United States Patent [19]

Bertsch

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[45] **May 21, 1974**

[54] **METHOD OF MAKING STONE RELIEFS**

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[21] Appl. No.: **889,851**

[30] **Foreign Application Priority Data**

Dec. 19, 1968 Germany 1815742

[52] **U.S. Cl.** **117/8.5,** 117/5.5, 117/6, 117/38, 156/2, 156/12

[51] **Int. Cl.** **B44d 1/52,** B65b 33/00

[58] **Field of Search** 117/8.5, 5.5, 6; 156/2, 156/12; 117/38

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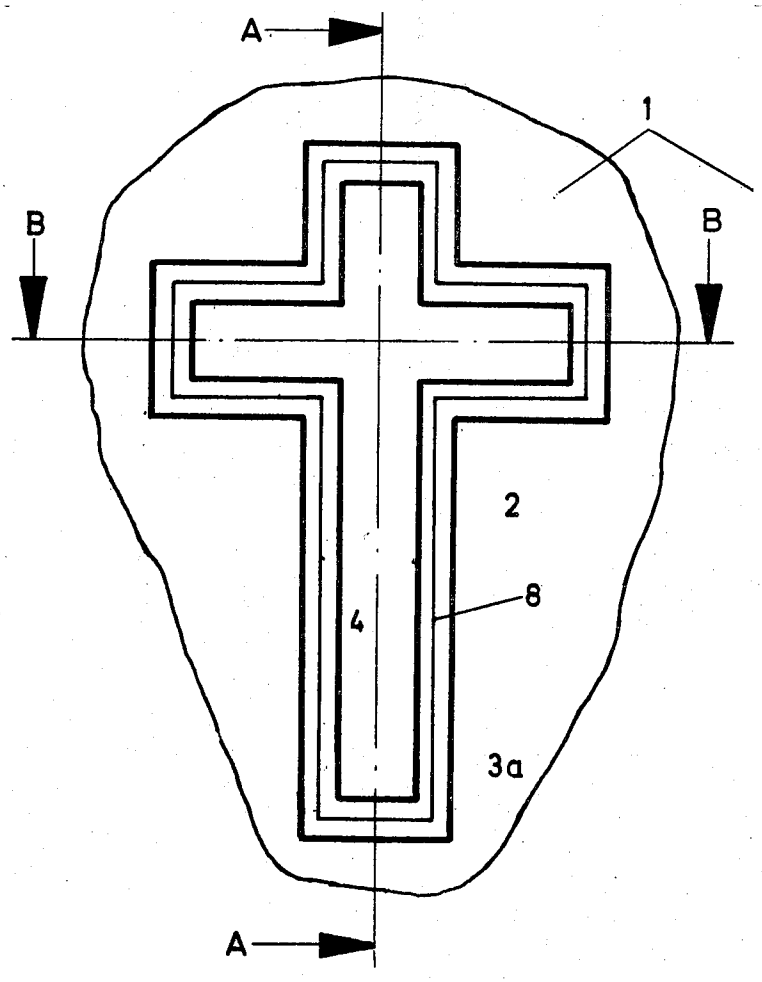
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Primary Examiner—Leon D. Rosdol
Assistant Examiner—MIchael F. Esposito
Attorney, Agent, or Firm—Michael S. Stricker

[57] **ABSTRACT**

Contaminants are removed from an exposed surface of a stone element on which a relief is to be produced. The exposed surface is covered with a self-adhesive foil which is intimately adhered thereto in surface-to-surface contact and which is resistant to etching fluid capable of attacking the stone element. An illustration of the desired relief is provided on the exposed side of the foil. Successive sections of the foil are removed, each matching the outline of a portion of the illustration to thereby expose corresponding portions of the surface. To the respectively exposed portions of the surface etching fluid is applied of a concentration and for a period of time requisite to etch the respective exposed portion to desired depth, before another section of the foil is removed and etching fluid is applied to the newly exposed portion.

9 Claims, 10 Drawing Figures



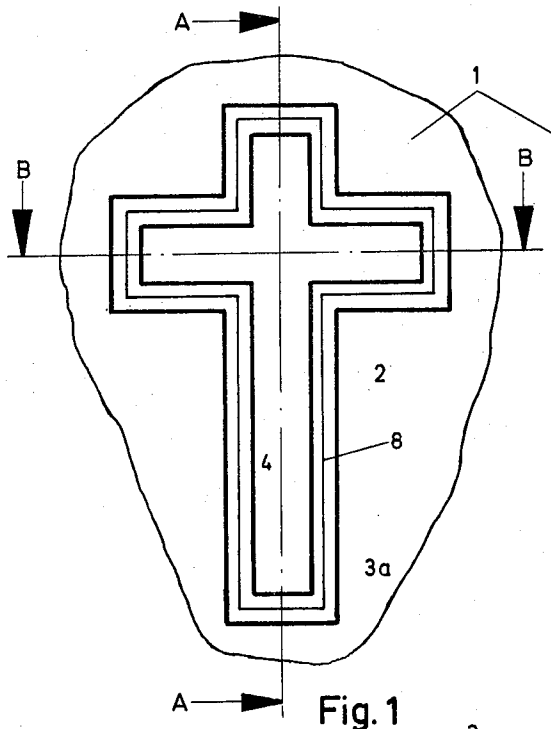


Fig. 1

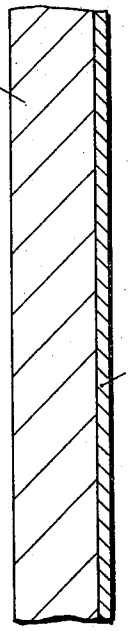


Fig. 2

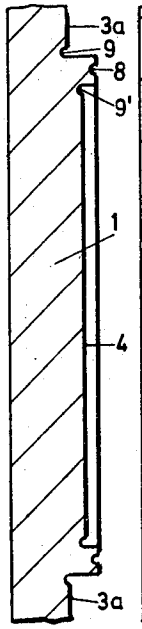


Fig. 9

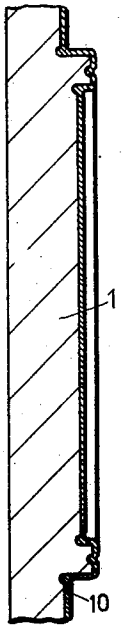


Fig. 10

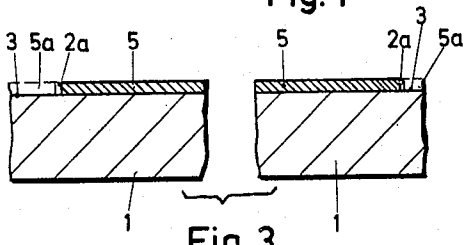


Fig. 3

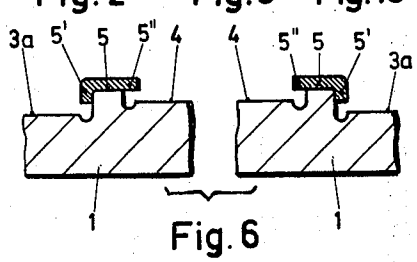


Fig. 6

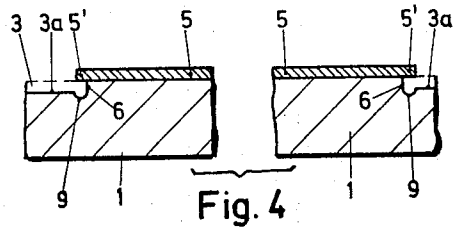


Fig. 4

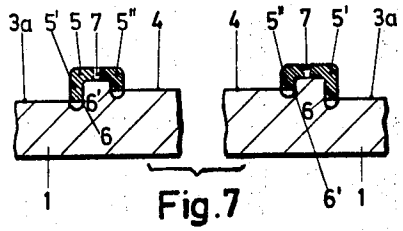


Fig. 7

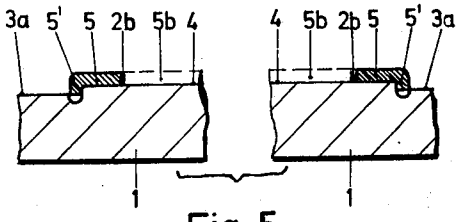


Fig. 5

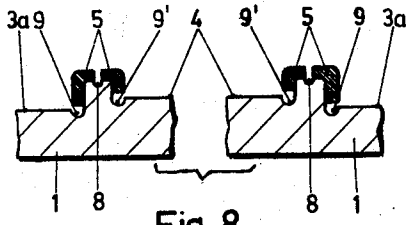


Fig. 8

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METHOD OF MAKING STONE RELIEFS

BACKGROUND OF THE INVENTION

The present invention relates generally to stone reliefs, and more particularly to a method of making such stone reliefs.

The use of reliefs—that is sculptures involving the projection of figures, ornaments and the like from a background—for decorating purposes dates back to antiquity. Many different types of relief work have been developed, and a host of different materials have been used. Thus, it is known to provide reliefs in pressed or cast metal, in form of wood carvings and in stone. The latter material is used especially where the relief is to be provided on a rough or course-textured background, such as a wall, and for such applications relief in natural stone or stone-like materials are customary.

Reliefs can be made by modeling in plastic material, by forming casts of original objects to which plastic materials are applied and subsequently removed when they have hardened, or by the removal of material from a blank to thereby obtain the desired appearance of the relief. The latter approach is that which is historically employed in the making of stone reliefs, particularly in the making of natural stone reliefs. Material is removed manually by means of suitable tools, such as chisels, drills, gouges and the like.

Reliefs produced in this manner in stone are the product of great skill on the part of the artist. They are exceedingly time-consuming to produce and concomitantly expensive. Moreover, and particularly where lines in the relief are close together and/or where the artisan has incorrectly evaluated the structure of the stone, even a skilled artisan frequently cannot avoid irreparable errors or damage.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to overcome the aforementioned disadvantages with respect to the production of stone relief.

More particularly it is an object of the present invention to provide an improved method of making stone reliefs, particularly reliefs in natural stone.

In pursuance of these objects, and others which will become apparent hereafter, one feature of the invention resides in a method of making stone reliefs which, briefly stated, comprises the steps of removing contaminants from an exposed surface of a stone element on which a relief is to be produced, and intimately adhering to and covering said exposed surface in surface-to-surface contact with a self-adhesive foil resistant to etching fluid capable of attacking the stone element. On the exposed side of the foil an illustration of the desired relief is provided. Now, sections of the foil which each match the outline of a portion of the illustration are successively removed, to thereby expose corresponding underlying portions of the surface. To the respectively exposed portions of the surface etching fluid is applied of a concentration and for a period of time requisite to etch the respective exposed portion to the desired depth, before another section of the foil is removed and the etching process repeated.

The treatment of the exposed surface of the stone element for removal of contaminants is carried out in known manner, for instance by washing with an acid—e.g., concentrated hydrochloric acid—or a lye solution.

Thereupon, the surface is thoroughly washed—e.g., with water—to remove all traces of the lye or acid, dried, and provided with the aforementioned self-adhesive foil. It will be appreciated that at least one side of the foil—that is the one which will be exposed after the foil has been applied to the stone element—must be capable of accepting an illustration of the desired relief, in form of a sketch or the like. This illustration can be provided before the foil is applied or it can be provided after the foil has been applied to the stone element. How the illustration is applied to the foil is immaterial, and tracing, free-hand sketching and printing are mentioned here only as illustrative examples.

By resort to my invention it is possible to provide reliefs in stone, particularly in natural stone, of the most varied figures, ornaments or the like; moreover, these reliefs need not be produced by highly skilled artisans, but only by persons who have been trained in carrying out the novel method. If the method is carried out with a reasonable amount of care it will almost invariably result in the production of flawless reliefs, thereby eliminating rejects, quite aside from the fact that it is of course less time consuming and therefore less expensive than the conventional method, particularly when considered in conjunction with the fact that it is carried out not by highly skilled artists but by readily trained production personnel. Some reliefs are in simple line form while others are raised above and bordered by a free surface, that is a surface portion which is not provided with relief. Again, there are reliefs which have relatively large planar surface areas within the outline of the relief configuration, and which are offset from other portions of the relief by fine lines. These latter possibilities are readily achievable by exposing the surface portions corresponding to the large areas— that is by removing the corresponding sections of foil—and treating each such surface portion in successive stages of which each may last approximately 7 – 8 minutes, for example—each involving the application of an etching fluid, the removal of the etching fluid and the drying of the exposed surface area whereupon the marginal portions of the foil bounding the surface area under treatment are tightly pressed against the edge face of the gradually deepening depression whose outline corresponds to the exposed surface area. This guarantees the formation of sharply defined edges at the juncture between surface portions which are etched to a differential depth. Of course, the depth can be regulated at will by varying the concentration of the etching fluid, varying the time period for which the etching fluid is allowed to contact the respective surface area of the stone element, and varying the number of times for which the etching fluid is applied. The use of the marginal portions of the foil in the aforedescribed manner prevents the etching fluid from attacking the edge faces bounding the deepening recess so that these edge faces will be sharp and clearly defined.

Fine contours within the outline of the relief can be provided by removing narrow strip-like portions of the foil corresponding to the respective fine contour to be produced, whereupon the underlying exposed portion of the stone element surface is subjected to one or several relatively short—for instance 2–3 minutes—treatments with etching fluid which in addition may have a reduced concentration if desired. Subsequently the etching fluid is removed by washing with water or the

like in conventional manner. Here, again, the depth to be achieved can be varied at will.

When the various etching steps are completed, but before the residual sections of the foil are removed which still cover those portions of the stone element surface which are not at all to be etched, the washed and dried element with the residual foil sections still adhering thereto may have applied to it suitable coloring matter, for instance a dispersion dye, and this may be accomplished by spraying the coloring matter onto the stone element. By varying the colors and their concentration, as well as varying application time, a great variety of different effects can be produced without having to depart from the simple application procedure. It is possible, for instance, to provide more coloring matter in the narrower grooves of the relief than on the larger surface areas thereof to thereby obtain special effects.

Evidently, a variety of different etching fluids is suitable for carrying out the novel method. The selection will depend largely upon the type of stone to be etched. Thus, hydrochloric acid has been found particularly suitable for use with limestone, such as marble and shell lime. Mixtures of acids and concentrated lyes are also usable.

In some circumstances it is desirable to apply a layer of a protective substance on the finished relief. This is not ordinarily necessary if the relief is to be mounted within a closed room, unless damaging gases, smoke or the like can be expected to be present in such room. However, the application of such protective substance is almost invariably advisable where the relief is to be exposed to the ambient atmosphere, for instance at the outside of buildings or the like. Naturally, different materials are suitable for such protective coatings and they are well-known to those having skill in the art. Their selection will depend to a large extent upon the deleterious contents in the ambient atmosphere against which the relief is to be protected. Generally speaking, however, such a protective coating must not detract from the appearance of the material, which means that it should be colorless, transparent and reflection free.

The novel features which are considered as characteristic for the invention are set forth in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary top-plan view of a stone element provided with a relief in form of a raised cross;

FIG. 2 is a section on the line A—A of FIG. 1 showing the stone element with the protective foil applied, before initiation of the work;

FIG. 3 is a fragmentary section on the line B—B of FIG. 1 showing the prepared stone element of FIG. 2 in a first operational stage;

FIG. 4 is a view similar to FIG. 3 showing the element in a further operational stage;

FIG. 5 is a view similar to FIG. 4 showing an additional operational stage;

FIG. 6 is a view similar to FIG. 5 showing the next-following operational stage;

FIG. 7 is a view similar to FIG. 6 showing a succeeding operational stage;

FIG. 8 is a view similar to FIG. 7 showing the final operational stage;

FIG. 9 is a view similar to FIG. 2 but showing the completed stone relief; and

FIG. 10 shows the stone relief of FIG. 9 in the same view but with a protective layer applied.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, it will be seen that in FIG. 1 I have illustrated a stone relief in form of a raised cross which is provided on a stone element **1**. The cross **2** is surrounded by a marginal surface portion **3***a* of the stone element **1**, and within the outlines of the cross **2** there is an inner planar surface portion **4** which is recessed below the highest level of the cross **2**, but not to the extent of the surface portion **3***a* (compare FIG. **9**).

To produce the stone relief shown in FIG. **1**, an exposed surface of the stone element **1** is first cleaned of contaminants by washing with an acid or a lye, and subsequent removal of the acid or lye and drying of the exposed surface. Thereupon a self-adhesive foil **5** is applied and tightly pressed onto this surface, as shown in FIG. **2**. The foil **5** must be resistant to the acid or lye which is to be used for removing material from the stone element **1**; this acid or lye will hereinafter be referred to as the etching fluid for the sake of convenience. The outer exposed side of the foil **5** is previously or subsequently provided with an illustration of the desired relief. It is also possible to provide the illustration on a separate sheet, for instance a so-called "decal" and to apply it to the outer side of the foil **5**.

Thereupon, the foil **5** is severed along the outer line **2***a* of the cross **2**, as shown in FIG. **3**, and the outer portions **5***a* of the foil **5** are removed. This exposes the underlying surface portions of the stone element **1**. This surface portion **3** is now thoroughly cleaned in conventional well-known manner, and any residual adhesive from the foil **5** which might still adhere, is removed. Now the stone element **1** is exposed repeatedly to the influence of etching fluid, i.e., hydrochloric acid, for respective periods of approximately 7–8 minutes, in order to remove material from the surface portion **3** until the level **3***a* is reached as shown in FIG. **4**. During each such etching stage, the etching fluid penetrates slightly below the marginal portion of the foil **5** into the stone and thus produces along and substantially below the marginal portion **5'** of the foil a groove **9**. After each etching stage, the respective marginal portion **5'** is bent inwardly and tightly pressed against the inner edge face **6** of the respective groove **9** whereby the thus-covered edge face **6** is protected against further attack by the etching fluid during the next etching stage so that sharply delineated outer contours are obtained for the relief.

After the surface portion **3** has been etched to the desired depth to thereby obtain the level **3***a* of FIG. **4**, the foil **5** is severed along the interior contour line **2***b* of the cross **2**, and the foil portion **5***b* is removed. This exposes the underlying surface portion **4** of the stone element **1**, and in the same manner as before this surface portion **4** is subjected to one or several etching stages. The inner marginal portions **5''** of the remaining foil sections are again bent over into the developing etching

groove (compare FIG. 6) in the same manner in which this has been illustrated and described with reference to FIG. 5. This results in sharp internal contours for the cross 2, also.

In FIG. 1, I have shown thin lines 8 intermediate the inner and outer contours of the cross 2. To produce these lines 8 a narrow foil strip 7 is removed as shown in FIG. 7. The thus-exposed surface portion is now subjected for a short period of time to treatment with the etching fluid whereby a narrow groove 8 is etched into the surface of the stone element 1 along the cutout 7 and constitutes the intermediate line 8. Depending upon the desired depth for the groove 8 the application of etching fluid may be shorter or longer. The groove 8 is shown in FIG. 8 and it will be seen to be shallower when the etching grooves 9, 9' which bound the outer and inner contours of the relief.

After all etching steps are completed the residual foil sections are removed—that is those still present in FIG. 8—and the now exposed stone element 1 is provided with the relief visible in FIG. 9 in section. If desired the element 1 may now have applied to it, for instance by spraying, a dispersion dye which settles more strongly in the etching grooves than on the planar surfaces and which provides a particularly good three-dimensional appearance. Finally, and as shown in FIG. 10, the exposed side of the stone element 1 which is provided with the relief may now be coated with a layer 10 of a suitable material which protects against attack by deleterious agents present in the ambient atmosphere, and which—while its particular composition is selected in dependence upon deleterious agents to which the element 1 is expected to be exposed—should meet the requirements that it be colorless, transparent and non-reflective so as not to conceal the texture of the stone element.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of embodiments differing from the types described above.

While the invention has been illustrated and described as embodied in a method of making stone reliefs, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. A method of making stone reliefs, comprising the steps of removing contaminants from an exposed surface of a stone element on which a relief is to be produced; intimately adhering to said exposed surface in surface-to-surface contact therewith an adhesive provided on one side of a foil which is resistant to etching fluid capable of attacking said stone element; providing on the other side of said foil an illustration of the desired relief; successively removing sections of said foil each matching the outline of a portion of said illustration, to thereby expose corresponding surface portions of said surface; applying to at least some of said exposed surface portions an etching fluid of requisite concentration for a predetermined period of time required to produce a depressed surface portion which is bounded by edge faces; removing the applied etching fluid; drying the depressed surface portion; deflecting marginal zones of the foil which bound said depressed surface portion, into tight overlying engagement with said edge faces so as to cover the latter; and repeating at least the steps of applying and removing while said marginal zones cover said edge faces, to thereby obtain sharply defined edge faces at the juncture between respective surface portions.

2. A method as defined in claim 1, wherein the step of applying said etching fluid also comprises applying said etching fluid to others of said exposed surface portions at least once and for a period of time considerably shorter than said predetermined period of time, removing the thus-applied etching fluid, and drying the respective other exposed surface portions.

3. A method as defined in claim 2; and further comprising the step of applying coloring matter to said depressed surface portions prior to removal of residual sections of said foil from still covered portions of said surface.

4. A method as defined in claim 3, wherein said coloring matter is a dispersion dye.

5. A method as defined in claim 3, wherein the step of applying said coloring matter comprises spraying said coloring matter onto said depressed surface portions.

6. A method as defined in claim 3, wherein first ones of said depressed surface portions are etched in form of narrow and shallow grooves, and wherein second ones of said depressed surface portions are etched in form of deeper recesses having relatively large surface areas, and wherein the step of applying coloring matter comprises applying said coloring matter more heavily in said grooves than in said recesses.

7. A method as defined in claim 3, wherein first ones of said depressed surface portions are etched in form of narrow and shallow grooves, and wherein second ones of said depressed surface portions are etched in form of deeper recesses having relatively large surface areas.

8. A method as defined in claim 3; and further comprising the subsequent steps of removing said residual sections of said foil so that said surface is again exposed with the desired relief provided therein; and coating said surface and relief with a layer of transparent material capable of protecting said surface and relief against mechanical and atmospheric damage.

9. A method as defined in claim 8, wherein said layer of protective material is colorless and non-reflective.

* * * * *