Nov. 7, 1972 R. L. JONES 3,702,180

MOLD FOR CASTING CONCRETE PANELS

Filed March 23, 1970 2 Sheets-Sheet 1

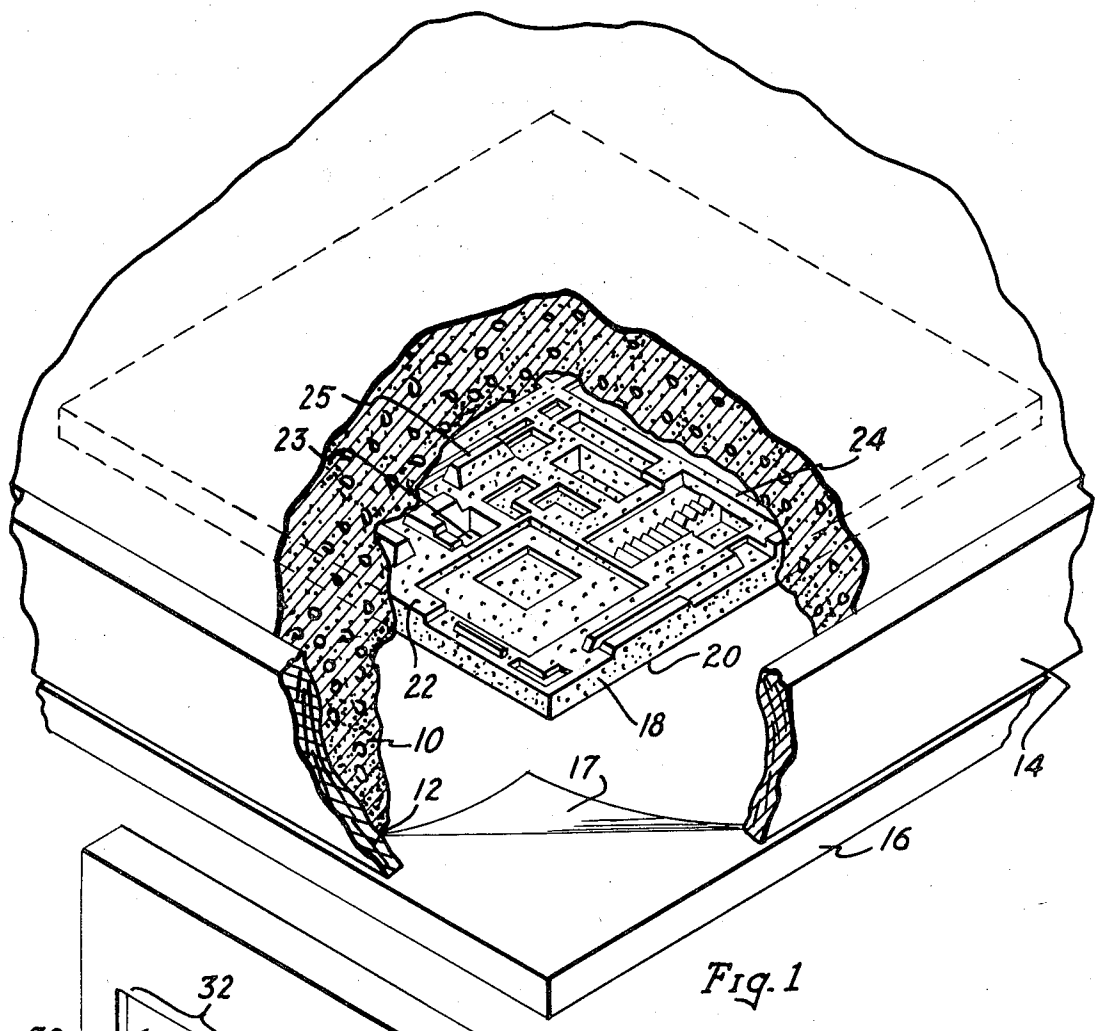


Fig. 1

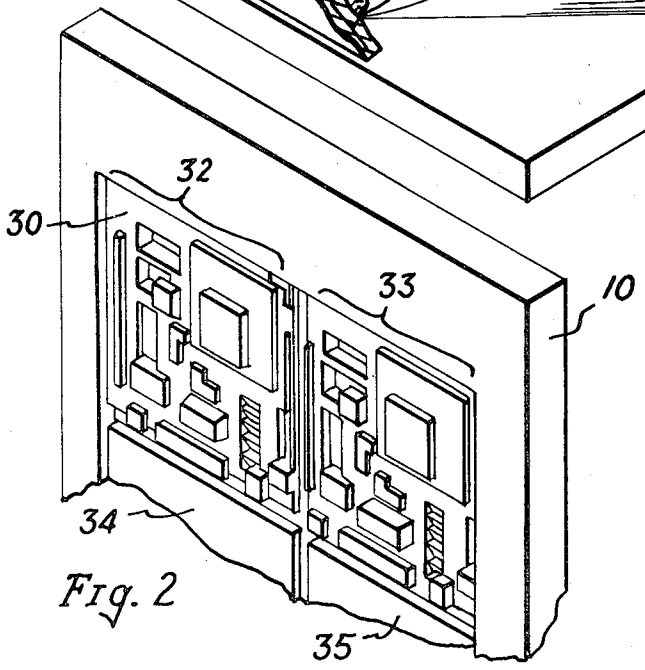


Fig. 2

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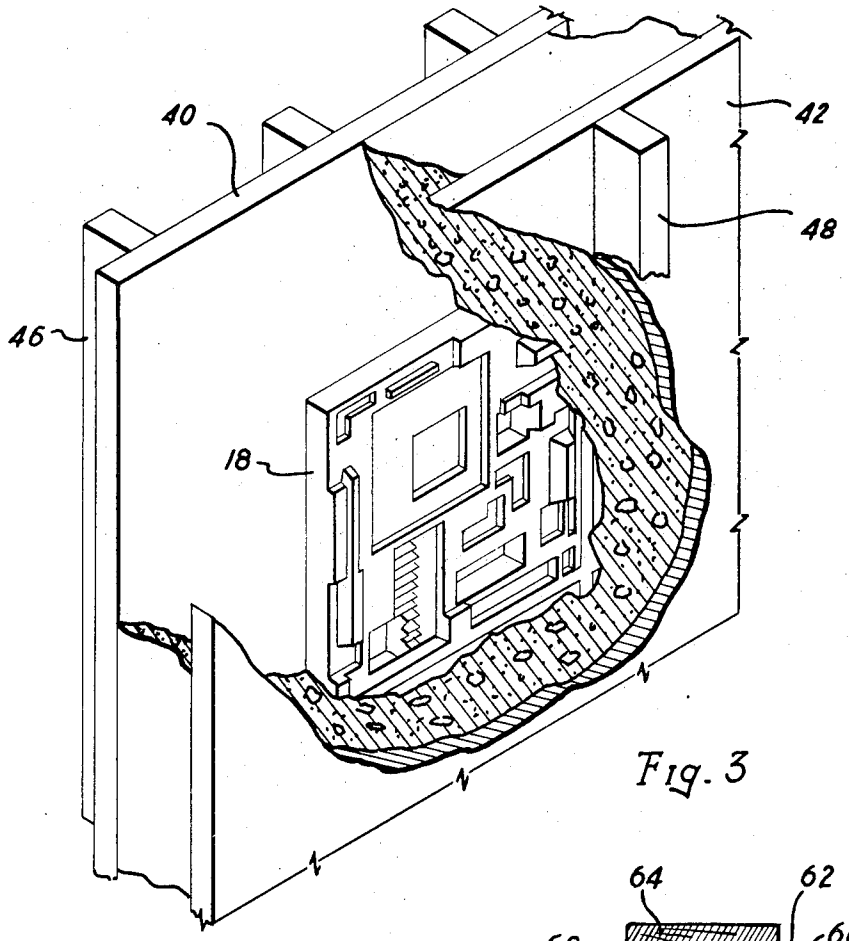


Fig. 3

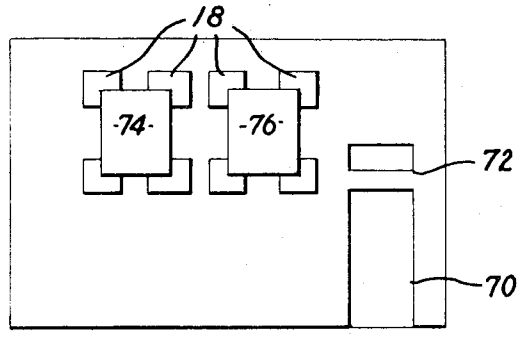


Fig. 5

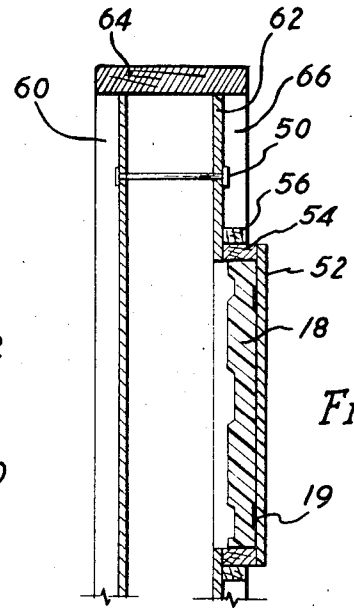


Fig. 4

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MOLD FOR CASTING CONCRETE PANELS

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Continuation-in-part of application Ser. No. 569,397, Aug. 1, 1966, now Patent No. 3,515,779. This application Mar. 23, 1970, Ser. No. 21,755

The portion of the term of the patent subsequent to June 2, 1988, has been disclaimed

Int. Cl. E04g 11/00

U.S. Cl. 249—188 6 Claims

ABSTRACT OF THE DISCLOSURE

A mold is described that comprises a flat, thin plate formed from a rigid and substantially non-compressible cellular plastic foam, preferably polystyrene foam. The mold has a flat, smooth face and, on its opposite face, bears an intaglio pattern of an artistic relief.

DESCRIPTION OF THE INVENTION

This application is a continuation-in-part of my copending application, Ser. No. 569,397, filed Aug. 1, 1966, now Pat. 3,515,779, issued June 2, 1970.

This invention relates to a mold for casting concrete walls and ceilings.

Concrete has become a commonly used material of construction for walls and other flat exposed surfaces of modern buildings. The walls of these building are cast in place or are formed with "tilt-up" panels. In the latter construction, the foundation and flooring for the building is constructed, generally from concrete and, then, forms to contain the concrete for the wall panels are framed on the floor or other adjacent flat area. The frame is built with the desired thickness for the wall, generally from 2 to 15 inches. Door and window spaces are placed in the frame and then concrete is poured into the frame, compacted with vibration, the upper surface is finished and the concrete is permitted to cure. After curing, the concrete forms are removed and the concrete wall is tilted upright and moved into place on the foundation. The wall is secured to adjacent walls and braces.

A major disadvantage of the concrete wall construction is the unattractiveness of the large expanse of wall which heretofore has not been provided with any integral artistic relief or design. This has been compensated to some degree by mosaic or tile work which has been applied to the walls; however, the expense of this finishing of the walls has precluded the use of artistic relief and limited it to the more costly construction. Accordingly, there exists a need for inexpensive means to provide artistic relief to the concrete walls used in the building industry.

Ideally, both from a materials and labor viewpoint, the means for creating the artistic relief should utilize the concrete itself to form the relief pattern since precast relief patterns require additional labor for attachment to the wall and are subject to breaking during storage and handling. Difficulty is experienced however in attempts to create a molded relief in the precast concrete walls because such relief must be formed with molds that are efficient and operative without requiring any major variation in the normal practice of casting the walls or the resultant labor requirements would greatly increase the cost of the construction to levels that would prohibit use of the molds. Because such molds are to be used in rough construction environments, they must be able to withstand considerable abuse in handling without damage. Preferably, the molds should be disposable and used only once to avoid the necessity for cleaning the intricate intaglio pattern in the mold.

It is an object of this invention to provide a mold useful for casting artistic reliefs in concrete walls.

It is also an object of this invention to provide a disposable mold for such purpose.

Other and related objects will be apparent from the following description of the invention.

I have now found that the preceding objects can be obtained by the use of a concrete mold which comprises a generally flat or thin plate of a rigid, non-compressible, cellular plastic foam having a thickness slightly greater than the depth of the desired relief and bearing an intaglio impression of the artistic relief on one of its faces. The opposite face of the plate is smooth for resting upon a floor or other support within the frame used for forming the concrete wall or for attachment to one of the inner faces of the form used for a poured in place wall. Of particular advantage when used for the plate is rigid polystyrene foam which posses the maximum of very desirable property for this use. Some of these properties are low cost, low density, high water repellancy, high compressive and bending strengths and a surface of variable texture to permit control of the texture of the concrete panel.

The invention will now be described by reference to the figures, of which:

FIG. 1 illustrates the casting of a "tilt-up" concrete wall in accordance with my invention;

FIG. 2 illustrates a portion of the concrete wall of FIG 1;

FIG. 3 illustrates the casting in place of a concrete wall in accordance with my invention;

FIG. 4 illustrates an alternative construction of the framing used for casting in place of a concrete wall; and

FIG. 5 illustrates the layout of a typical wall using the molds of my invention.

Referring now to FIG. 1, there is illustrated a concrete panel **10** that is contained within a form defined by frame members **12** and **14**. Suitable metal reinforcing members of conventional shape e.g., rods, are placed within the form to add structural strength to the wall. The form is generally constructed from wood framing members at the construction site, although metal or plastic forms can be used when a large number of identical panels are to be constructed. The panel is cast on a table or floor **16** which can be covered with a parting agent such as the plastic film **17**. The concrete is poured into the form and after curing, the form is removed and the panel is tilted up on one edge and moved to the perimeter of the floor **16** and secured to structural members and adjacent panels to define a vertical wall of a building. Alternatively, the panel **10** could be a ceiling panel which is raised into engagement and secured to structural beams or rafters.

As previously mentioned, the plainness and monotony of the large exposed surfaces that are normally constructed results in an artistically uninteresting building, particularly when the expensive decorative dressing cannot be economically justified.

My invention, however, readily and inexpensively provides an artistic relief for the concrete panels. This is shown in FIG. 1 as comprising the mold **18** having a generally flat side **20** that rests on floor **16** and an exposed flat side or face **22** having an intaglio pattern of a suitable artistic relief. Mold **18** is illustrated resting on the upper surface of floor **16** to which it can be secured by any suitable means, e.g., fasteners such as concrete nails or preferably an adhesive or mastic. The mold **18** could also be contained within a frame on a subfloor so that the intaglio face of mold **18** is flush with floor **16**. In this manner, use of the mold does not reduce the wall thickness. An example of this type of placement of mold **18** will be described in greater detail in reference to FIG. 3 where the technique is applied to a poured in place wall. With most walls, however, a series of molds **18** can

be placed to provide a ribbed wall that is substantially as strong as the solid, unrelieved wall and the offset mounting shown in FIG. 4 is not necessary.

Mold **18** is illustrated with a modernistic relief on its face and has four repetitive patterns that are divided by ribs **24**. The mold is formed from cellular plastics that are rigid and that possess a sufficient compressive strength to withstand the loading of the concrete without appreciable strain. The mold illustrated measures 2 feet on each side wtih an area of 4 square feet; however, the size can be greatly varied if desired, e.g., panel molds that have an area from 0.1 to 100 square feet can be fabricated, if desired. Preferably, the molds have from 4 to about 100 square feet for ease of fabrication and handling. The thickness of the mold can also be greatly varied, depending on the depth of the desired relief. Mold **18** as illustrated has a maximum thickness of 1.75 inches at **25** and a minimum thickness at **23** of 0.5 inch. The ribs **24** are 1.5 inches thick. In general, the molds should be sufficiently thick to have a resistance to flexing. The minimum thickness should be from 0.005 to 0.2 times the longest length of the panel; preferably from about 0.05 to about 0.1 times this length.

Although polystyrene foam is the most preferred material for construction of mold **18**, any other suitable plastic foam that is rigid and substantially non-compressible can be used. The foam chosen should have a compressive strength sufficient to withstand up to about 150 pounds per square foot without appreciable strain since concrete walls with thickness up to about 12 inches may be formed above the mold. For poured in place walls, foams having compressive strengths of from 10 to 20 p.s.i. are adequate and will be useful on walls up to about 20 feet in height. An example of a suitable foam is cellular polystyrene having a density of about 1.5 pounds per cubic foot. Suitable plastic foams include polyurethane foams of the closed cell or rigid type, cellulose acetate foams, phenolic foams, closed cell polyvinyl chloride foams, and epoxy foams. The mold **18** is fabricated from the plastic foams using conventional technology, e.g., "steam molding" of the polystyrene beads where the beams are pre-expanded into a mold cavity with the pattern of the artistic relief and then fused together by heat, generally steam. Other foams such as the polyurethane foams can be foamed in place in the mold cavity while the vinyl foams can be formed into mold **18** by injection molding.

The cellular plastics are ideally suited for mold **18** because of their water repellancy and, after the concrete has cured, the wall is tilted into place and the mold **18** stripped from the panel. The use of polystyrene foam insures a substantially non-adhering mold without the need for any parting agent. Polystyrene foam also provides control of the texture of the relieved surface of the concrete. The surface of polystyrene foam can be widely varied from a smooth surface illustrated in mold **18** of FIG. 3 to a coarse surface shown in FIG. 1. This variation is achieved by control of the molding conditions in forming mold **18**, i.e., temperature and pressure and by variation in the size of the polystyrene expandable beads which are commercially available with diameters ranging from 0.4 to about 2.0 millimeters; the larger beads being chosen for a coarser textured concrete surface.

FIG. 2 illustrates a portion of the wall **10** which is tilted into a vertical position. The mold cavity is shown at **30** and the desired artistic pattern appears in contiguous blocks **32** and **33**. A similar relief is also formed at **34** and **35**, although this relief has been omitted from the drawing.

FIG. 3 illustrates the use of the mold of my invention as applied to concrete walls that are poured in place. In this construction, vertical forms are constructed with opposing and generally parallel panels **42** and **44** which have stiffing braces **46** and **48**. Frequently tie rods such as **50** shown in FIG. 4 are used to support the panels at the desired spacing and these rods are spaced across the panels at sufficient intervals so as to prevent the weight of the concrete from bowing the panels **42** and **44**. The mold of my invention, **18**, is employed in this type of construction simply by affixing the mold to the inside surface of one or both of panels **42** and **44**. Again, this can be accomplished with mechanical fasteners such as staples or with an adhesive on the back side of the panel. After the panel has been secured onto the panel **40** at the desired location, the panel **40** is then used to frame the form in the conventional manner. Thereafter, concrete is poured into the mold and permitted to cure to produce a wall with a suitable artistic relief.

FIG. 4 illustrates an alternative mounting of the mold **18** which, contrary to the mountings of FIGS. 1 and 3, does not reduce the wall thickness. In this mounting, panel **62** is cut out and an offset panel **52** is attached opposite the cut out portion of this wall with side walls **54** and furring strips **56**. Mold **18** is placed within this cavity so that its outer surface is flush with the inner face of panel **62**. The remainder of the forming is conventional with tie rods **50**, panel braces **60** and **66** and, often, wooden bracing **64**. FIG. 4 also illustrates the mastic or adhesive **19** on the back side of mold **18** which is used to secure the mold in the form and prevent accidental movement of the mold during the pouring of the concrete. This adhesive can be placed on the mold at the factory and the adhesive can be covered with a thin plastic film, e.g., polyethylene of 0.5 to 5 mils thickness. When the molds are used, the film can be stripped from the mold and the mold pressed against the supporting panel **52**. The back surface of the mold can be covered with an adhesive such as a water soluble adhesive, e.g., partially hydrolyzed polyvinyl acetate or an organophilic adhesive such as tar, cellulose acetate, etc. A double faced tape can also be applied to the back of the panel. Preferably, the adhesive can be spotted at one or more points across the surface, e.g ., at each corner and in the center as shown at **19**.

A typical wall layout showing the positioning of the molds **18** is shown in FIG. 5. In this illustration, a tilt-up wall is to be fabricated with an opening **70** for a door and opening **72** for a transit. Window openings **74** and **76** are shown in the wall and at each corner of the windows, molds **18** are shown. This also illustrates another advantage of the rigid plastic foams for this purpose since these foams can be readily cut at the job site with a saw or knife to permit placing the artistic relief at any desired location in the wall.

The polystyrene foamed plastics constitute preferred materials for the construction of the artistic molds of this invention. The following paragraphs will illustrate the fabrication of the preferred molds.

Commercially available, expandable polystyrene beads having diameters ranging from about 0.4 to about 2.0 millimeters, preferably about 1 millimeter, are charged to a preliminary, unconfined expansion to obtain a bulk density equivalent to the real density desired in the finished mold, e.g., about 1.5 pounds per cubic foot. The beads are charged to a pre-expander vessel at atmospheric pressure. The vessel comprises an upright drum having a central, vertical shaft which is rotatable and is driven by an electric motor. A plurality of rods are secured to the inner wall of the drum and project, radially, towards the central shaft in alternate relationship to similar rods that are secured to the shaft and project radially towards the drum wall. The beads are placed in a feed hopper and are aspirated into the bottom of the drum by a jet of steam. The beads rise in the drum in contact with the steam which heats them sufficiently to cause expansion of the beads to the desired density while the rods of the rotating shaft agitate the mass of beads sufficiently to prevent their fusion. A free-flowing stream of beads overflows into an outlet at the top of the drum and is ready for processing in the mold press.

The desired artistic relief is formed as a metal pattern, typically cast aluminum, which is provided with internal flow passageways for injection of steam to heat the pattern. This pattern is placed on a platen of a fluid actuated press and seats against a mold cavity carried on the opposing platen. The metal mold is preheated by steam, the mold cavity is filled uniformly with the pre-expanded beads, the platens are clamped together and steam is injected into the cavity. The steam causes the beads to expand further and fuse together in a homogeneous foam. The mold is then cooled by a circulating water stream, opened and the finishd artistic foam panel is ejected. The entire cycle can be performed automatically using commercial molding machines. Typical conditions comprise use of 12–20 p.s.i.g. steam pressure on the mold cavity with times for preheat of 20–40 seconds, expansion and fusion of 5–40 seconds and a cooling period of about 1.5 to 12 minutes.

The resulting polystyrene foam molds are relatively easy to strip from the concrete panels after use. To obtain a preferred surface on the artistic mold which exhibits essentially no adhesion to concrete, the beads are sintered in the fabrication of the polystyrene artistic molds. This is accomplished by preheating the cast metal pattern to a sufficiently high temperature to sinter the polystyrene beads which are pressed in direct contact with the metal surface. This tends to seal the mold surface and reduce its porosity to the point where there is essentially no adhesion between the concrete and the polystyrene artistic mold.

The preceding illustration of the preferred mode of practice of the invention is not intended to be unduly limiting of the invention but, instead, it is intended that the invention include the elements and steps and their obvious equivalents.

I claim:

1. A mold for placing within a form for containing concrete and for creating artistic reliefs in concrete panels which are formed by casting concrete in the form and against said mold which comprises a generally flat, thin

plate formed from a rigid and substantially non-compressible cellular plastic foam, said plate having an area from about 0.1 to about 100 square feet, a thickness greater than the desired depth of relief in said concrete panel, sufficient to resist flexing and from about 0.005 to 0.2 times its maximum dimension; a substantially smooth first face for positioning against an inner face of said form, and on its opposite face an intaglio pattern of said artistic relief molded therein to a depth greater than the depth of the surface texture of said plate.

2. The mold of claim **1** having an area from about 4 to 100 square feet.

3. The mold of claim **1** formed from expandable polystyrene beads which are molded against a positive pattern of said relief.

4. The mold of claim **1** wherein said plastic foam has a compressive strength from 1 to about 20 p.s.i.

5. The mold of claim **1** formed of a polyurethane foam.

6. The mold of claim **1** bearing an adhesive on its substantially smooth face.

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U.S. Cl. X.R.

249—15, 140; 264—51