Jan. 10, 1956 H. V. ANDREWS 2,729,894

PLASTIC DIE MODEL AND METHOD OF MAKING SAME

Filed Aug. 6, 1952

FIG. 1

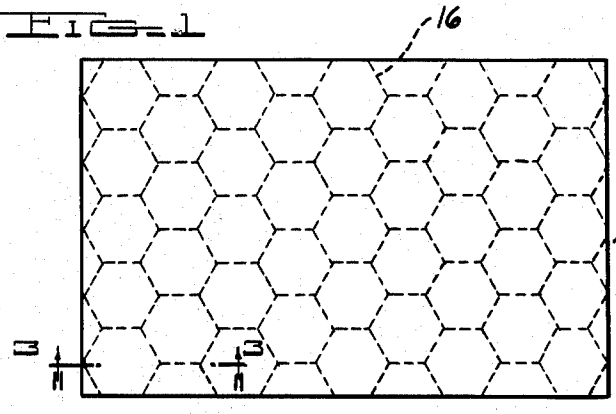


FIG. 7

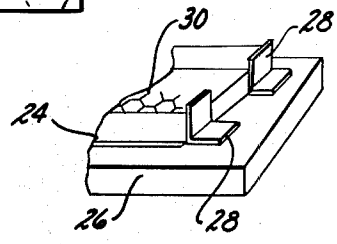


FIG. 2

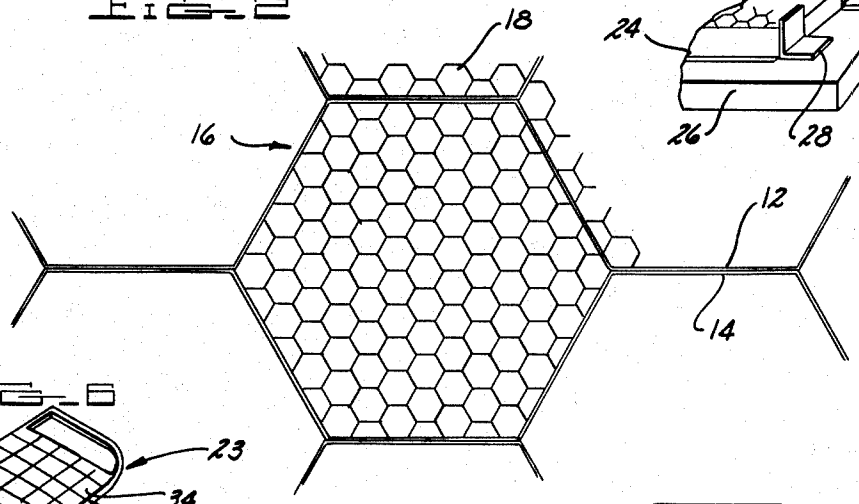


FIG. 6

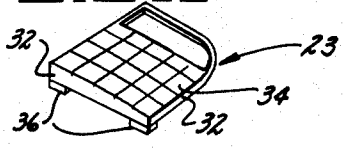


FIG. 4

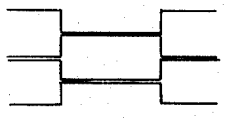


FIG. 3

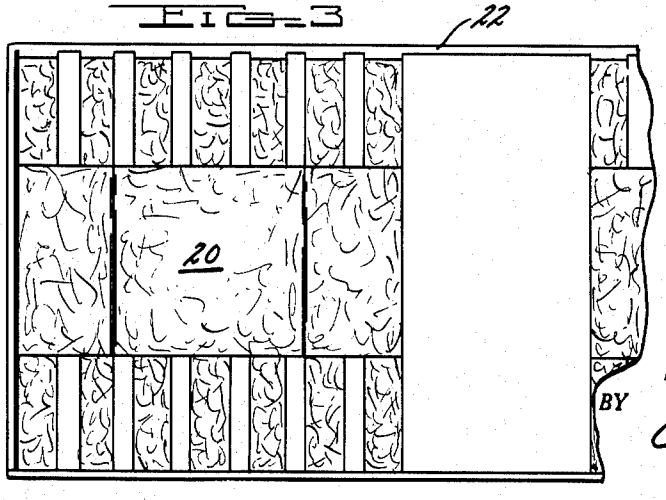
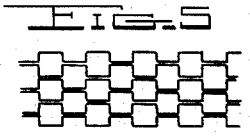


FIG. 5



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PLASTIC DIE MODEL AND METHOD OF MAKING SAME

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6 Claims. (Cl. 33—174)

The present invention relates to a plastic die model and the method of making the same.

It is conventional practice to use an expensive grade of wood when forming die models for items such as automobile panels, doors and the like. There are many disadvantages in using wooden die models, but to date this has been the best method developed. Among the disadvantages of the wooden die models are the excessive weight and the failure of the model to retain close dimensions. The failure to retain the desired dimensions is due to warping of the wood, and changing in the dimensions due to changes in atmospheric temperature and humidity.

Therefore, it is a principal object of the present invention to provide a die model which will retain close dimensions within extremely limited tolerances and which is light in weight.

It is another object of the present invention to provide such a die model which is sturdy in construction and which may be economically constructed.

It is a further object of the present invention to provide a method for forming a plastic die model which is simple and efficient and involves a minimum number of positive steps.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

Figure 1 is a top view of a rectangular die model using the construction of the present invention,

Figure 2 is an enlarged fragmentary view of a portion of the die model of Figure 1 showing the internal cell structure,

Figure 3 is an enlarged fragmentary section taken along the line 3—3 in the direction of the arrows, Figure 1

Figures 4 and 5 show alternate configurations of the cell structure which may be used in place of the hexagonal cells shown in Figs. 1–3,

Figure 6 is a perspective view of a plastic die model of an automobile door formed according to the present invention with the contour templates in position, and

Figure 7 is a perspective view of the initial set up of the cell structure of the die model of Figure 6.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to the drawings a rectangular shaped die model is indicated generally at **10** in Figure 1. The model is formed of complementary sheets of polyester impregnated fiberglass cloth such as the sheets **12** and **14** which are affixed together to form hexagonal shaped cells **16**.

These cells are preferably about five inches across. Smaller hexagonal filler cells **18**, also formed of polyester impregnated fiberglass, are then disposed at the top and bottom of each of the primary cells **16** and extend a short distance into the said primary cell. These filler cells **18** are preferably approximately one-half inch across. The hollow center **20** of each primary cell **16** is filled with a phenolic foam resin. The foam resin extends to within 1/16" of the top of each filler cell **18** adjacent the model face, and a surface plastic **22** extends 1/16" down into each filler cell **18** and 1/16" above the primary cells **16**. The primary cell and filler cell construction holds the die model surface plastic stable and breaks up structural strains which may develop when the surface plastic is setting. The foam core of the model renders the model light and easy to handle.

The model is constructed according to the following method. Strips of polyester impregnated fiberglass cloth are passed between a steam heated barrel having half hexagon impressions and a runner having half hexagon teeth thereon which mate with the impressions in the barrel. As the polyester impregnated fiberglass cloth passes through the device it is formed into a sheet of half hexagon impressions such as the strip **12** or **14** and is dry and ready for use when it emerges. Both the large primary hexagonal cell strips and the smaller filler cell strips are formed in this manner. The large primary cells **16** are formed by securing the large five inch strips together. The filler cells **18** are formed by securing the small sheets of 1/2" hexagonal fiberglass together.

In constructing a plastic die model of an automobile door **23**, for example, a full size door template **24** is placed flat on a steel table **26**. Two large 90° angle plates **28** are then placed at and against the bottom edge of the door template **24**. A strip of the five inch impressed polyester impregnated fiberglass of the desired length is then placed on edge within the template and it is shimmed and clamped on the angle plates 1/8" inside of the edge of the template. Additional sheets of the 5" fiberglass are then placed in position and sealed one to the other to complete a nest or honeycomb **30** of 5" primary cells **16**. The honeycomb **30** is then removed as a unit from the template and the ends and sides are sanded or ground to a size which is 1/8" short of the inside edge of the template. The sides of the honeycomb are wrapped with impregnated polyester fiberglass cloth binding and a finish coating **32** of polyester plastic is added around the model to exceed 1/8" for later shaping. A preliminary base line is then established and female templates **34** are placed down into the honeycomb for approximately every 5 inches of model surface. After the templates **34** are worked in 1/16" below the normal surface with a disc sander or the like, the templates are removed.

The honeycomb structure **30** is set firmly on the waxed steel table **26** and a clay fillet is run around the honeycomb to seal it to the table. Strips of the one-half inch polyester impregnated fiberglass cloth of the desired length are then inserted into each primary cell **16** and are lowered to the table surface to form the bottom filler cells **18**. A phenolic plastic foam resin is then poured into each primary cell **16** and is allowed to foam or rise. Any such resin is suitable so long as it is relatively shrink-free after curing and will be stable to close dimensions, such as $\pm 1/10{,}000$ inch. The Kish phenolic foam resin has been found satisfactory. During such foaming, additional strips of the one-half inch fiberglass cloth are placed into each primary cell at the top thereof. The phenolic resin rises through the cells **18** formed by the latter one-half inch strips and is scraped even with the top of the honeycomb. The foam plastic is allowed to set for a period from four to five hours and then the mod-

el is removed from the table and baked in a suitable oven at approximately 250° F. until dry.

Next the model is taken back to the steel table **26** and turned over on its face. The back is cleaned thoroughly and a thin coat of polyester plastic is painted on. Immediately thereafter a sheet of polyester impregnated fiberglass cloth is laid over the back area. The back area is allowed to dry and then the edges are cleared and locating pads **36** formed of laminated impregnated fiberglass cloth are positioned on the back of the model. The pads are secured to the model with cadmium coated screws which will not rust or corrode. The model is then turned over so that the locating pads are flat on the table **26**. The face of the model is then cleared of foam plastic with a sander or other suitable means so that each individual one-half inch filler cell has a depression $\frac{1}{16}$" deep. These depressions permit the surface plastic which is later poured to enter each filler cell and break up any strain which might develop in the surface plastic. Next a six inch piece of polyester impregnated tape is wrapped around the model to hold the surface plastic on the face of the model as the surface plastic is poured. The model is then cleaned with air and a face surface of polyester plastic is poured to extend at least $\frac{1}{16}$" above the honeycomb and down into the $\frac{1}{16}$" depressions in the filler cells **18**. Any of numerous polyesters are suitable. The surface plastic must be relatively shrink-free after curing and should hold a close dimension such as $\pm\frac{1}{10,000}$ inch. Triallyl cyanurate is an example of such a polyester. The female face templates **34** are then set up again and pressed into the surface plastic until they are positioned properly. After all the templates are properly positioned, the model is allowed to set until the surface plastic is hard. The face templates **34** are then removed and the outlining door template **24** is placed on the back of the model. The model is then shaped all around by machine to the exact outline of the door template. The template is then removed and the surface of the model is worked until the impressions in the plastic caused by the templates are removed. The model is then cleaned with air and finished.

The same principles may be applied to the method of female duplication wherein a female is made from a male model, the primary cells and filter cells being formed atop the male model to the desired contour and then being filled with foam resin and coated with surface plastic as explained previously.

The word "honeycomb" is used herein to describe a unitary group of cells, and it is to be understood that the cells may have shapes other than hexagonal.

From the foregoing, it will be seen that I have provided a simple and lightweight die model which is dimensionally stable and which is relatively free of internal stresses and strains. The method for forming such die models is novel and efficient and comprises a small number of simple and positive steps.

Having thus described my invention, I claim:

1. A close dimension plastic die model comprising a unitary outer honeycomb structure formed of a plurality of substantially vertical primary cells of plastic impregnated fibrous material, a plurality of groups of smaller substantially vertical plastic filler cells, one group disposed within each of said primary cells, said groups of filler cells being formed separate from said primary cell structure and each group of filler cells being engaged at its outer boundaries with the adjacent primary cell so that said primary cell is a wall surrounding said group of filler cells, said filler cells being formed of a stable material of high compressive strength and extending substantially to the top level of the primary cell, a core of light weight, stable plastic having high compressive strength disposed within said primary and filler cells and extending short of the top of said filler cells, and a layer of low shrinkage surface plastic which will remain stable over a relatively large range of temperatures extending over and above the face of said honeycomb structure and into the primary cells and filler cells to the core in said filler cells, said primary and filler cell structure relieving internal stresses and strains and adding to the strength of said die model.

2. A close dimension plastic die model comprising a unitary outer honeycomb structure formed of a plurality of substantially vertical primary cells of plastic impregnated glass fiber material, a plurality of groups of smaller substantially vertical filler cells of plastic impregnated glass fiber material, one group disposed within each of said primary cells, said groups of filler cells being formed separate from said primary cell structure and each group of filler cells being engaged at its outer boundaries with the adjacent primary cell so that said primary cell is a wall surrounding said group of filler cells, said filler cells extending substantially to the top level of the primary cell, a core of light weight stable foam plastic disposed within said primary and filler cells and extending short of the top of said filler cells, and a layer of low shrinkage surface plastic which will remain stable over a relatively large range of temperatures extending over and above the face of said honeycomb structure and into the primary cells and filler cells to the core in said filler cells, said primary and filler cell structure relieving internal stresses and strains and adding to the strength of said die model.

3. A close dimension plastic die model comprising a unitary outer honeycomb structure formed of a plurality of substantially vertical primary cells of plastic impregnated fibrous material, a plurality of groups of smaller substantially vertical short-length filler cells, one group of said filler cells being disposed at the bottom of each of said primary cells and one group of said filler cells being disposed at the top of each of said primary cells, said short-length filler cells leaving an open central portion in each of said primary cells, a core of light weight, stable plastic having high compressive strength disposed within said primary and filler cells and extending entirely throughout the bottom filler cells and the central portion of the primary cell but extending short of the top of the top filler cells, and a layer of low shrinkage surface plastic which will remain stable over a relatively large range of temperatures extending over and above the face of said honeycomb structure and into the primary cells and top filler cells to the core in said filler cells, said primary and filler cell structure relieving internal stresses and strains and adding to the strength of said die model.

4. The method of forming a close dimension die model comprising the steps of forming a honeycomb structure of substantially vertical primary cells of plastic impregnated fibrous material, shaping the honeycomb structure of primary cells to the desired contour, sealing the sides of the honeycomb structure with plastic tape, inserting a group of separate substantially vertical plastic filler cells within each of the primary cells so that each group of filler cells contacts the adjacent primary cell at the side boundaries of said groups, applying a light weight plastic of high compressive strength within said filler cells to form a core, sealing the bottom of the die model with plastic, affixing a casing around the sides of said model so that it will extend above the top face of the honeycomb structure, applying a stable, low-shrinkage surface plastic to the top face of the honeycomb structure so that said surface plastic extends within each filler cell and above the face of said honeycomb structure, removing the casing, and finishing the surface plastic to the proper dimensions.

5. The method of forming a close-dimension plastic die model comprising the steps of affixing together complemental strips of plastic impregnated fibrous material to form a unitary honeycomb of substantially vertical primary cells, shaping the honeycomb structure of primary cells to the desired contour, sealing the sides of the honey-

comb structure with plastic tape, forming a plurality of separate honeycomb structures of smaller substantially vertical filler cells by affixing together complemental strips of plastic impregnated fibrous material, inserting a honeycomb structure of filler cells into each of the primary cells so that the side boundaries of said filler cells contact the sides of the primary cell and the tops of said filler cells are even with the top of the primary cell, applying a light-weight plastic of high compressive strength within said filler cells to form a core, sealing the bottom of the die model with plastic, affixing a casing around the sides of said model so that it will extend above the top face of the primary honeycomb structure, applying a stable, low-shrinkage surface plastic to the top face of the primary honeycomb structure so that said surface plastic extends within each filler cell and above the face of said primary honeycomb structure, removing the casing, and finishing the surface plastic to the proper dimensions.

6. The method of forming a plastic die model comprising the steps of affixing together complemental strips of plastic impregnated fibrous material to form a unitary honeycomb of substantially vertical primary cells, shaping the honeycomb structure of primary cells to the desired contour, sealing the sides of the honeycomb structure with plastic tape and applying a finish coating of stable, low-shrinkage surface plastic to said plastic tape, forming a plurality of groups of smaller substantially vertical filler cells of short depth by affixing together complemental strips of plastic impregnated fibrous material, inserting one such group of filler cells in each

primary cell at the bottom thereof so that the side boundaries of said filler cells contact the sides of the primary cell, pouring a stable foam plastic of high compressive strength into said primary cells, inserting another group of short depth filler cells into the top of each primary cell so that the filler cells and primary cell are level at their tops, thus leaving the central portion of said primary cell unoccupied by filler cells, sealing the bottom of the die model with plastic, cleaning the foam plastic out of each top filler cell to the depth of approximately $\frac{1}{16}$ inch, affixing a casing around the sides of said model so that it will extend above the top face of the primary honeycomb structure, applying a stable, low-shrinkage surface plastic into the filler cells to extend approximately $\frac{1}{16}$ inch therein and $\frac{1}{16}$ inch above the face of the honeycomb of primary cells, removing the casing, and finishing the surface plastic to the proper dimensions.

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