Feb. 28, 1967 B. G. STEED 3,305,992

HOLLOW CORE DOOR CONSTRUCTION

Filed June 8, 1964 3 Sheets-Sheet 1

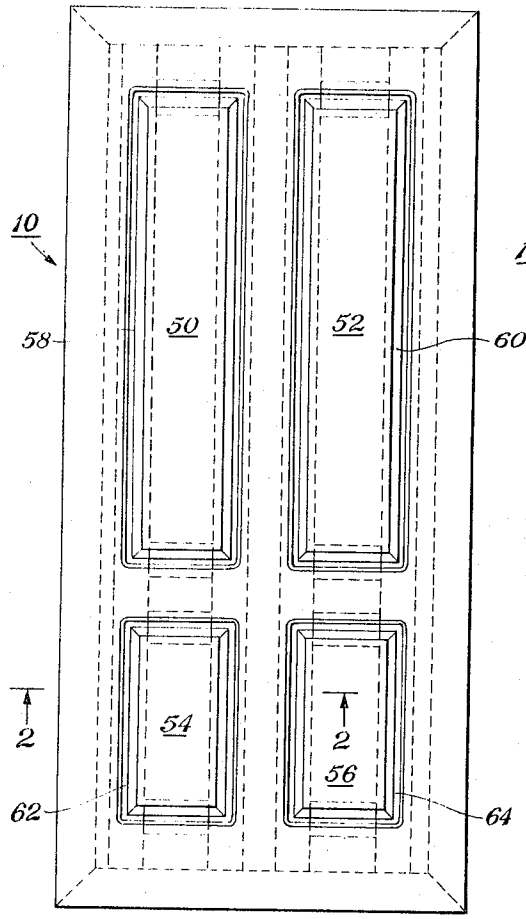


Fig. 1

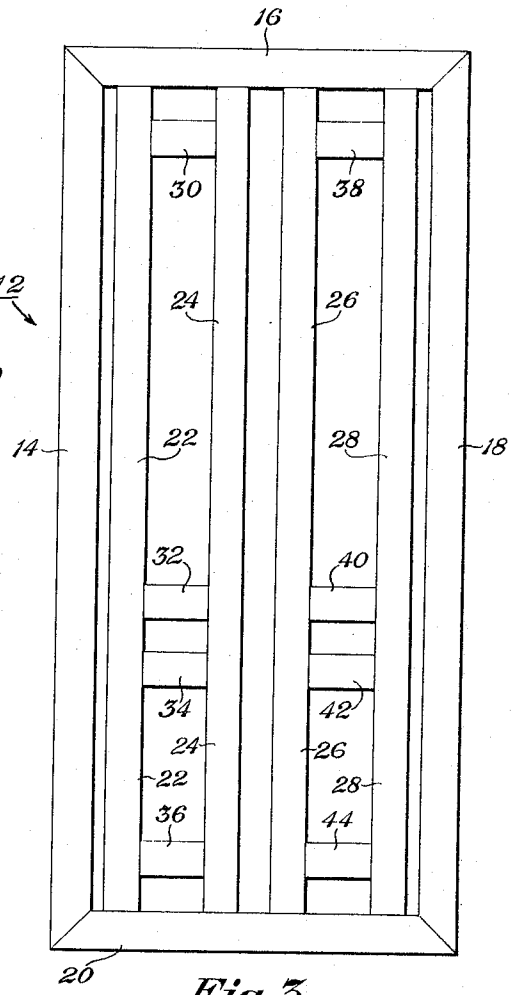


Fig. 3

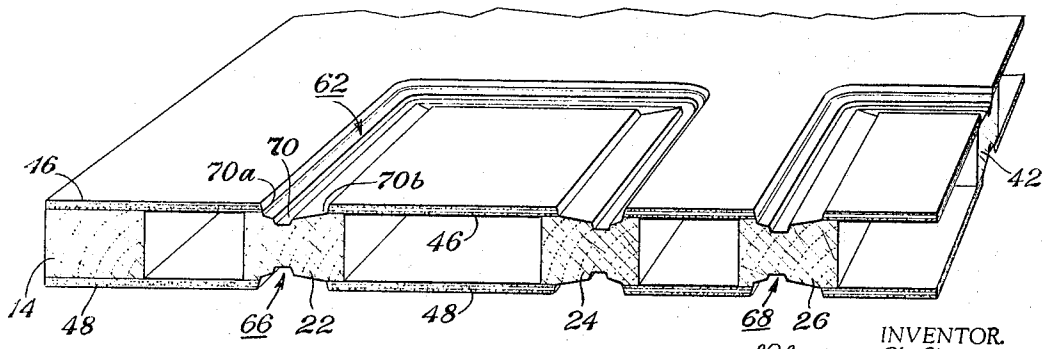


Fig. 2

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HOLLOW CORE DOOR CONSTRUCTION

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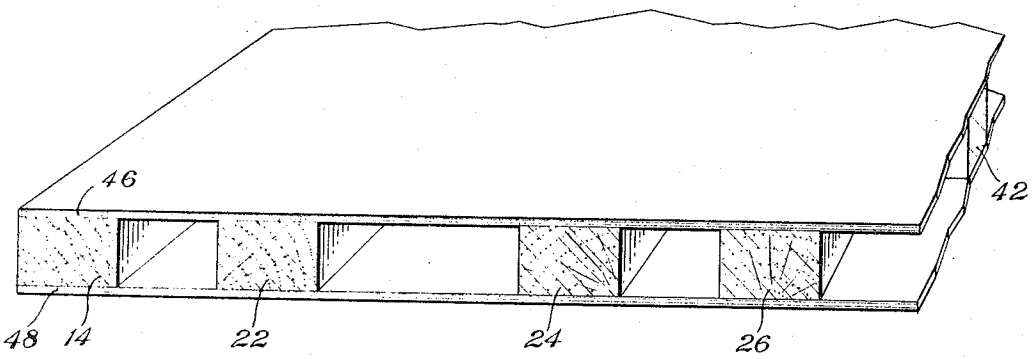


Fig. 4

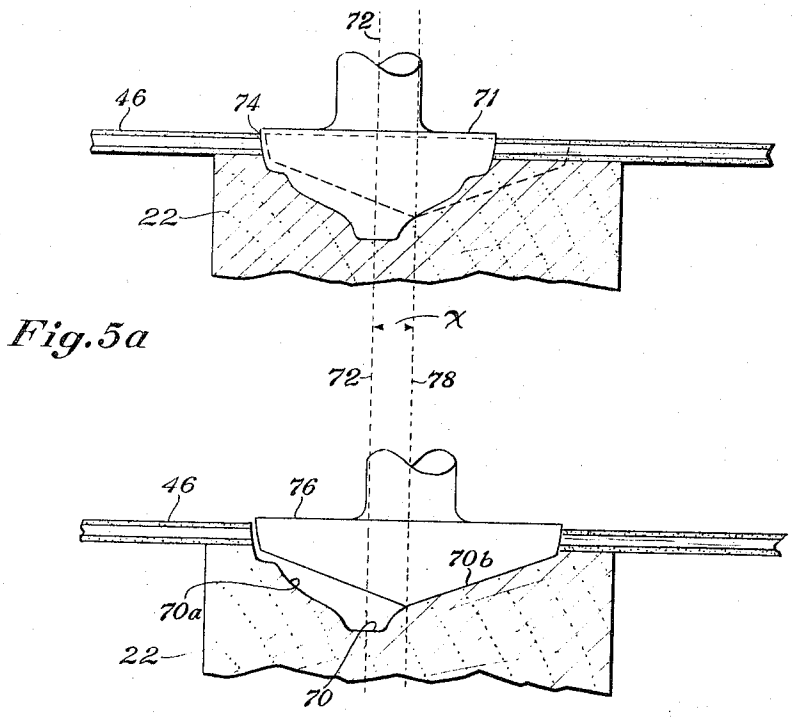


Fig. 5a

Fig. 5b

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HOLLOW CORE DOOR CONSTRUCTION

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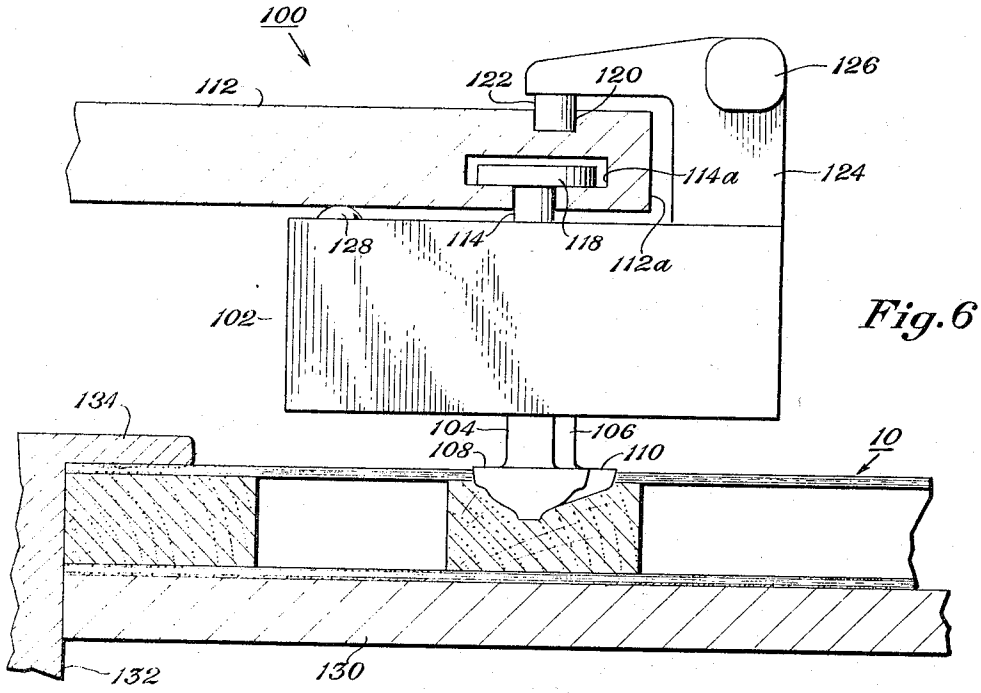


Fig. 6

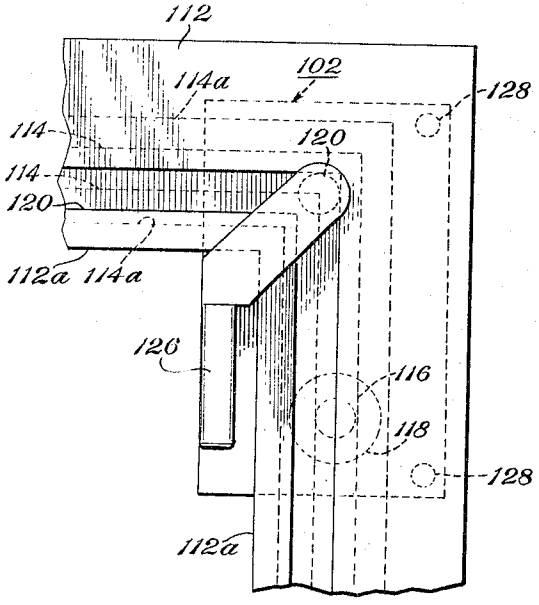


Fig. 7

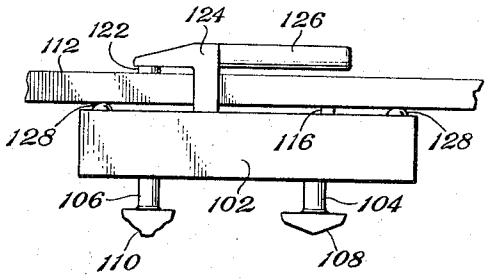


Fig. 8

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3,305,992

HOLLOW CORE DOOR CONSTRUCTION

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6 Claims. (Cl. 52—314)

The present invention relates to doors, partitions and similar prefabricated panel constructions, and more particularly, but not by way of limitation, relates to a method for manufacturing hollow core doors having decoratively-engraved faces, to the resulting article of manufacture, and to an apparatus for performing the method.

As is well-known, many doors presently in use today have an interior frame covering on each side of sheets of plywood. This type of door is commonly referred to as a hollow core door. These doors are relatively inexpensive due to reduced cost of materials and reduced cost of fabrication, but in general are available only with plain faces due to the fact that the plywood sheets are so thin that no decorative groove or interruptions in the planar surface can be made. The doors which are generally considered to be more attractive are fabricated from a plurality of panels which are held by an interlocking framework. In general this type of door has a face which appears to be engraved in that it has surface irregularities which produce an attractive design. However, the paneled doors of conventional construction are substantially more expensive than hollow core doors.

In accordance with the present invention, a hollow core type door, partition or other construction panel, may be engraved with grooves to a substantial depth so as to interrupt the otherwise planar face and produce a more attractive appearance simultating the more expensive doors fabricated from panels. The door constructed in accordance with the present invention is comprised of a frame formed of strips generally outlining the engraved design in the face of the door, a sheet of material covering the frame to form the face of the door, and a groove formed in the face of the door having a depth greater than the thickness of the sheet in zones shadowed by the strips.

In accordance with the method of the present invention, a frame is formed of strips generally outlining the door and the design to be engraved, a sheet of material is bonded to the frame, and grooves are formed in the sheet and the backing strip of greater depth than the thickness of the sheet to produce the desired engraved design.

In accordance with an important aspect of the invention the grooves are made of irregular cross-sectional configuration by passing separate router tools along parallel paths spaced one from the other such that the opposite sides of the grooves are milled by the different tools. This process permits the formation of a non-symmetrical groove which more nearly simulates the conventional panel type door construction and in general eliminates the undesirable appearance which would result from merely routing a conventional symmetrical groove on the face of the door.

The invention also contemplates a novel apparatus for manufacturing an engraved door or other panel of the type described comprised of support means for supporting a door, a mill holder having two spaced rotary shafts disposed at right angles to a door supported by the support means, a milling tool rotated by each shaft having a sweep, and means for guiding the mill holder along a predetermined closed path such that the shafts travel along parallel closed paths spaced apart a distance less than the combined sweep of the tools.

Therefore, an important object of the present invention is to provide a hollow core door having a more decorative appearance.

A further object of the present invention is to provide a hollow core door having an appearance simulating a more expensive panel type door.

Another object of the present invention is to provide a door construction of the type described which may be economically manufactured.

A further object of this invention is to provide a process for manufacturing a door of the type described.

Still another object of this invention is to provide a process for forming a decorative groove in the face of a door or the like which is not symmetrical about a center line, yet which may easily be formed in substantially any pattern, including right angles.

A still further object of the present invention is to provide a process for manufacturing a hollow core door of the type described on an economical mass production basis.

A still further object of this invention is to provide an apparatus for engraving doors and panels with unsymmetrical grooves of the type described by a single pass of a milling tool.

Many additional objects and advantages will be evident to those skilled in the art from the following detailed description and drawings, wherein:

FIGURE 1 is a view of the face of a door constructed in accordance with the present invention;

FIGURE 2 is a sectional view taken substantially on lines 2—2 of FIGURE 1;

FIGURE 3 is a view of the interior frame of the door of FIGURE 1 and serves to illustrate one step of the method of the present invention;

FIGURE 4 is a sectional view similar to FIGURE 2 which serves to illustrate another step of the method of the present invention;

FIGURES *5a* and *5b*, taken in conjunction, illustrate further steps of the method of the present invention;

FIGURE 6 is a somewhat schematic view illustrating a portion of an apparatus constructed in accordance with the present invention for engraving doors and the like in accordance with the method of the invention;

FIGURE 7 is a top view of a portion of the apparatus of FIGURE 6; and,

FIGURE 8 is a side view of a portion of the apparatus of FIGURE 6.

Referring now to the drawings, a door constructed in accordance with the present invention is indicated generally by the reference numeral **10**. The door **10** is comprised of an interior frame indicated generally by the reference numeral **12** and illustrated in FIGURE 3. The frame **12** is comprised of peripheral strip members **14**, **16**, **18** and **20** which are interconnected by miter joints and form the outline and edges of the door **10**. Vertically-disposed interior strips **22**, **24**, **26** and **28** extend between the top and bottom peripheral strips **16** and **20** and are secured thereto. Transversely-extending strips **30**, **32**, **34** and **36** are connected between the strips **22** and **24**. Similarly, transverse strips **38**, **40**, **42** and **44** are connected between the vertical strips **26** and **28**. The strips forming the frame **12** will customarily be of a relatively inexpensive wood. The strips are preferably interconnected by glue or other bonding agent, but may be interconnected by any suitable means such as, for example, nails. The width of the strips, particularly the interior strips, is greater than the width of the grooves to be milled therein as hereafter described.

Sheets of relatively thin plywood **46** and **48** are bonded to the opposite sides of the frame **12** and are co-extensive with the frame to form the opposite faces of the doors.

As illustrated, the door **10** has four simulated panels **50**, **52**, **54** and **56** which are formed by continuous grooves **58**, **60**, **62** and **64**, respectively.

As can be seen by reference to FIGURE 3 and to the dotted lines of FIGURE 1, the interior strips of the frame **12** generally outline the respective simulated panels and in particular shadow or back up the grooves outlining the simulated panels. For example, the strips **22**, **34**, **24** and **36** generally outline the panel **54** and shadow the groove **62**. The grooves, for example, groove **62** as best seen in FIGURE 2, are of greater depth than the thickness of the plywood sheet **46** and are therefore partially formed in the strips **22**, **34**, **24** and **36**. An identical or similar engraved pattern may be provided on the back side of the door **10** as illustrated by the grooves **66** and **68** in FIGURE 2.

It will be noted that the grooves are not symmetrical and have a deep channel portion **70**, a relatively steeply sloping irregular outer wall **70***a*, an irregular inner wall **70***b* of less slope. This groove construction closely simulates the appearance of conventional doors constructed from a plurality of panels by tongue and groove techniques and also eliminates the undesirable appearance which a symmetrical groove would have of being placed there purely for decorative purposes. Although as illustrated, the grooves define rectangular panels, it is to be understood that panels of substantially any shape may be provided, in which case the strips of the frame **12** would be so oriented as to shadow and back up the grooves.

In accordance with the method of the present invention, the interior frame **12** is first fabricated substantially as illustrated in FIGURE 3. Then the sheets of plywood **46** and **48** are bonded to the frame by a suitable glue or other bonding agent. The grooves are thin milled in the face of the hollow core panel in the areas backed by the strips of the interior frames to form the desired engraved design. As previously mentioned, the grooves are cut to a depth greater than the thickness of the plywood sheets. The deep channel portion **70** and outer wall **70***a* of the grooves are first formed by a router tool **71** having a configuration substantially as shown in FIGURE 5*a*. The router tool **71** has an axis of rotation **72** disposed normal to the face of the door. The routing tool preferably has a vertical cutting edge **74** of greater depth than the thickness of the plywood **46** so as to reduce the likelihood of producing a ragged edge along the plywood. Next a second router tool **76** having a configuration substantially as illustrated in FIGURE 5*b* is used to form the interior wall **70***b*. The second router tool **76** has an axis of rotation **78** that is moved along a path spaced from and parallel to the path followed by the axis of rotation **72** of the first router tool **71** by a distance less than the combined sweep of the two tools. As used herein, the sweep of each tool shall be considered as the distance from the axis of rotation to the outermost cutting edge. Therefore, if distance between the paths of the axes of rotation of the two tools is less than the combined sweep of the two tools, a single groove will be milled or more precisely, routed. As illustrated, it will be noted that the sweep of the second tool **76** is less than the distance from the axis of rotation **78** of the second tool to any portion of the opposite outer wall **70***a* cut by the first router tool **71** so that the bottom channel **70** and wall **70***a* will be cut only by the first router tool and the opposite or inner wall **70***b* will be cut by the router tool **76**. In accordance with the broader aspects of the invention, it is not necessarily essential that the router tools be limited to forming only one wall of the groove. Any combination of the overlapping router tools may be employed to cut various portions of the groove and form unsymmetrical grooves. However, when square corners are to be turned as in the case of the continuous grooves illustrated in FIGURE 1, it is important that the router tool cutting the inner surface not cut any portion of the outer surface. If the inner tool does cut a portion of the outer wall of the groove, it will be impossible to turn a sharp or right angle corner because of the different radii of the outer edge cut by the two tools as the tools pass around the corners as will hereafter be described in greater detail.

An apparatus for manufacturing a door in accordance with the present invention is illustrated in FIGURES 6–8 and indicated generally by the reference numeral **100**. The apparatus **100** is comprised of a dual shaft mill holder **102** from which a pair of spaced, parallel drive shafts **104** and **106** extend. The mill holder **102** includes a suitable drive mechanism (not illustrated) for rotating the shafts **104** and **106** at a relatively high speed. Milling cutters commonly referred to as router blades **108** and **110** are mounted on the shafts **104** and **106**. The router blades **108** and **110** may correspond in shape to the tools **71** and **76** heretofore described in connection with FIGURES 5*a* and 5*b*.

The mill holder **102** is suspended from a guide rail **112** for movement along a predetermined path corresponding to a groove to be cut in the face of a door **10**. The guide rail **112** has a first guide channel **114** which receives a first guide pin **116**. The guide pin **116** is precisely lined with the axis of rotation of the first shaft **104**. A head portion **118** is provided on the guide pin **116** and is received in an enlarged portion **114***a* of the channel **114** to support the mill holder **102**. A second guide channel **120** is formed in the top of the rail **112** and receives a second guide pin **122** which is precisely aligned with the axis of rotation of the second shaft **106** The guide pin **122** is connected to the mill holder **102** by a bracket **124** extending around the interior edge of the guide rail **112**. The first and second guide channels **114** and **120** extend in parallel relationship with the centers thereof spaced apart a distance corresponding to the desired spacing between the axes of rotation of the router blades, such as for example, the distance *x* illustrated in FIGURE 5*a* and 5*b*. As previously described, the distance *x* is less than the combined sweep of the two milling or router blades **108** and **110**.

The guide rail **112** may be continuous and in order to outline a panel of the door **10** must turn four right angles by means of mitered corners substantially as illustrated in FIGURE 6. In FIGURE 6 the guide channels **114** and **120** are illustrated in dotted and solid lines, respectively. The guide pin **122** is illustrated at the corner of the turn and, as illustrated, is designed to trail the guide pin **116**. As will be noted in FIGURE 7, the bracket **124** extends diagonally forward from the guide pin **122** by an angle of at least 45° in order to clear the inside edge **112***a* of the rail **112**. A handle **126** may extend forwardly from the bracket **124** to facilitate manually moving the mill holder **102** along the rail **112** as will hereafter be described. Or if desired, the mill holder **102** can be moved along the rail by any suitable mechanism (not illustrated). Spherical rollers **128** are rotatably received in sockets (not illustrated) in the mill holder **102** and are positioned to engage and roll on the underside of the guide rail **112** and properly orient the router blades with respect to the guide channels.

Door **10** or other workpiece is supported and may be raised into engagement with the router blades **108** and **110** by a suitable support **130**. A guide plate **132** may extend along two edges of the door at right angles to properly orient the door with respect to the guide rail **112**. The guide plate **132** may be associated with a horizontally-disposed stop plate **134** against which the upper face of the door is raised for both properly positioning the upper face and also for securely holding the door between the plate **134** and the support **130** as the groove is cut in the door.

In operation, the support **130** is lowered until the door panel in the form illustrated in FIGURE 4 will slide under the router blades **108** and **110** into engagement with the guide plate **132**. After two adjacent edges of the door are butted against the guide plate **132**, the door will be prop-

erly oriented with the backing strips of the frame beneath the guide channels of the guide rail **112**. The mill holder **102** is then energized to rotate the router blades **108** and **110** and the support **130** raised until the door **10** engages the stop plate **134** which may extend around the periphery of the door. The operator moves the mill holder **102** along the rail in a direction such that the router blade **108** precedes the router blade **110**. By pressing downwardly and outwardly on the handle **126**, the spherical rollers **128** may be biased upwardly against the under surface of the guide rail **112** to assure that the shafts **104** and **106** are oriented normal to the face of the door **10** and also to insure that the guide pins **114** and **122** are firmly pressed against the outer edges of the guide channels **114** and **120**, respectively.

As the leading guide pin **116** approaches a right angle corner, the pin is jammed tightly into the outer edge of the corner and then kicked around the corner. The trailing guide pin **122** continues to follow until it reaches the position illustrated in FIGURE 7 at which time care is taken to maintain the pin in contact with the outer edges of the guide channel **120**. By reason of the fact that the guide channels **114** and **120** are always in parallel relationship and uniformly spaced and the guide pins **116** and **122** are precisely aligned with the axes of rotation of the router tools, the router blade **110** will follow the router blade **108** in the same relative position illustrated in FIGURES *5a–5b* and FIGURE 6 at all times. In this regard it will be noted that it is desirable when turning a right angle that the radius or sweep of the blade cutting the outer wall of the groove, i.e., router blade **108**, be of minimum radius so as to reduce the curvature of the outer edge of the final groove cut in the door panel to a minimum. It is important that the other router blade **110** cut only the interior wall of the groove. If the sweep of the blade **110** is great enough to cut a portion of the outer wall of the groove, a portion of the groove at the corner will not be cut due to the different sweeps of the router blades and the groove will have undesirable anomalies at the corners. Each of the continuous grooves **58**, **60**, **62** and **64** can be cut separately, or four separate guide rails and mill holder units **102** may be provided on a single system for either individual manual operation or simultaneous mechanical operation.

From the above detailed description of preferred embodiments of the invention, it will be appreciated that an improved hollow core door, partition or similar panel construction has been described. The door has the economical advantages of a hollow core construction, yet can be decoratively engraved to produce any desired design. In particular, the hollow door may simulate a paneled door of more costly construction. A method for fabricating doors or other panels on an economical, mass production basis with a minimum use of expensive fabrication materials has also been described. The method includes a means for forming a decorative groove having an unsymmetrical cross section of substantially any shape to be formed. In particular, the method permits the simulation of a paneled door construction by reason of providing a means for turning right angle corners. An apparatus or system for manufacturing doors and for engraving panels in general with unsymmetrical grooves with considerable precision on a mass production basis has also been described.

Although preferred embodiments of the invention have been described in detail, it is to be understood that various changes, substitutions and alterations can be made in the parts and combinations thereof and in the steps and sequences thereof without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A hollow core panel having an engraved design on the face thereof formed by grooves comprising:

a frame formed of strips defining the periphery of the panel and strips within the periphery generally outlining the engraved design,

a sheet of material bonded to each of the strips and covering the frame to form the face of the panel, and

grooves cut in the face of the panel through the sheet of material into the strips generally outlining the engraved design to form the engraved design, the sheet of material being bonded to the strips along both edges of the sheet formed by the grooves.

2. A hollow core panel having an engraved design in the face thereof as defined in claim **1** wherein:

the grooves have a non-symmetrical cross-sectional configuration.

3. A hollow core panel having a design on the face thereof formed by grooves comprising:

a frame formed of interconnected strips generally outlining the design, the strips leaving openings in the frame and having a width greater than the width of the grooves,

a relatively thin sheet of material bonded to one side of the frame and covering the openings through the frame, and

grooves of greater depth than the thickness of the sheet cut through the sheet and into the adjacent strips to produce the design, the sheet of material being bonded to the strips along both edges formed by the grooves to produce a hollow space defined by the sheet of material and the strips.

4. A hollow core door having a design on one face thereof formed by grooves comprising:

a frame formed of strips outlining the door and the design, the portions of the strips shadowing the grooves having widths greater than the widths of the grooves, the frame having opposite, generally planar sides,

a sheet of material bonded to each side of the frame forming opposite faces of the door, and

grooves cut through one of the sheets of material into the adjacent strips to a greater depth than the thickness of the sheet to form the design, the sheet being bonded to the strips along both edges of the grooves to form a hollow core defined by the strips and the sheet.

5. A hollow core door as defined in claim **4** wherein:

both faces of the door are provided with groove designs.

6. A hollow core door having a simulated panel formed in the face thereof by an endless groove comprising:

a frame formed of strips outlining the door and the simulated panel, the strips outlining the simulated panel having a width greater than the width of the corresponding portion of the groove,

a sheet attached to and covering one side of the frame, and

an endless groove of greater depth than the thickness of the sheet formed in the sheet and the strips outlining the panel, the portion of the sheet within the endless groove being bonded to the frame around the periphery of the sheet formed by the groove.

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