, a band of metal having a width controlled by the distance between shielding members is deposited on the material as it passes over the mask.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages thereof will be better understood from the following description considered in connection with the accompanying drawing in which a presently preferred embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description only, and is not intended as a definition of the limits of the invention.

In the drawing:

FIGURE 1 is a perspective view of a sheet of material passing over the frame and grid of the mask;

FIGURE 2 is a plan view of the mask; and,

FIGURE 3 is a cross-sectional view in the direction 3—3 of a shielding member attached to the frame.

The actual details of this invention are best more fully described by referring to the accompanying drawing. Referring now to FIGURE 1, the frame is comprised of a generally rectangular base 10 to which is attached a frame body 12 oriented in the horizontal plane. The overall frame dimensions in the present embodiment which have given optimum results in 14 inches long by 9 1/4 inches wide. It is, of course, within the scope of the invention to employ a frame having a one piece construction rather than a base and frame body as described herein. Extending along the inside edges of sides 14 and 14a of frame body 12 are grooves 22 and 22a (FIGURE 2). Grooves 22 and 22a are adapted to receive lips extending from both ends of the shielding members 20. A grid is formed within the frame by a plurality of shielding members 20 which extend between sides 14 and 14a and supporting members 18 which extend between sides 16 and 16a of frame 12 and which intersect the shielding members. Inlet pipe 20 and outlet pipe 30 carry cold water through frame body 12 to keep it comparatively cool

while resting on a hot metal evaporator. The present invention does not always require such cooling pipes, however, as in many instances the metal evaporator is itself water cooled. In such a case the mask requires only a frame to contain the shielding members and crossing support members without any cooling pipes being necessary. A sheet of substrate material to be metalized (in the case of capacitor manufacturing processes dielectric material) is passed over the mask in a direction parallel to shielding members 20 and to sides 16 and 16a of the frame. While passing over the mask dielectric material 40 is kept under tension and makes intimate contact with the surface of the mask.

In FIGURE 3 is shown a shielding member 20 adjustably engaged to frame body 12. As shown shielding member 20 is a bar having a generally rectangular cross section and of arcuate configuration having lips 24 and 24a (for which a dimension of $\frac{1}{8}$ " x $\frac{1}{8}$ " was found to be optimum extending from both ends. An overall length dimension of the shielding members such as, $7\frac{1}{4}$ inches has given satisfactory results.

At spaced intervals along the length of shielding member 20 are several cut out sections 32. These cut out sections are of such configuration and dimension that supporting members (18 of FIGURE 1) can be inserted into them in such a manner that a flush surface is presented at the intersection of the shielding member and the support member. In the present embodiment the cut out sections can be $0.25 \pm .005$ inch in width, and can be located at intervals of $0.95 \pm .010$ inch. The depth of the cut out sections can be 0.375 inch. Shielding member 20 is adjustably engaged to frame 12 by means of extending lips 24 and 24a which are adapted to fit into grooves in the sides of frame body 12. When the shielding member is in the desired position, fastening members 34 and 34a are screwed into frame 12 thereby applying pressure to bearing plates 36 and 36a which lock lips 24 and 24a securely into position. If it is desired to move the shielding member into a new position within the frame, lock nuts 34 and 34a are loosened thereby releasing pressure on bearing plates 36 and 36a which in turn allow extending lips 24 and 24a to slide along a groove (22 in FIGURE 1) in the sides of the frame body. Thus, the distance between adjacent shielding members can easily be adjusted, thereby controlling the width of the metalized band deposited.

Referring again to FIGURE 1, several shielding members 20 are positioned in frame body 12 in such a manner that the curvature of each shielding member is towards the upper side of the mask, and so that they extend across the width of frame body 12 between sides 14 and 14a. Extending lips 24 and 24a (FIGURE 3) at either end of the shielding members engage grooves 22 and 22a (FIGURE 2) located in the inside edges of sides 14 and 14a. The grooves extend along the entire inside length dimension of these sides. It is thus possible to slide shielding members 20 along frame body 12 in either direction between frame sides 16 and 16a; i.e., in a direction normal to the path of a substrate material. It is within the scope of the invention to provide various other means for adjustably engaging the shielding members within the frame. For instance, in the case where no cooling pipes are required for the frame, it is possible to employ rods extending between sides 16 and 16a and parallel to sides 14 and 14a of the frame which rods pass through holes in the ends of all shielding members. If lock nuts are then also passed over the rods until positioned adjacent to a shielding member it is possible to slide the shielding members along the rods until the lock nuts are tightened. With the lock nuts tightened the shielding members are securely locked in place.

Extending in a direction normal to that in which the shielding members extend are a plurality of support members 18. These are bars of generally rectangular configuration which extend between sides 16 and 16a of the frame.

In the present embodiment bars $10\frac{3}{4}$ " long, $\frac{1}{4}$ " wide and $\frac{3}{8}$ " deep have given optimum results. Each support member has a width dimension such that it can be inserted into cut out sections (32 FIGURE 3) located at intervals along the length of shielding members 20. These support members are so dimensioned that when inserted into the cut out sections of the shielding members the shielding members can slide along the length of the support members. A further important aspect of these support members is that when inserted into the cut out section of the shielding members the top surfaces 26 of the shielding members and of the support members are flush. This feature is important to facilitate the smooth movement of substrate material 40 over the surface of the mask. The function of supporting members 18 is to support the weight of the substrate material and thus to prevent it from sagging as it passes over the mask surface. When the shielding members and the intersecting support members are in position within the frame, the grid formed thereby has a slightly curved top surface. This curvature of the surface of the mask is necessary to enable the substrate material (which is under tension) to maintain a constant smooth contact with the surface of the mask as it passes over it.

Referring to FIGURE 3, base 10 has means for attaching the mask to a metal evaporator. Inlet pipe 28 conveys cold water around the periphery of frame body 12 and discharges it from outlet pipe 30. The function of the water cooling system is to maintain the frame body at a relatively low temperature when the mask is attached to a hot metal evaporator. If the metal evaporator being used has an independent cooling system, these cooling pipes can be eliminated from the invented structure.

In operation, the invented mask is attached to the top of a metal evaporator in a generally horizontal plane by screws located in the base 10 of the mask. Shielding members 20 are moved to predetermined positions so that the openings between them will allow metal vapor to be deposited on a substrate material to a desired band width. If, while the metalizing process is carried out, it appears that a shadow effect is occurring the position of the shielding members can be adjusted to compensate for the decreased band width. The adjustment of the shielding members is carried out by loosening locking nuts 24 and 24a located adjacent to both ends of the shielding members in the frame body. When locking nuts 24 and 24a have been loosened the shielding members can be moved in either direction between sides 16 and 16a of the frame. Extending lips 24 and 24a at both ends of the shielding members engage grooves 22 and 22a in sides 14 and 14a of the frame and thus retain the shielding members within the frame while they are sliding to a new position. Since the shielding members have cut out sections 32 into which intersecting support members fit it is unnecessary to remove the supporting members while adjusting the shielding members. This is because the support members fit into the cut out sections in a manner that allows a sliding action between the two members. When the shielding members are in their new positions, lock nuts 34 and 34a are again screwed into the frame and lips 24 and 24a are secured. A sheet of substrate material 40 is passed over the mask at a constant velocity in a direction parallel to the longitudinal axis of the shielding members. Substrate material 40 is kept under sufficient tension so that it maintains intimate contact with the curved surface of the mask as it passes over it. Metal vapor rising through the openings in the grid of the mask is thus deposited in a continuous band of a precisely determined width on the underside of substrate material 40.

The advantage of the invented mask as described is that the width of a metalized band being deposited can be adjusted easily by adjusting the distance between shielding members without having to construct a new

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mask. This enables the same mask to be used on various metalizing jobs requiring different metalized band widths and also makes it possible to compensate for the deleterious shadow effects without having to construct a new mask.

Although this invention has been disclosed and illustrated with reference to particular applications, the principles involved are susceptible of numerous other applications which will be apparent to persons skilled in the art. The invention is, therefore, to be limited only as indicated by the scope of the appended claims.

What is claimed is:

1. In a vapor deposition apparatus, an adjustable masking comprising:
 - a generally rectangular frame having two sets of generally parallel sides, said frame adapted to being attached to the top of a metal evaporator in the horizontal plane;
 - a plurality of arcuate shielding members, said shielding members comprising a bar having a longitudinal axis, two ends with lips extending therefrom, and a plurality of cut out sections spaced along said longitudinal axis, said bar being capable of being disposed horizontally across said frame and said extending lips adapted to adjustably engage opposite sides of said frame; and,

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- a plurality of support members, said support members having a longitudinal axis and two ends, said support members capable of being disposed within the frame in a direction normal to the longitudinal axis of said shielding members and said support members being adapted to slidably engage said cut out sections in said shielding members and to form a flush top surface therewith, thereby forming a grid within said frame and having a convex top surface, wherein said top surface is juxtaposed to the substrate surface to be coated and whereby said shielding members may be selectively, longitudinally positioned by sliding along said support members to any desired position within said frame.
2. The adjustable mask of claim 1 having cooling means located within said frame for cooling said frame.

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