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Patton

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[54] **STRUCTURAL MEMBER**

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[51] **Int. Cl.²** **E04C 3/29**

[58] **Field of Search** 52/309, 364, 367, 368, 52/376, 725

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[57] **ABSTRACT**

A structural member for residential, commercial and other types of buildings, to serve the function of such components as joists, studs and beams, is comprised of a body of high impact plastic with an internal or external strip of sheet metal. The attachment to these structural members of other structural components, such as flooring, ceiling panels or wall panels, is accomplished by pointed fastening devices such as nails penetrating the sheet metal associated with the plastic members. The combination of the metal and the plastic in surface contact with each other will reliably retain these fastenings whereas the plastic alone or the sheet metal alone might be incapable of retaining them.

2 Claims, 4 Drawing Figures

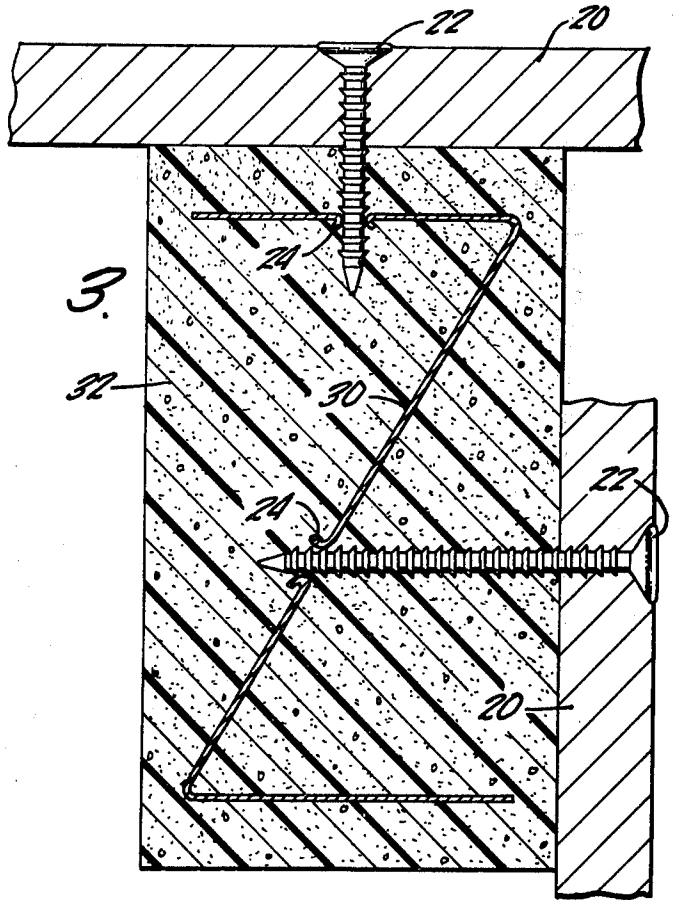


FIG. 1.

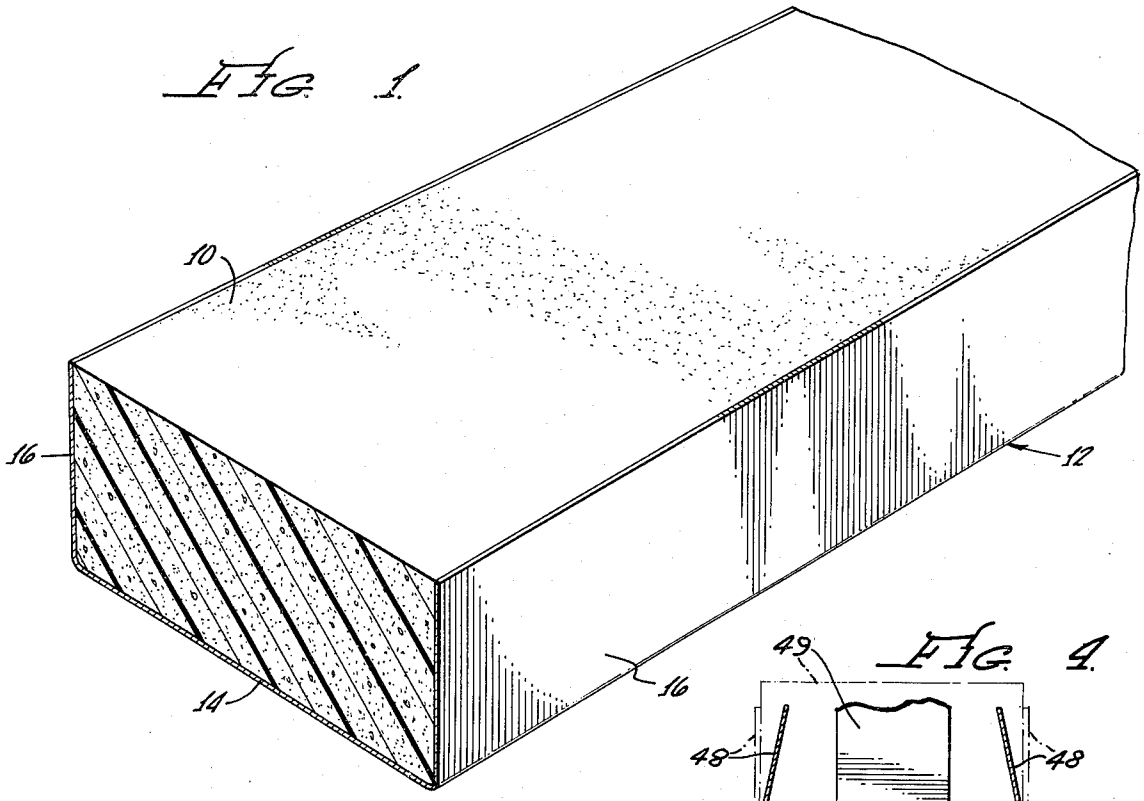
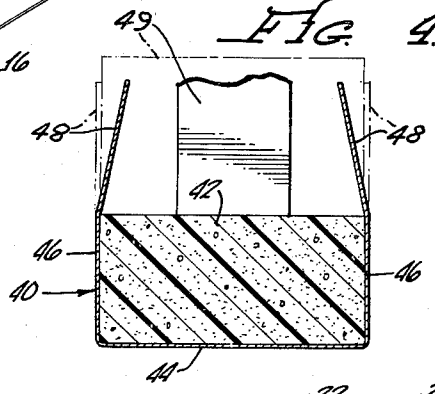


FIG. 4.



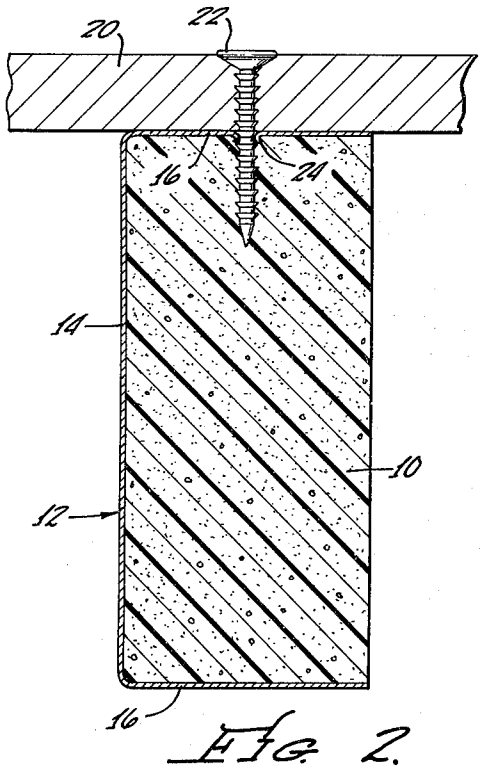
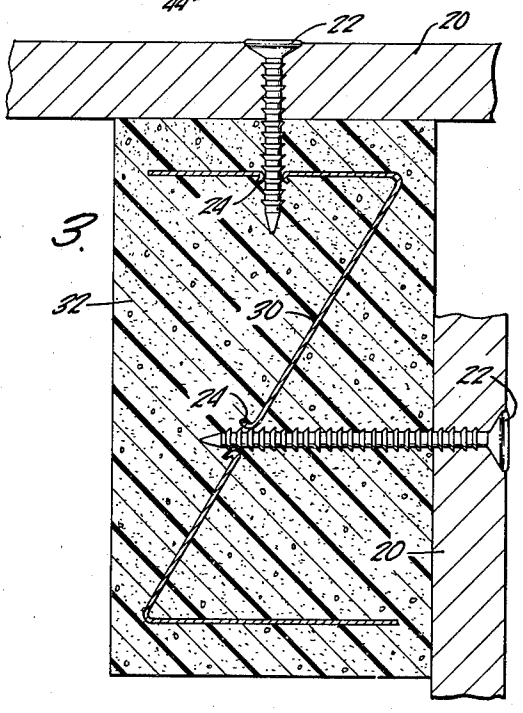


FIG. 2.

FIG. 3.



STRUCTURAL MEMBER

BACKGROUND OF THE INVENTION

It has long been the custom to construct the skeletal portions of small buildings, such as residences, farm buildings, small commercial buildings such as stores, from wooden components. Those skeletal portions of the structure are the floor supports, ceiling supports, roof supports and wall framing, and the elements that make up these skeletal portions of the structures are usually called joists in the case of floor and ceiling structures, rafters in the case of roof supports, and studs making up the wall framing. A thickness of two inches is familiar in all of these types of building structure components, and widths of four inches, six inches, eight inches and ten inches are equally familiar, four inches being the usual widths of studs and the other widths being found in joists and rafters.

It has been the custom to use wood in the making of these building components. This involved the processing of the wood from forest to finished product including, as a very important step, drying and seasoning of the wood to minimize warping after the wooden element has been incorporated into the framing of a building. Timber being a product of nature, the world's supply is not inexhaustable, and utilization is constantly increasing as the world's population increases. Conservation programs, including reforestation, have been launched to replenish the supply of timber but these programs are slow in coming to fruition. Moreover there are significant areas of the world in which timber for supplying these structural components is not available.

SUMMARY OF THE INVENTION

It follows from the foregoing that a conveniently usable and inexpensive substitute for wooden studs and other building components is needed, and the present invention embodies such a substitute. In the preferred embodiment of the invention the principal component of the stud or beam is a molded body having the dimensions of the wooden structure member for which it is a substitute, formed of an expanded synthetic polymer composition. For example it may be a high impact polyester foam such as polyurethane, polystyrene, polyethylene or polypropylene. It may be a phenolic resin, an epoxy foam or a foamed silicone. The body of plastic material has associated with it a strip, preferably coextensive with the body of plastic in its longitudinal dimension, of sheet metal. The sheet metal strip may be a surface covering or it may be molded into the interior of the plastic body. In accordance with one embodiment of the invention the metal strip is in channel form adhesively attached to the exterior of the body of plastic material and in accordance with another embodiment of the invention it is Z-shaped and is entirely encased in the plastic body. The metal of which the strip is formed is of a thickness and texture to accommodate penetration by pointed fastening devices, such as nails, in imperforate areas, but of sufficient thickness and stiffness to retain its shape apart from and prior to incorporation into the product. The sheet metal performs an important function in the retention of fasteners such as nails and in addition it contributes a reinforcing effect to the finished product. If the sheet metal is perforated in areas where nails are to be driven, the perforations should preferably be very small in comparison with the diameters of any nails likely to be used.

DESCRIPTION OF THE DRAWINGS

For a complete understanding of the invention reference may be had to the following detailed description, to be interpreted in the light of the accompanying drawings wherein:

FIG. 1 is a perspective view of an end fragment portion of an embodiment of the invention, in the configuration of a two-by-four with the sheet metal strip carried on the exterior;

FIG. 2 is a cross-sectional view of a structural member as in FIG. 1 with a fragment of another structural member, which might be a wall panel or a plank, secured thereto by means of a nail;

FIG. 3 is a cross-sectional view similar to FIG. 2 but showing an embodiment of the invention in which the sheet metal strip is entirely encased in the plastic material and is Z-shaped; and

FIG. 4 is an end view showing an extension of the concept shown in FIG. 1, to serve the purpose of a rail, such as for aligning and supporting studs.

DETAILED DESCRIPTION

Referring now to the drawings and particularly to FIG. 1 the reference numeral **10** designates a body of plastic material, preferably an expanded synthetic polymer composition. As set forth hereinbefore it may be polyurethane, polystyrene, polyethylene or polypropylene. It may be a phenolic resin, an epoxy foam or a foamed silicone. It will be generally identified hereinafter as comprised of a high impact polyester foam. As indicated in FIG. 1 the body of polyester foam is surrounded on three sides by, and accordingly fills, a channel designated generally by the reference numeral **12,** preferably of sheet metal and comprised of a web portion **14** and side flanges or walls **16.** The side walls or flanges **16** are, in the embodiment shown in FIG. **1,** normal to the web portion **14** and are of equal height. With the exposed surface of the body of polyester foam flat and flush with the free edges of the side walls **16** of the channel **12** the combination of the body of polyester foam and the sheet metal channel has a rectangular cross-section. The particular embodiment shown in FIG. 1 has the cross-sectional proportions of a two-by-four, but it will be understood that it could have the cross-sectional proportions of any of the wooden components used in construction projects, such as, for example, one-by-one, two-by-two, two-by-six, two-by-eight, two-by-ten, four-by-four, or the proportions of planking. It may correspond in length to any of the usual wooden structural framing components.

The structural component shown in FIG. 1 may be made by confining the channel **12** on its three sides to prevent deformity of the channel due to expansion of the foamed plastic, by covering the top of the channel **12** to confine the plastic material to the dimensions of the channel **12,** and by injecting the polyester foam producing ingredients into the covered channel. By confining the sheet metal channel to the desired configuration on three sides and confining the polyester foam within the channel, expansion of the foam in any direction is prevented and the desired density of the polyester foam may be achieved.

Densities of the expanded polymer composition, when cured, may be achieved in a range from one pound per cubic foot to densities in the range of forty

to fifty pounds per cubic foot. By comparison, white pine generally ranges from twenty-two to about thirty-one pounds per cubic foot and yellow pine from twenty-three to thirty-seven per cubic foot. It has been found that structural components such as exemplified in FIG. 1 which are somewhat lighter than conventionally employed wooden equivalents have as great or greater load bearing capability than the wooden equivalents. They are also chemically and physically stable, are not subject to decay, and are fire resistant to the point of being self-extinguishing.

The sheet metal of which the channel **12** is formed is preferably a ferrous metal of sufficient thickness to be self-supporting as a channel prior to the filling of the channel with the polyester foam. A thickness in a range from **26** to **30** gauge has been found to be adequate for the purpose and its texture should be such that it is readily penetrable by pointed fastening devices such as nails, without prior perforation. The polyester foam bonds firmly to the surface of the metal without any special treatment of the metal surface, although the bonding may be enhanced by a previous coating of the metal with any commonly available paint. The polyester foam-filled channel may be cut to desired lengths by means of hand tools ordinarily employed on construction jobs.

It is the usual custom to secure to framing components such as studs, joists and rafters, other structural components such as flooring planks or panels, in the case of floor joists, wall board panels in the case of studs, and ceiling panels in the case of ceiling joists, by means of nails. FIG. **2** shows a structural component, such as a wall board **20** secured to a stud by means of a nail **22.** A type of nail which has been found to be well adaped for securing structural components to studs or other structural members is called a ring-shank nail and it is this type of nail that has been shown in FIG. **2.** Another type of nail which has also been found well adapted for use for this purpose is the serrated nail, a type of nail which has spiral ribs. If the sheet metal has a thickness of **26** to **30** gauge as previously mentioned, the pointed nail **22** may be driven through the imperforate metal.

The nail, in penetrating the metal, deforms the metal inwardly into a somewhat conically shaped ring or ridge as indicated at **24.** The displaced metal in turn penetrates the plastic and it appears that the penetrated plastic exerts a pressure on the ring tending to force it into contact with the shank of the nail. Depending upon the density of the plastic the displacemment of plastic by the shank of the nail after it has passed beyond the ring **24** appears to generate a pressure of the plastic upon the shank of the nail and upon the rings of that shank so that in a dense plastic the nail has fairly good gripping properties and reasonable resistence to withdrawal. However, with the metal penetrated by the nail and the ring **24** in engagement with the shank of the nail and backed by the plastic, the combination of the sheet metal and the plastic has excellent nail retaining properties. It has been found that the force required to withdraw the nail from the metal clad structural member **10** is comparable with or exceeds the force required to withdraw a nail of equivalent size from an equivalent wooden structural member.

It will be recognized that apart from or in addition to any contribution by the displaced plastic to retention of the nail, either by direct contact of the plastic with the shank of the nail or by the exertion of pressure by the plastic on the outside of the deformity in the metal, the composition of the metal may be such that it has memory properties biasing the deformity in the metal into clinging engagement with the shank of the nail.

With regard to use of imperforate sheet metal, as mentioned hereinbefore, it should be understood that the use of perforated metal is not precluded, if for any reason an advantage might result from the use of perforated metal. It would be desirable, in that event, that the perforations be small relative to the diameter of nails likely to be used, so that regardless of where in relation to the perforations the points of nails might penetrate the metal, substantial deformity of the metal will occur.

FIG. **3** shows an alternative form of structural element in accordance with the invention, and this has also been shown in the configuration of a two-by-four. In this embodiment of the invention, the sheet metal member **30** is Z-shaped and is entirely encased in the plastic **32.** The Z-shaped strip of metal **30** which is encased in the plastic member **30** throughout the length of that member serves to reinforce the member and this reinforcement is enhanced if the bends in the metal are quite sharp.

With the form of the structural member in FIG. **3,** panels or other structural components may be secured thereto on any of the four sides, because a nail driven from any side, if of sufficent length, will penetrate and be gripped by the metal contained in the structural member. FIG. **3** shows in fragmentary form panels or other structural members attached to an edge as well as to a face of the plastic two-by-four.

Still another embodiment of a structural member in accordance with the present invention is shown in FIG. **4.** It represents a track which may be employed, in the position shown, as a floor track for supporting and aligning a row of studs in the construction of a wall. In an inverted position, it may be employed as a ceiling track to fit over and align the studs forming a wall.

The track member, designated generally by the reference numeral **40** resembles the structural member in FIG. **1** in that it is comprised of a body of plastic material **42** encased on three sides by a sheet metal channel comprised of a web portion **44** and side flanges **46.** The side flanges extend higher than the exposed surface of the body of molded plastic **42** and these extensions **48** preferably bend inwardly slightly at the point where they clear the upper surface of the plastic.

The exposed surface of the molded plastic member **42** serves as the support for the lower ends of studs, one of which is shown in FIG. **4** and designated by the reference numeral **49,** and the studs may be fitted into position by rotating them about their own centers sufficiently to lower them between the extensions **48** of the flanges **46** and then twisting them so that from edge to edge they stand transversely of the molded plastic member **42,** the extensions **48** of the flanges **46** being spread apart as the twisting takes place. The track member **40** may be nailed to the supporting floor or surface by nails driven downwardly through the exposed surface of the plastic member **42** before or after the studs are mounted, or nails may be driven into the member **44** obliquely downwardly through either or both of the flanges **46** and through the web portion **44** and into the supporting surface. Also, studs mounted in position on the track **40** may be secured thereto by nails driven obliquely downwardly through either face of the stud and through its lower end and into the ex-

posed surface of the track **40**, or obliquely downwardly through either or both of the extensions **48** of the flanges **46** into the edge of the stud and downwardly through its end and into the plastic portion of the track **40**. Alternatively, it may be found adequate merely to drive nails straight into the studs from the sides through the extensions **48** of the flanges **46**, through the flanges **16** of the stud **12** and into the stud.

What is claimed is:

1. A structural element for incorporation into structures such as private and public buildings and for retaining wall components and the like which comprises:

an elongate molded body having at least two generally flat surfaces disposed in parallel planes and formed of an expanded synthetic polymer composition; and

a sheet metal member encased in the molded body generally coextensive with the molded body longitudinally thereof and said sheet metal body having a Z-shaped cross-sectional configuration and being formed of a metal having sufficient stiffness to provide self maintenance of the Z-shaped cross-section yet having a penetrability to accommodate the driving of nails therethrough and so disposed in said molded body as to have the portions representing the arms of the Z-shape occupying planes generally parallel to and spaced inwardly from the aforementioned flat faces of the molded body and the intermediate portion of the Z-shape extending obliquely of the arms between opposite ends of the said arms of the Z-shape to accommodate penetration of the embedded sheet metal member by nails of appropriate length driven into the molded body from either of the aforementioned flat faces and also nails driven into the molded body between and generally parallel to arms of said Z-shape with resultant deformity of the sheet metal into the portion of the molded body that is backing the sheet metal on the side opposite the side of penetrative entry of the nail.

2. A structural element as defined in claim **1** wherein:

the molded body has a rectangular cross-section other than square; and

the orientation of the Z-shaped metal member disposes the arm portions thereof generally parallel to the planes of the narrow faces of the molded body.

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