Sept. 9, 1958 B. K. G. WAGNER 2,850,771

PREFABRICATED BUILDING CONSTRUCTION

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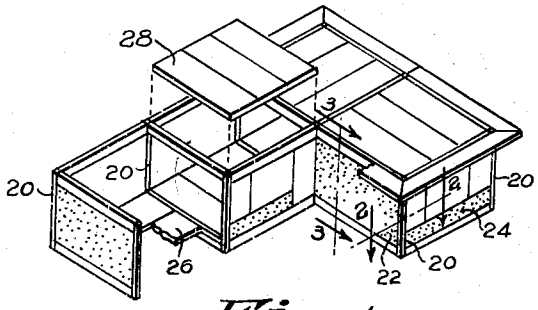


Fig. 1

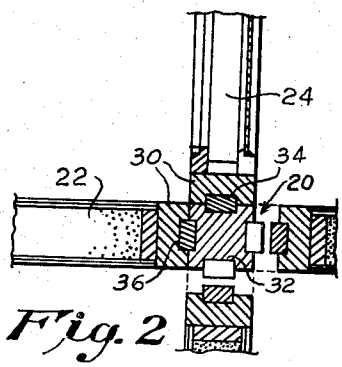


Fig. 2

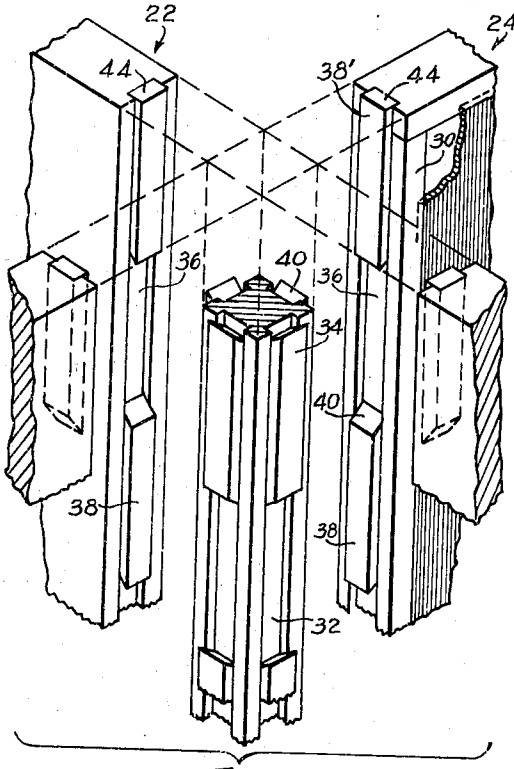


Fig. 5

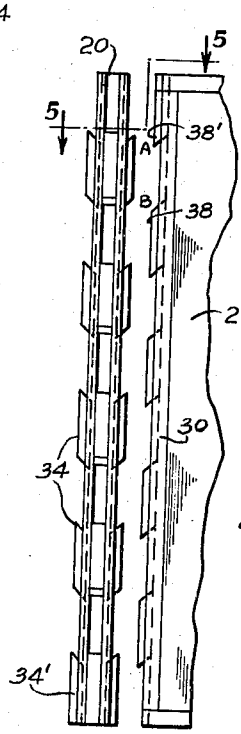


Fig. 4

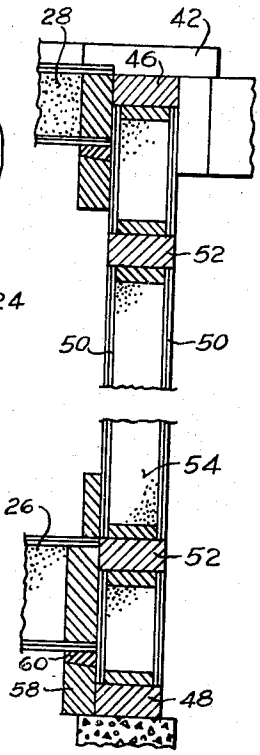


Fig. 3

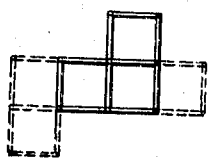


Fig. 6

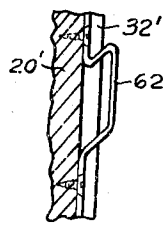


Fig. 7

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PREFABRICATED BUILDING CONSTRUCTION

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4 Claims. (Cl. 20—2)

This invention pertains to a system of building construction, and especially to improvements in the design of structural units and connections to provide effective prefabrication and simple erection of a wide variety of building types.

Basically, the invention provides prefabricated components which can be produced, shipped and assembled at relatively low cost, the assembly being capable of an almost unlimited number of variations according to a modular plan. Modular design and prefabricated components are of course not themselves novel in building construction, but the present invention embraces structural and design improvements which provide a practical and efficient solution to several problems which have heretofore prevented or discouraged the use of the known principles referred to above.

At the heart of the present improvements is a novel form of structural connection between a vertical post or column and the vertical edge of a fabricated wall panel. The connection is in the nature of a vertical spline, continuous in the vertical direction when the connection has been been established, but formed of mating and interlocking portions on the post and wall respectively. The connection is such that these parts are mutually supporting, and in combination with a preferred floor and roof panel connection to be described, permits a complete assembly forming a room or house to be achieved without the addition of assembly screws, nails or other fasteners.

The advantages of this novel connection are peculiarly related to the modular and prefabricated system. A basic feature of modular design (i. e., a design based upon a fundamental dimension common to different or multiple components of a whole) is that the use of a relatively small number of different kinds of parts permits assembly of a very large number of different structures. As applied to prefabricated housing, modular design effects savings in reduced cost and complexity of the tooling for manufacture, and reduces inventory requirements sharply. Besides these, a more important saving is of course found in the reduced assembly labor required at the building site, particularly as to skilled labor. By providing the assembly connections as integral parts of the fabricated components, the present invention effects a further important saving in the total cost of the structure. Such saving is a primary feature of the invention.

A second important advantage provided by the invention, and one also specially related to modular construction, lies in the fact that modification or expansion of an existing structure is rendered extremely simple. The existing components are readily separated or disconnected where necessary, without damage thereto, and the required additional columns and wall panel units connected into the structure as desired. In many cases, a room or rooms can be added without disconnecting parts already assembled, as will be described in detail below.

The novel connection structure, which can be disassembled without injury to the parts, provides a further

advantage in that the components have high salvage value. Temporary or emergency structures can be removed and re-used either for temporary or permanent buildings.

The way in which the present invention satisfies the above, and other aims will best be understood by referring now to the following specification of a preferred form of the invention, and to the accompanying drawings, in which

Fig. 1 is a perspective view, partly exploded, of a complete housing unit incorporating the invention.

Fig. 2 is a horizontal sectional view of a portion of Fig. 1, taken on line 2—2 of that figure.

Fig. 3 is a partial vertical sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a view in elevation showing one post or column and an end portion of a wall unit to be connected thereto.

Fig. 5 is an exploded perspective view of a corner connection, with the post partly in section looking along line 5—5 of Fig. 4.

Fig. 6 is a plan view suggesting some of the varieties of floor plan arrangement which can be achieved by combining the components in different ways.

Fig. 7 is a fragmentary vertical section of a building unit employing a metal connector in place of a spline.

In describing the invention in what follows, and for ready understanding of its principles as well as of more detailed features, a specific preferred form and material will be used as typical. However, it is to be understood that other materials and forms can be employed for equivalent results, within the scope of the invention. Thus, reference will be made to the use of wooden structural elements, the basic post or column being for example made of wood 4 by 4 inches in cross section, and somewhat over 8 feet in length, the wall unit frames being built up of 2 by 4 inch stock with ⅜ inch plywood facing panels or the like. Also, a basic 12 foot module for horizontal dimensions is assumed.

As shown in Fig. 1, a house made according to the invention comprises four bays or room units, each 12 by 12 feet square. It may rest upon a foundation or slab, but preferably the corner posts of all the bays will rest upon individual footings of concrete or even of wood suitably treated to resist rot and insect infestation. All the corner posts or columns **20** are identical, but the wall panel units such as **22**, **24** will differ in containing door and window openings as desired. Other than these posts and walls, the basic structure involves only floor and roof elements whose structure does not form an essential part of the present invention.

The typical bay of 12 by 12 feet dimensions in plan may have a 7½ foot ceiling height, and each wall panel will therefore be about 8 by 12 feet, which can readily be shipped and can be handled by not over four men for installation. The floor and roof units **26**, **28** are preferably made up of three 4 by 12 foot sections, to facilitate shipping and handling.

The basic novel feature of the invention lies in the connection between post and wall panel to provide strength and rigidity without assembly fasteners, and this connection is detailed in Figs. 2 to 5 of the drawings. In Fig. 2, a typical post is shown at a building corner, being again designated by numeral **20**. Each wall panel **22** or **24** has a frame including a vertical member **30** which will engage a face of post **20** when the connection is made.

The four vertical faces of post **20** are grooved, as at **32**, and secured in spaced position along and within each groove are a plurality of spline blocks **34**, separated from one another by amounts equal to their common

length (plus a slight fitting allowance). The outer face of each vertical frame element **30** of the wall unit is similarly grooved, as at **36**, and in this groove are secured splines blocks **38** arranged alternately to those of post **20**. The spline blocks **34** and **38** are preferably glued and screwed in place within their respective grooves as a part of the factory operation.

The upper and lower terminal faces of the spline blocks are bevelled or slanted, as indicated at **40** (for example at 45 degrees to the vertical to minimize waste in their fabrication) so that the weight of a wall unit maintains the connection against lateral displacement in the direction of the plane of the wall unit. In other words, the spline blocks are hooked to one another by a slight vertical raising of wall unit **24** before it is butted against post **20** in Fig. 4. Because the spline blocks are recessed for half their depth in the respective grooves **32**, **36** no horizontal movement transverse to the wall unit is possible, and a firm and rigid structure results.

The number of spline blocks per groove may be varied; five are used in the illustrated form, the total of ten in a connection filling the vertical measure to provide in effect a continuous vertical spline when the connection has been established. This continuous connection provides practically the strength of solid lumber at the joints. The use of several spline blocks also distributes the vertical load along the height direction and minimizes local compression loads. Moreover, it will be noted that the integrity of the connection does not depend entirely upon the security with which the blocks are fastened in their grooves; lateral motion is prevented by the interlock of spline blocks in the groove of the complementary piece. Also, when the roof or perimeter plate **42** is applied (as by nailing), the fact that the spline blocks fill the vertical measure prevents them from releasing their engagement even in the other horizontal direction.

The uppermost and lowermost spline blocks **34'**, **38'** are preferably flat-ended and coterminous with their respective post and panel units, as indicated for example at **44** in Fig. 5. While as just described both the upper and lower faces of the spline blocks are bevelled where they engage with one another, it is obvious that only half of the points of interfitting will be carrying the load; to wit, those points at which the blocks on the respective members are hooked together, as at A in Fig. 4. The respective spline block ends at B in Fig. 4 need not be bevelled, but may be shaped in any way so long as the blocks interfit properly. Bevelling at both ends will result naturally if the blocks are angle-sawed continuously from a strip.

A typical wall section is shown in Fig. 3, numeral **22** again designating a wall panel unit as a whole. The upper and lower frame pieces thereof are indicated at **46**, **48**, and plywood facing at **50** (see also Fig. 5). Intermediate wall unit framing is shown at **52**, and the interspace may be filled with thermal insulation as at **54**. To support the floor panels **26** (which may also be of cellular construction) a bevelled ledger strip **58** may be glued and nailed to the bottom frame element **48** all around each bay or room, and the floor panels will have similarly secured thereto strips **60** bevelled to rest upon strips **58**. The floor sections float satisfactorily without permanent fastening, with this arrangement. Roof panels **28** may be supported in like fashion (Fig. 3) but will be held down by the perimeter plate **42** bolted or nailed in place and supporting any desired roofing cover.

It has been stated that the individual posts **20** are preferably based upon footings or piers, which may for example be of concrete and provided each with a bolt upon which the corner post may be threaded. A suitable method of assembly, having regard to the need for slight vertical as well as horizontal displacement between the post and panel to effect engagement of the spline blocks, is first to connect two wall panels to a common post, as at a corner, which post is bolted to its pier. Posts for the opposite ends of these two wall panels are preferably carried upon their respective piers, of pre-cast concrete standing in suitable excavated holes which have been spaced 12 feet on centers. Before the postholes are backfilled, so that each post and its pier can be moved relatively freely, the end of a wall panel may be brought into the proper slightly elevated position, the post (and pier) moved sideways sufficiently to cause the spline blocks to engage properly, and the wall panel then allowed to descend to complete the engagement. This is perfectly feasible even at the final post which completes a rectangular assembly of wall panels defining a bay.

Where, as heretofore described, the flooring or flooring base consists of three parts, each of a suitable length to fit nicely within a bay, installation of the floor sections is preferably accomplished prior to closing a bay by its fourth wall. Thus, with three walls in place, the floor sections may be moved laterally into and through the opening representing the final position of the fourth wall, and carried straight across the bay and dropped upon the ledger strips **58**. The final one of the three floor sections, whose mating strip **60** must ultimately rest upon the ledger strip of the fourth wall, can easily be elevated from below as by lever tools, jacks or the like, while the fourth wall is connected to its end posts. Removal of the temporary floor support or jack will then allow this last floor section to settle into proper engagement with the last wall panel.

It will be noted that all four vertical faces of each post are grooved and provided with spline blocks. Thus any post at which two walls meet (either at a corner or between coplanar wall sections) is fully equipped to connect other wall sections to provide a three or four point intersection as in Figs. 2 and 5. If the exposed groove and spline blocks are objectionable, a fascia strip grooved to clear the spline block projections may be used to cover the exposed surfaces of posts **20**. Additional conventional interior space partitions and trim may obviously be employed as desired.

The novel connection of the invention may also be carried out using metal instead of wood for the parts. Fig. 7 indicates one way in which this can be accomplised, a post **20'** having the vertical groove **32'** in which is secured, as by screws, a continuous metal strip **62** formed to provide the equivalent of spline blocks in a repeat pattern along the length of the post. The manner in which this modification may be applied to a wall panel frame member will be obvious from what has been said respecting the use of wooden pieces. Such a metallic connection may be used upon wooden members, or upon posts and wall panel units formed wholly or partly of metal or other materials. It will be obvious to those skilled in the art that so long as the material employed is of adequate strength, other material may be substituted for wood or metal. Thus, the structural elements and their connectors may be formed of plastic materials, concrete and the like without departing from the principles described herein.

Fig. 6 illustrates the flexibility of the arrangements and the ease with which rooms or bays may be added or removed. The solid lines indicate a basic 3-bay house, to which three additional bays are to be added as shown in dash lines. While the construction has, for clarity of understanding, been described in connection with a single-story building, it is obvious that the same system can be employed for multi-story arrangements by using posts of suitable length with their spline blocks **34** at the inter-story region so spaced as to allow for necessary floor thickness between stories. Moreover, the construction described is in no way limited to dwelling, but is equally well adapted to buildings for other purposes, schools, storerooms, hospitals and the like.

What is claimed is:

1. A structural connection for the mating portions of vertical building wall elements, comprising a continuous uninterrupted series of interengageable parallelepipedal projections having their common load-bearing surfaces inclined to the horizontal, and secured in alternation in central vertical grooves in the mating portions of said wall elements in spaced vertical relation, the projections secured to each element projecting beyond the groove in which they are secured and into the groove between projections of the mating element, to form together a continuous column-loaded connection between the elements from top to bottom; the face width of said projections being a substantial fraction of the thickness of the wall elements.

2. A structural connection in accordance with claim 1, in which one of said elements is a vertical post, and the other is a wall panel unit.

3. A structural connection in accordance with claim 2, in which said post has four vertical faces each grooved and with a series of said projections secured in all of the face grooves.

4. A building structure formed of individual prefabricated wall panel elements connected to one another by post elements, the connection between each panel and a post comprising wide facing grooves centrally disposed in the respective mating portions from top to bottom thereof, and wide interlocking spline blocks secured to said elements in spaced relation in the grooves and staggered vertically as between the respective elements, the blocks secured to each element being correspondingly bevelled top and bottom in the plane of the panel elements and projecting beyond the element into the groove of the adjacent element to form together a continuous vertical spline filling said grooves from top to bottom as well as in horizontal section.

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