

Dec. 24, 1940.

E. O. NORRIS

2,226,382

MATRIX FOR ELECTROFORMING FORAMINOUS SHEETS

Filed April 22, 1938

2 Sheets-Sheet 1

Fig. 2.

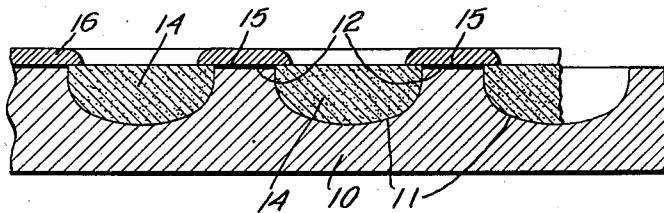


Fig. 3.

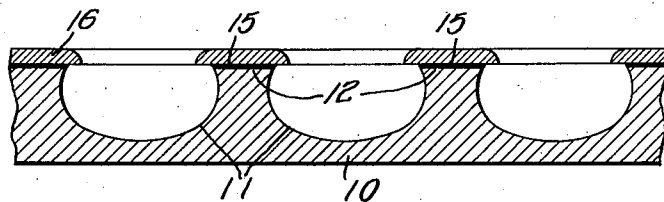


Fig. 4.

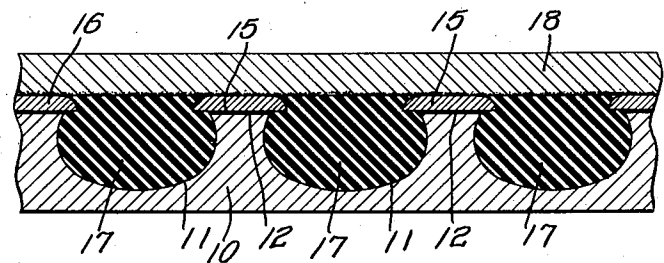


Fig. 5.

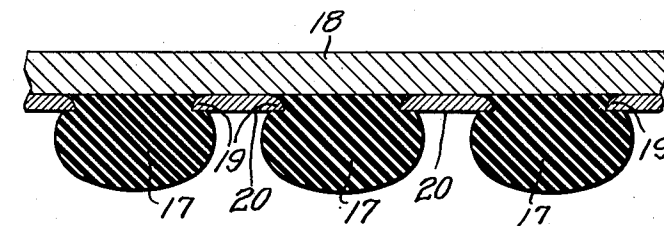
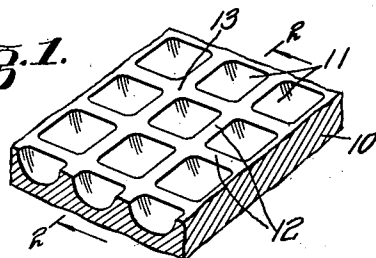


Fig. 1.



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2 Sheets-Sheet 2

Fig. 6.

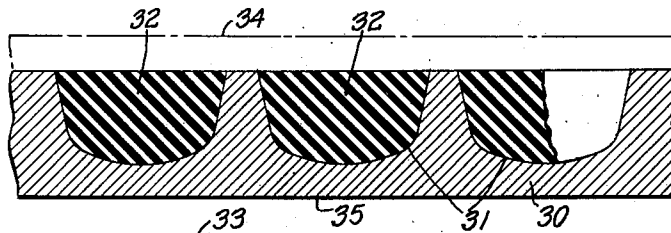


Fig. 7.

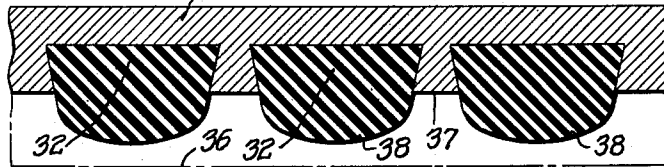


Fig. 8.



Fig. 9.



Fig. 10.

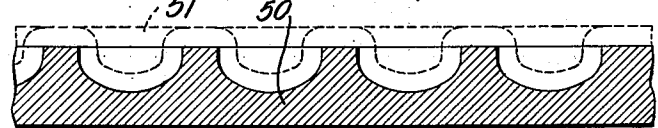


Fig. 11.

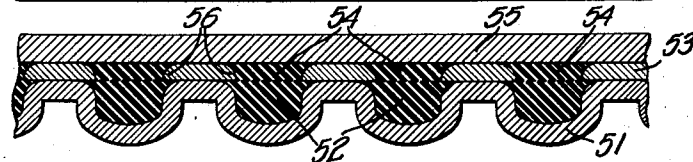


Fig. 12.

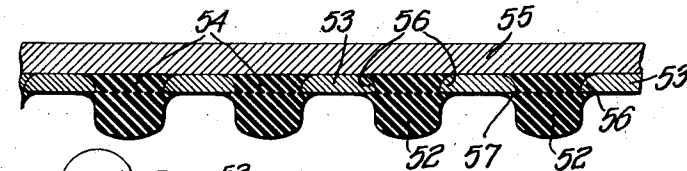
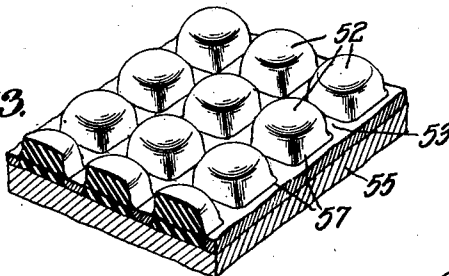


Fig. 13.



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MATRIX FOR ELECTROFORMING FORAMINOUS SHEETS

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Application April 22, 1938, Serial No. 203,504

5 Claims. (Cl. 204—281)

This invention relates to the electroformation of reticulated sheet material but more particularly relates to a matrix on which such electroforming may take place, and the process of producing the matrix. The particular matrix described is adaptable for the production of foraminous sheet suitable for dials, stencils, or the like, or as screen for filtering liquids, segregating material, grading material to size, exclusion of insects from buildings, photo-engraver's use, and in fact for any purpose that such a fabric is adapted to serve.

In the matrix which I am about to describe, one important object that is accomplished is that of making possible the production of what term for convenience "thick" foraminous sheet. By this term I mean to designate foraminous sheet that is relatively thick compared to the cross-section dimensions of the apertures. When foraminous sheet is electrolytically deposited on a matrix, the lands of which are flush with the electrically non-conductive areas, the deposit builds laterally at twice the rate at which it builds in thickness, and before the desired thickness is obtained the lateral encroachment of the deposit over the insulated areas has progressed so far that the process must be discontinued or else the holes will either be closed up or nearly so. For many purposes screen made in such a manner is too thin compared with its hole size and land width. By my present process I am able to electrolytically deposit foraminous sheet which has a relatively high ratio of thickness to hole size.

I accomplish my object by employing a matrix the exposure surface of which consists of crossed channels or valleys the bottoms of which are of metal or other material capable of receiving an electrolytic deposit and the walls of which are defined by protuberances projecting above the metal surface of the base plate. These walls are composed wholly or partly of material, the surface of which is inactive to electrolytic deposition, which material I will refer to for purposes of this specification as "passive" material. Most passive material that is available for the purpose described is relatively fragile or disintegrable by the action of acids, alkalis, and other chemical and electrolytic reactions, or is only mildly adherent to a metallic surface, or it may have all of these and other defects which offer difficulties in using it as passive material in matrices of this character. A matrix for the purpose I have described must, in order to be commercially useful, be strong, not readily attacked by chemical

action in an electrolytic bath, and must be reasonably resistant to destructure effects which result from stripping an electroformed deposit therefrom. All of the above difficulties are overcome to a very great extent, and all the advantages above referred to and others are accomplished by my invention.

This application contains matter taken from my United States Patents Nos. 2,166,366 and 2,166,267, issued July 18, 1939.

Referring to the drawings,

Fig. 1 is a view in perspective of a metal plate in which a large number of pits have been formed for the reception of passive material;

Fig. 2 is a detailed sectional view in elevation along the line 2—2 of Fig. 1 but showing, in addition, further steps in the process;

Figs. 3, 4, and 5 are likewise detailed sectional views showing further steps in the preferred process, Fig. 5 illustrating the detail construction of the complete matrix;

Fig. 6 and Fig. 7 are views in sectional elevation showing a modified form of the process and a modified construction of matrix;

Figs. 8 and 9 show a still further modified process and modified construction of matrix;

Figs. 10, 11, 12, and 13 show a still further modified process of a further modified type of matrix.

Referring first to the preferred process and matrix illustrated by Figs. 1-5, both inclusive, a base plate 10 of copper, nickel or other electrically conductive material is provided on at least one face with pits or depressions 11, the plate thus presenting a surface with the lands 12 crossing each other at the junction areas 13. These pits may be created by any suitable process, but a convenient way is that described in my application Ser. No. 52,334 above referred to and, briefly stated, consists in first coating the surface to be pitted with light-sensitized photo-engraver's glue, photoprinting on the film of glue areas defined by the lands 12 (which may be accomplished by exposing the glue film to light through a negative of a half-tone screen), then developing and washing out, and thereafter etching to produce the pits.

The plate of Fig. 1 having been produced, the pits 11 are then filled with shellac or other passive substance 14 (see Fig. 2) and the entire surface including the lands 12 and junction areas 13 together with the exposed areas of shellac is smoothed down by any suitable method such as rubbing and polishing with abrasives and polishing powders.

The lands and junction areas are then covered with a "stripping film" 15—i. e., a film of material which, while still permitting of the reception of an electrolytic deposit, nevertheless permits the deposit to be stripped therefrom. In practice, of course, the shellac areas would likewise be covered with the material of the film, but since the material of the film is passive, it makes no difference in the subsequent operations, which will now be described.

After the stripping film has been applied, the base plate 10, with its shellac fillings 14, is employed as a cathode for the electrolytic deposition of some other metal than the metal of which the base plate is composed. If the base plate is of copper (which I prefer that it should be), the deposit 16 may be of nickel, for the reason that, as presently will appear, there are available methods for selectively dissolving copper to the exclusion of nickel.

The nickel 16 having been deposited, the shellac 14 is next thoroughly washed out of the pits 11 by washing and scrubbing with alcohol, resulting in the structure shown in Fig. 3, the nickel 16 being slightly adherent to the base plate 10, although strippable therefrom by the exertion of comparatively little force.

The next step in the process is illustrated in Fig. 4, wherein the pits 11 are shown as filled in this particular case with vulcanizable rubber composition 17, the level of the filling however being carried not only to the edges of the pits but also to a level flush with the top surface of the nickel deposit.

The entire surface may then be dusted with fine powder of bronze, graphite or any other substance having the characteristic of electrical conductivity and the whole may be employed as a cathode in an electrolytic bath and the deposit 18 laid thereon. The deposit 18 may be of nickel or copper or any other material which can be electrolytically united to the surface.

At this point the structure consists of the base plate 10 with the vulcanizable rubber composition fillings 17 practically non-adherent thereto, the nickel deposit 16 likewise practically non-adherent to the base plate, and the deposit 18 which is firmly adherent to the rubber fillings and to the nickel deposit. The deposit 18 therefore may be then stripped from the base plate carrying with it the rubber composition fillings and the nickel deposit 16, the whole constituting the unit illustrated in Fig. 5, and it will be noted that the rubber protuberances are firmly anchored by reason of the fact that they extend under what are, in effect, flanges 19 extending from the nickel deposit 16. In other words, they are not only strongly adherent to the deposit 18 but are also mechanically united therewith by an interlocking socket.

The unit shown in Fig. 5 may then be subjected to a vulcanizing process, the degree of vulcanization being however only such that the rubber protuberances 17 will yield readily to stripping of a deposit on the nickel bottoms 20 of the channels or valleys defined by the protuberances.

The unit illustrated by Fig. 5 may then after the bottoms of the channels 20 have been coated with a thin film of wax, chrome or other material that permits of a non-adherent electrolytic deposit, be employed as a cathode in an electrolytic bath, and the result will be a deposit of foraminous sheet thereon. The walls of the protuberances 17 confine the lateral spread of the deposit, and the deposit may therefore be carried

to any thickness desired. When the deposit has been completed, it may be stripped from the matrix surface, the stripping film permitting its release from the metallic bottoms of the channels and the deformability of the vulcanized rubber protuberances permitting its release from them without injuring them or loosening or tearing them from their anchorages to the plate 10. The plate 10, after being stripped from the matrix, may be used repeatedly for the production of additional matrices in the same manner as is above described with reference to the production of the matrix of Fig. 5.

In the modification of Figs. 6 and 7, the base plate 30 having been pitted as shown at 31 and the pits filled with passive material 32, is then subjected to cathodic electrolytic action until the backing 33 has been deposited to say the depth indicated by the broken line 34 of Fig. 6. Prior to applying this backing, the exposed surfaces of the passive material may be dusted with metallic or other electrically conductive powder in order that the fillings 32 shall adhere firmly thereto.

The plate with the fillings 32 may then be masked against corrosion by an etching reagent (which if the plate 30 be of copper may be ferric chloride) over all its parts except the surface 35, and etched from the plane indicated by the broken line 36 to the plane indicated by the full line 37. As will be seen, this results in a surface composed of channels or valleys the bottoms of which are of metal and the walls of which are of the passive material of the protuberances 32. The plate of Fig. 7 may be then used as a matrix for the electroforming of foraminous sheet in the same manner as in the case of the matrix of Fig. 5.

In the modification of Figs. 8 and 9, the plate 40 is shown as being provided with holes 41 extending from surface to surface. These holes may be produced in the same manner as pits 11 of Fig. 1 except that the etching is carried entirely through the plate. The holes may then be filled with passive material 42 and a metal deposit laid thereon in the same manner as is described with reference to the metal deposit 33 of Figs. 6 and 7, to the height say indicated by the broken line 43 of Fig. 8. The material deposited is indicated in Fig. 9 by the numeral 44. Then, after masking as in the case of Figs. 6 and 7, the plate 40 with its backing 44 is etched until its surface 45 is brought to the plane indicated by the line 46 in Fig. 9, leaving projecting therefrom the protuberances 47. This plate may be used as a matrix for the electroforming of screen in the same manner as the plate of Fig. 7.

In Figs. 10, 11, 12, and 13 a plate 50 is prepared in the same manner as is the plate of Fig. 1. Next, the stripping film is applied to the pitted surface of the plate, the stripping film covering not only the lands but the walls of the pits as well. The plate thus prepared is subjected cathodically to an electrolytic bath—say, of proper composition for copper deposition, and the plate 51 shown in section in Fig. 11 deposited thereon (see Fig. 11). The plate 51 is, in fact, an electrotype of the pitted surface of the plate 50. The pits on one side of the plate 51 are then filled with passive material 52 and the deposit 53 applied thereto, without however employing a stripping film. The deposit 53 is therefore firmly adherent to the plate or electrotype 51. Additional passive material 54 is then inserted and becomes adherent to the passive material 52.

After smoothing off the surface, the plate 55 is then applied by electrodeposition or otherwise and without interposition of a stripping film on the deposit 53.

5 The entire unit, comprising the plate 55, deposit 53, and masses of passive material 52 and 54, is stripped from the plate 51 and exhibits the construction shown in Fig. 12 with the protuberances of passive material forming the walls of
10 channels or valleys, the bottoms of which are of metal. It will be observed that the protuberances are mechanically locked to the backing plate 55 by reason of the fact that the material runs under the flanges 56; also, it will be observed
15 that the protuberances themselves slope slightly as shown at 57 to the bottoms of the channels. This unit constitutes a matrix suitable for the electroformation of foraminous sheet as in the case of the previously described matrices.

20 To be more specific with respect to the nature of the passive material that I have referred to, there are a number of suitable materials for this purpose, among which I would mention Bakelite, asphaltum, shellac, varnish, various hard wax
25 compositions, enamel including vitreous enamel, vulcanized natural rubber, and various synthetic rubbers. Other materials that exhibit passivity to electrolytic deposition under certain conditions of operation are chrome and aluminum.

30 I have described above certain embodiments of my invention and a preferred process with certain modifications thereof, but I wish it to be understood that these are illustrative and not
35 limitative of my invention and that I reserve the right to make various changes in form, construction, and arrangement of parts and also to make various changes in process of manufacture falling within the spirit and scope of my inventions, as set forth in the claims.

40 I claim:

1. A matrix adapted to serve for the electroforming of foraminous sheet comprising a base plate presenting a surface adapted to receive an electrolytic deposit and a plurality of protuberances of readily deformable resilient electrolyti-

cally passive material projecting from said base plate and mechanically interlocked therewith by means of a flange embedded in said base plate.

2. A matrix adapted to serve for the electroforming of foraminous sheet comprising a base plate presenting a surface adapted to receive an electrolytic deposit and a plurality of protuberances of readily deformable resilient electrolytically passive material projecting from said base plate and socketed therein, the socketed connection comprising a flange embedded in the material of the base plate.

3. A matrix adapted to serve for the electroforming of foraminous sheet comprising a base plate presenting a surface adapted to receive an electrolytic deposit and a plurality of protuberances of readily deformable resilient electrolytically passive material projecting from said base plate and extending into sockets in the same, the said sockets being tapered in a convergent direction as they approach the said surface and those portions of the protuberances contained in such sockets being likewise tapered to conform to the taper of the sockets.

4. A matrix adapted to serve for the electroforming of foraminous sheet comprising a base plate presenting a surface adapted to receive an electrolytic deposit and a plurality of protuberances of material having the resilience and deformable characteristics of partially vulcanized rubber projecting from said base plate and mechanically interlocked therewith by socketing in the same, the socketed connection comprising a flange about the rubber projection said flange being embedded in the material of the base plate.

5. A matrix adapted to serve for the electroforming of foraminous sheet comprising a base plate presenting a surface adapted to receive an electrolytic deposit and a plurality of protuberances of resilient and readily deformable rubber projecting from said base plate and mechanically interlocked therewith, the interlock being effected by means of flanges on the rubber projections embedded in the material of the base plate.

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