United States Patent

[11] 3,587,197

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[45] Patented **June 28, 1971**

[54] **PREFABRICATED CANTILEVERED BUILDING STRUCTURE**
31 Claims, 28 Drawing Figs.

[52] **U.S. Cl.** **52/73,** 52/79, 52/236
[51] **Int. Cl.** **E04b 1/34,** E04b 1/348
[50] **Field of Search** 52/73, 79, 236, 237

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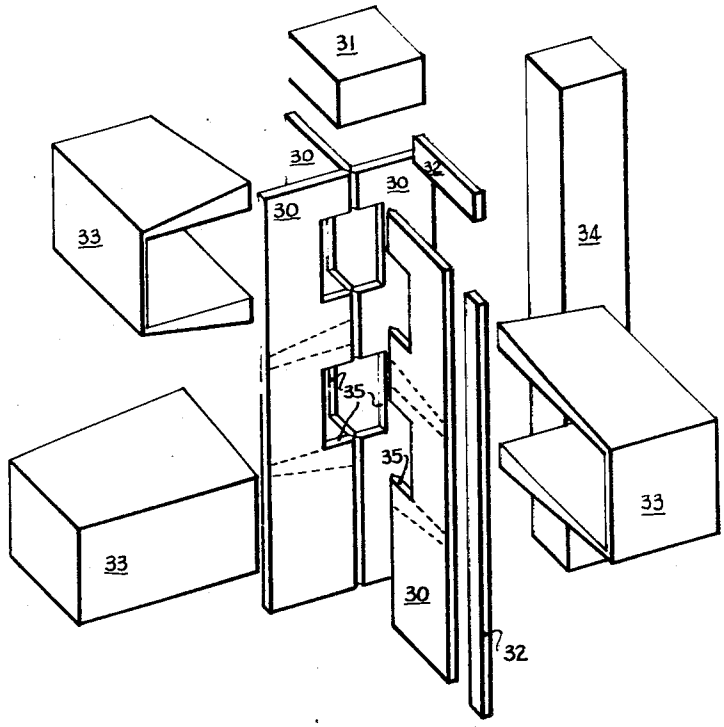
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Primary Examiner—Alfred C. Perham
Attorney—Gausewitz and Carr

ABSTRACT: A low-cost modular building designed to be mass produced at a remote location, transported to the building site, and erected in a short period of time. The building is comprised of five basic modular parts which are: (1) support parts—designed to carry the loads of the building; (2) a mechanical service unit—housing all necessary equipment for the building; (3) service line enclosures—containing all of the utility services; (4) enclosing units—providing the basic room or housing facility of the building; and (5) a vertical unit—providing vertical access between the various units and between the various units and the ground level.



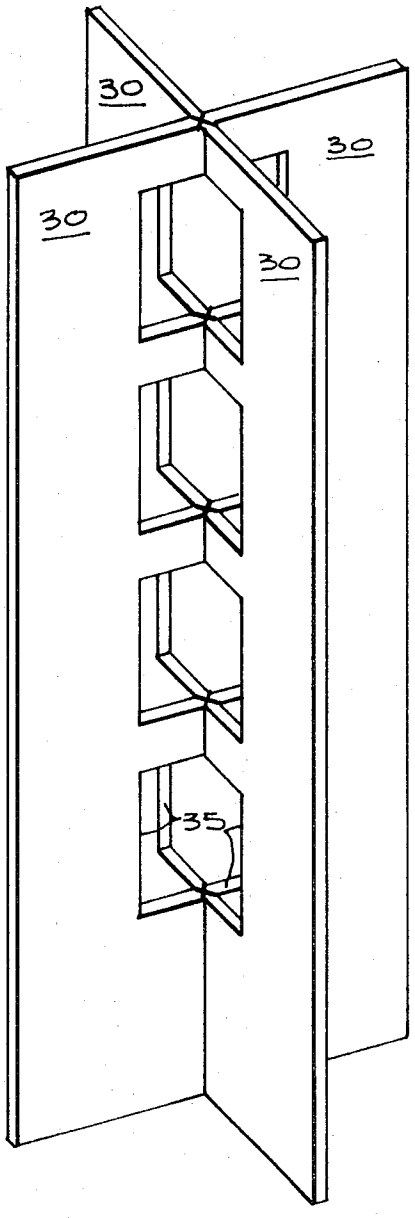


FIG. 1

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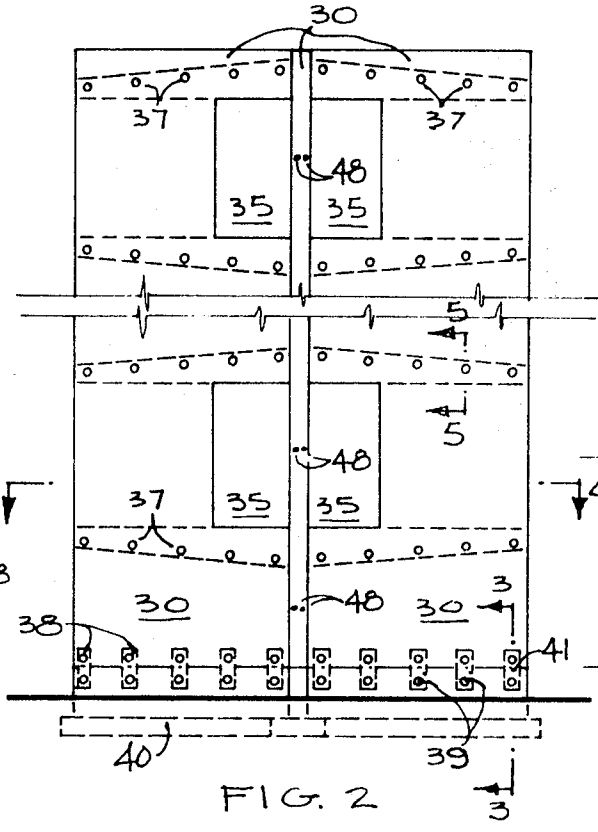


FIG. 2

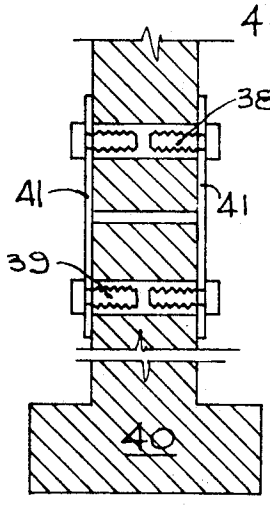


FIG. 3

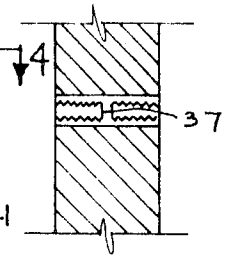


FIG. 5

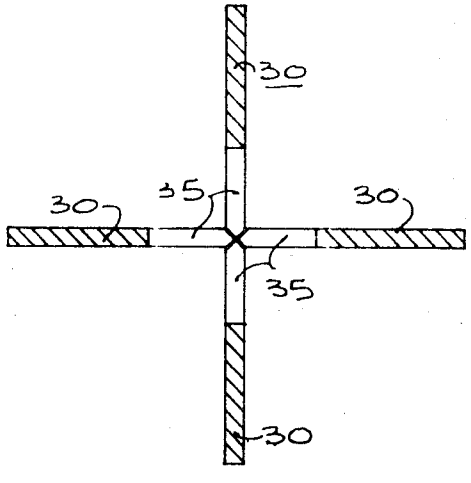


FIG. 4

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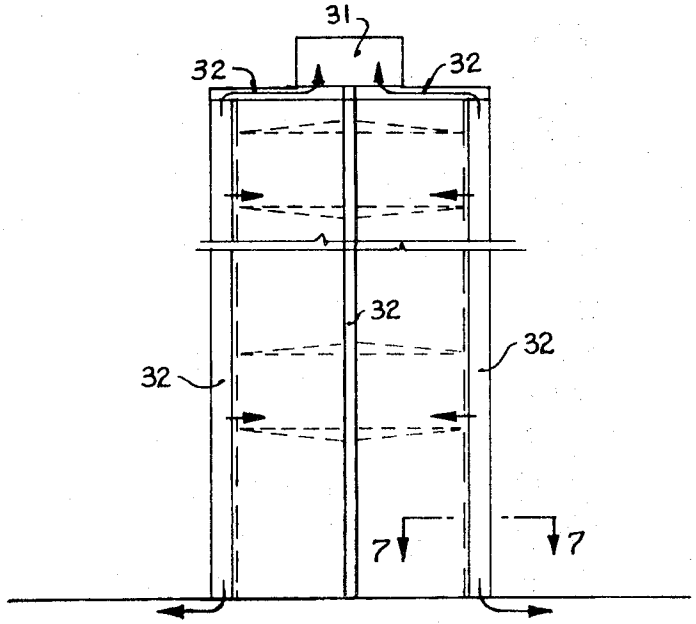


FIG. 6

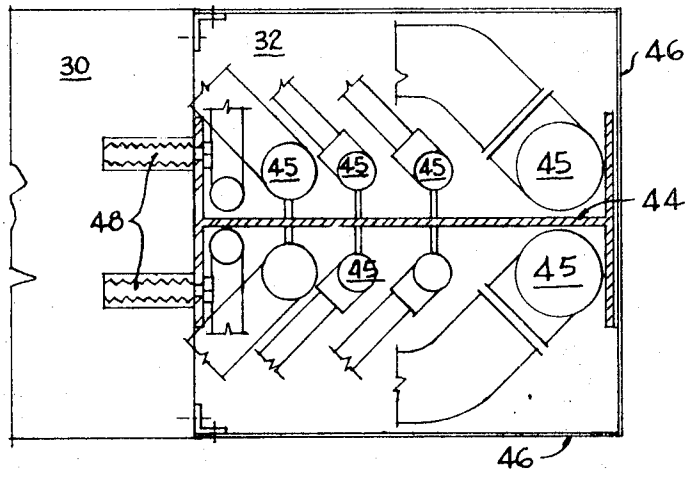


FIG. 7

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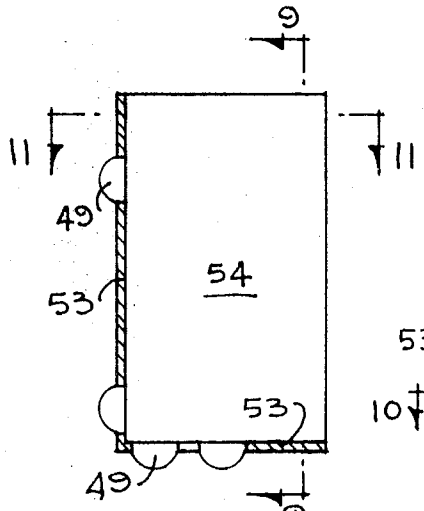


FIG. 10

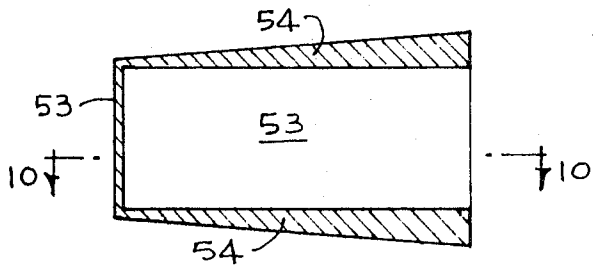


FIG. 9

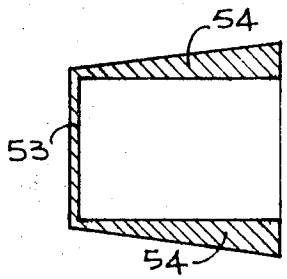


FIG. 11

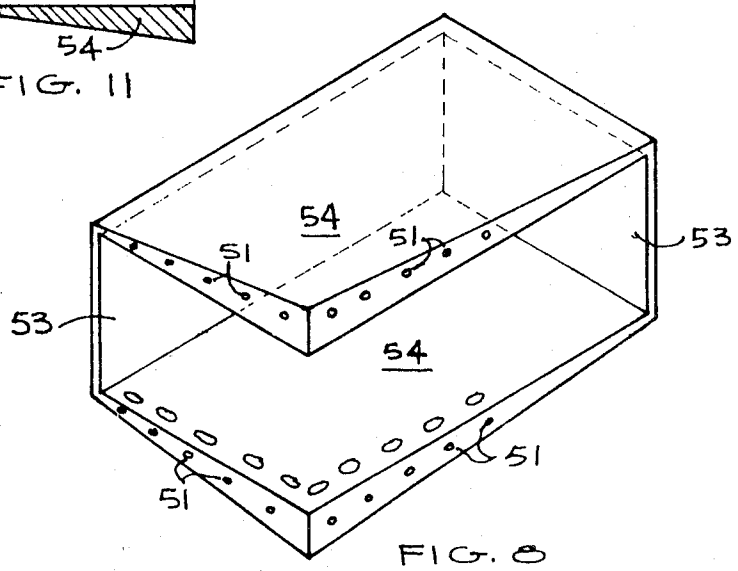


FIG. 8

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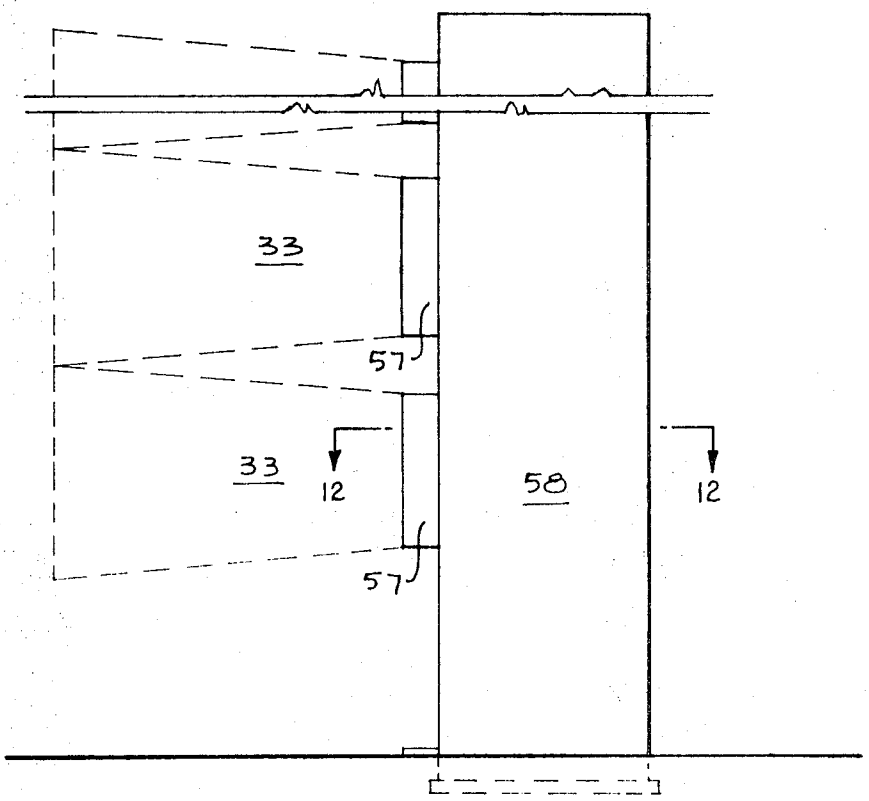


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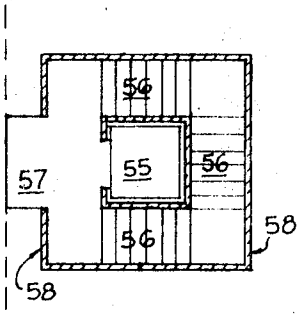


FIG. 12

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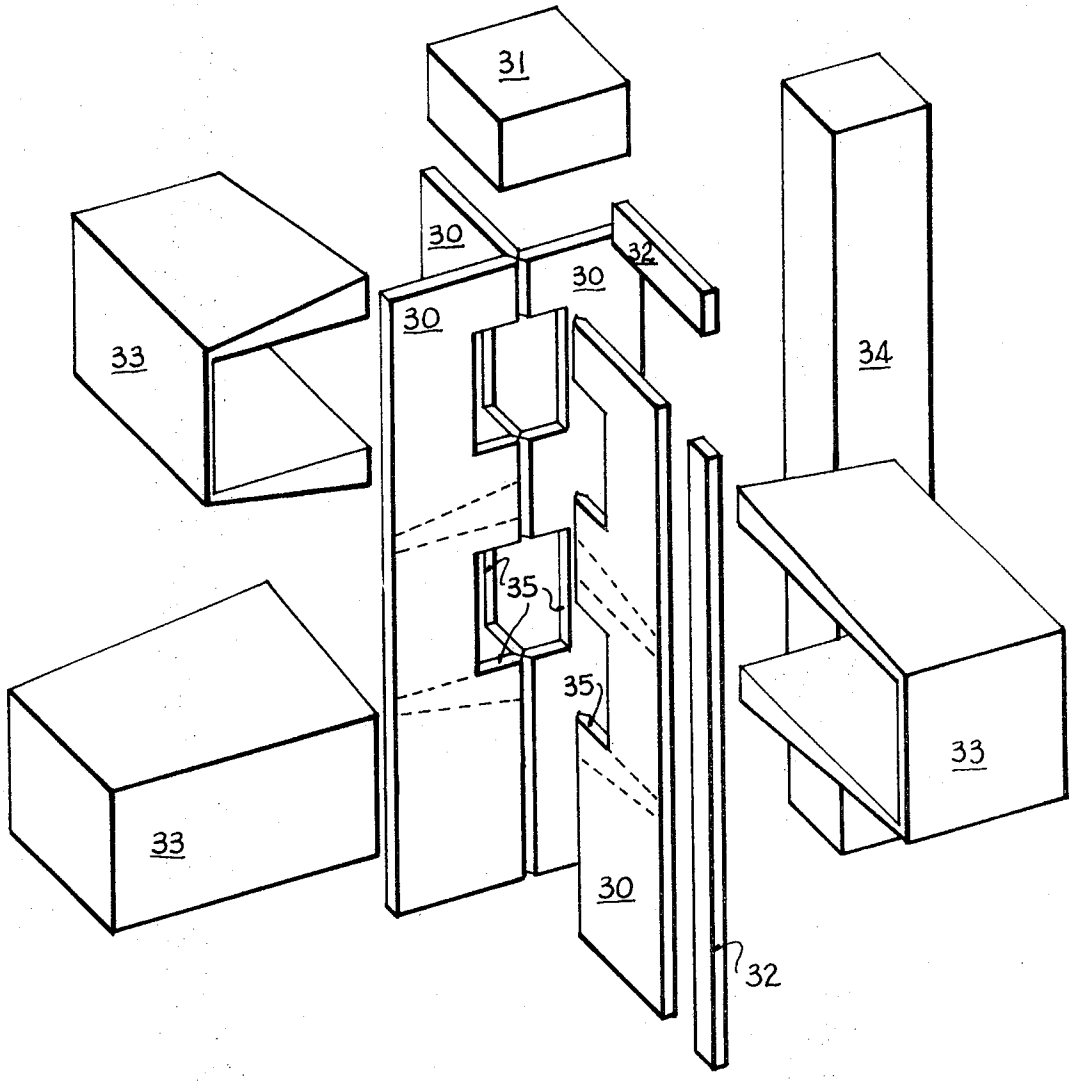


FIG. 14

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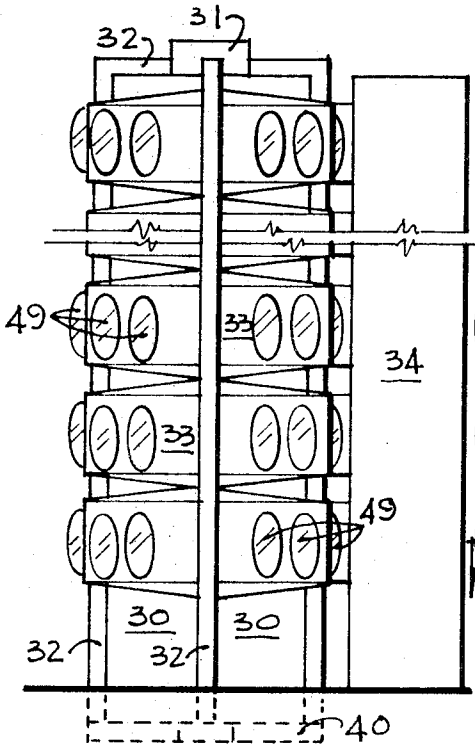


FIG. 17

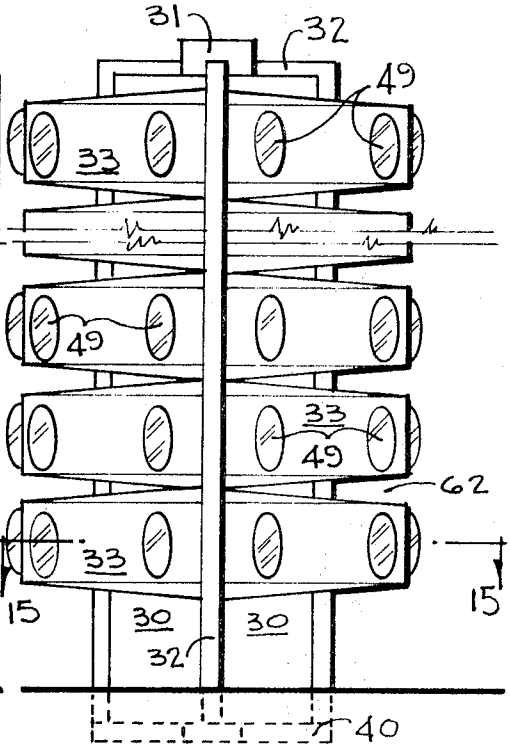


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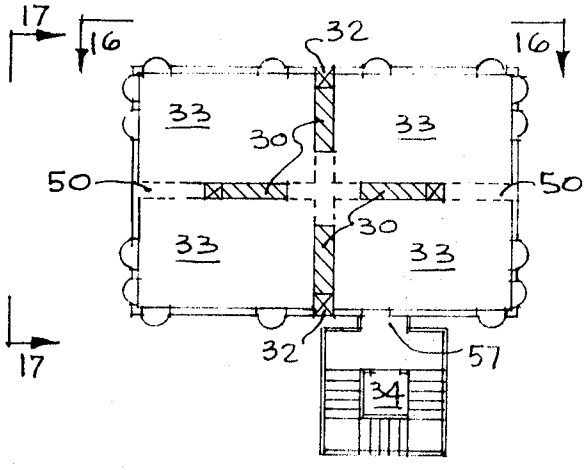


FIG. 15

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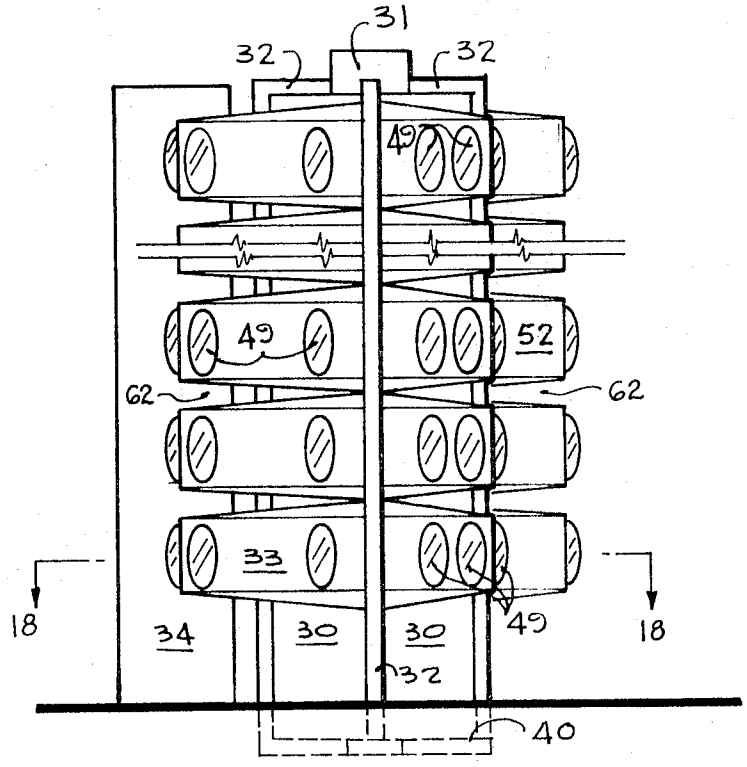


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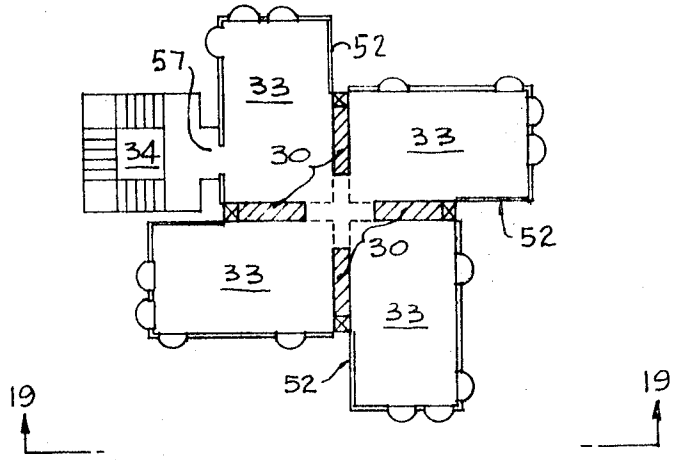


FIG. 18

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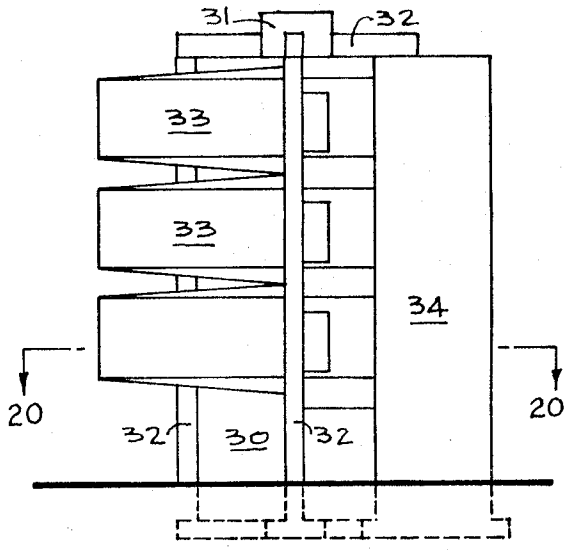


FIG. 21

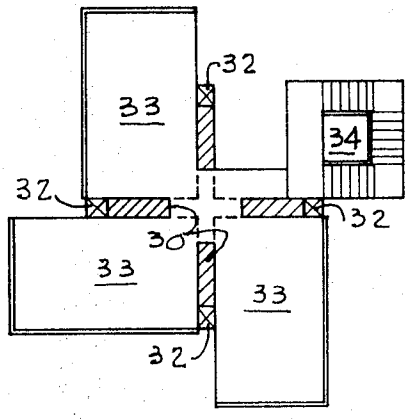


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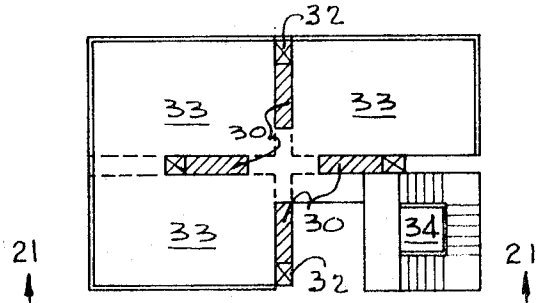


FIG. 20

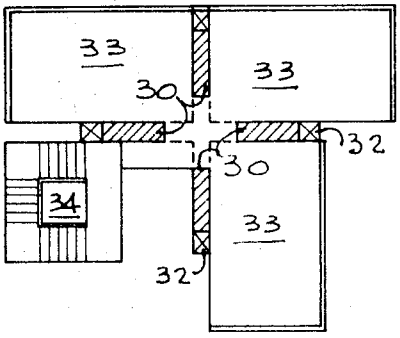


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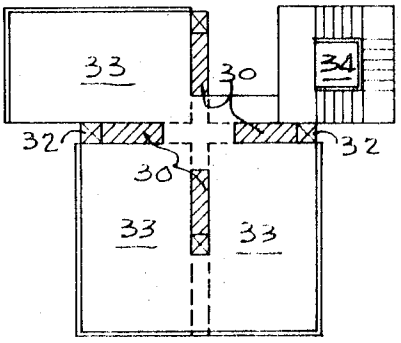


FIG. 24

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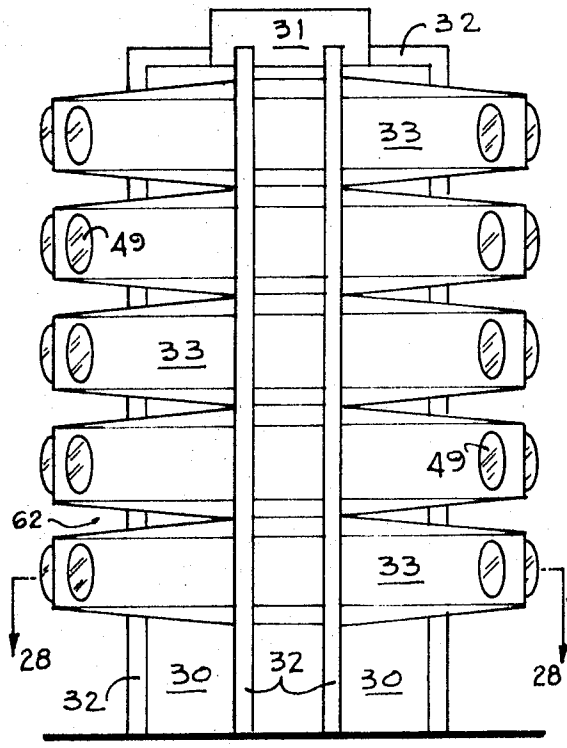


FIG. 27

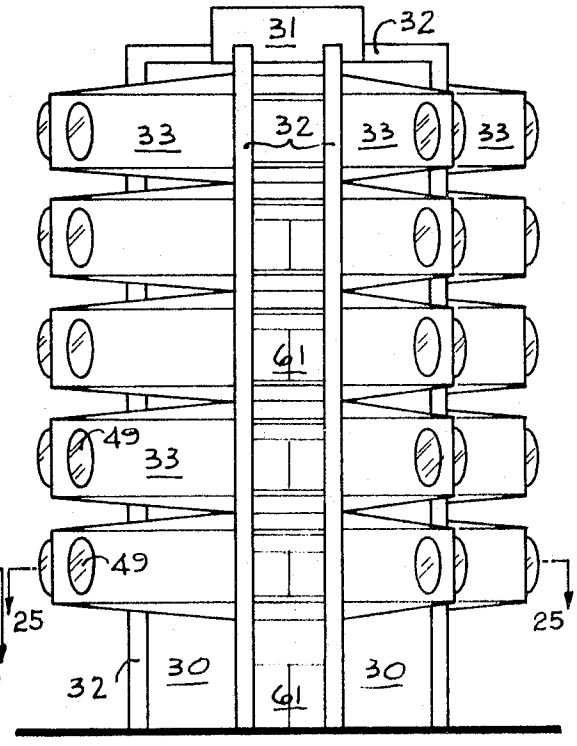


FIG. 26

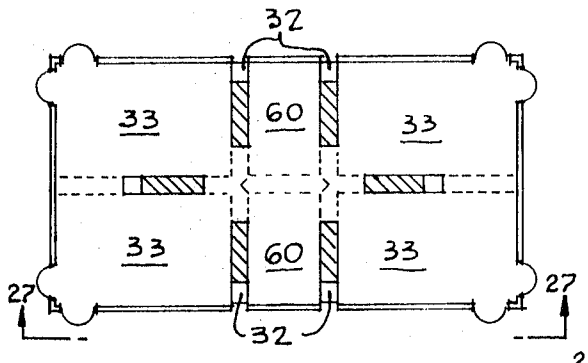


FIG. 28

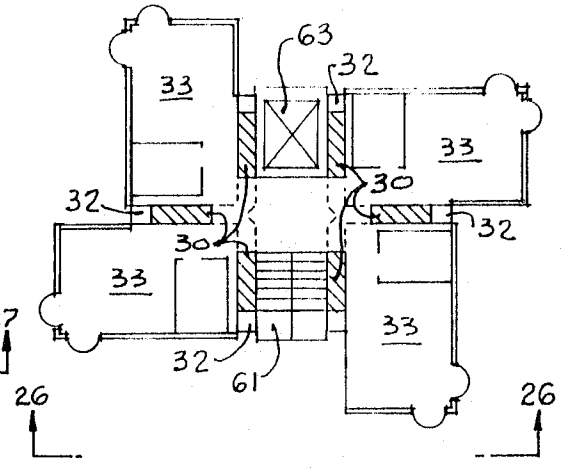


FIG. 25

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PREFABRICATED CANTILEVERED BUILDING STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the field of static structures. More particularly, it relates to the area of prefabricated portable buildings which can be mass-produced in remote locations, transported over highways to the building site, and erected or dismantled in a short period of time.

2. Description of the Prior Art

Despite the technological advances made in other industries, the building industry has remained relatively unchanged in recent years. Eighteenth-century construction methods are still being used to erect buildings. Foundations are laid, outer walls are erected, internal plumbing and internal wiring are installed, internal walls are erected, upper floors are added, followed by more plumbing, wiring and internal walls, until finally the roof is completed and the building finished. This method has proved to be very slow and costly and results in a structure that, once completed, is very hard to alter or dismantle without substantial loss or damage occuring to the building. The internal wiring and plumbing, once installed, become very hard to repair or replace because they are usually placed inside the internal walls and become somewhat inaccessible to repairmen.

SUMMARY OF THE INVENTION

The present invention relates to a building using only five basic component parts. These component parts are prefabricated on a mass production basis and transported over highways to the building site, where they are easily assembled into a complete building unit. The building is designed in such a manner to allow one room of the building to be removed or replaced without disturbing or interfering with other rooms of the building. If a utility line needs repair or replacement, it is accessible and can be easily repaired or removed and replaced with another unit without damaging or affecting other parts of the building. The building will be inexpensive to manufacture and easy to assemble at the building site, thereby saving on construction costs as compared with traditional building methods. Each horizontal unit of the building is separated from its adjoining vertical units by an air space thereby providing adequate sound insulation between vertical units. Using only the five basic component parts of the building, varied floor plans can be easily obtained and different floor plans can be obtained as between various floors of the same building, thereby allowing a variety of vertical as well as horizontal configurations of the building. The internal and external color and texture of the building can also be varied in order to increase the number of possible design configurations.

The building is comprised of a multistory tower, whose cross-sectional shape is generally T-shaped or cruciform, with cantilevered modular units attached to the sides of the tower. A mechanical service unit, containing all heating, ventilating and air-conditioning units, etc., rests on top of the tower and has enclosed utility pipes attached to it which run down the entire length of the tower. The enclosed utility pipes service all of the modular units of the building. Placed near the tower is a unit that provides vertical transportation between ground level and the various modular units attached to the tower.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of four support parts combined to form a support tower;

FIG. 2 is a side elevational view of the support tower and foundation;

FIG. 3 is a fragmentary vertical sectional view showing the interface between the support parts and the foundation taken along line 3–3 of FIG. 2;

FIG. 4 is a horizontal sectional view of the support tower taken along line 4–4 of FIG. 2;

FIG. 5 is a fragmentary vertical sectional view of the support parts showing the bolt inserts taken along line 5–5 of FIG. 2;

FIG. 6 is a side elevational view of a support tower showing the position of the mechanical service units and the service line enclosures;

FIG. 7 is a horizontal sectional view of a service line enclosure taken along line 7–7 of FIG. 6;

FIG. 8 is a perspective view of an enclosing unit;

FIG. 9 is a vertical sectional view taken along line 9–9 of FIG. 10;

FIG. 10 is a horizontal sectional view of an enclosing part taken along line 10–10 of FIG. 9;

FIG. 11 is a vertical sectional view of an enclosing part taken along line 11–11 of FIG. 10;

FIG. 12 is a horizontal sectional view of the vertical circulation unit taken along line 12–12 of FIG. 13;

FIG. 13 is a side elevational view of a vertical circulation unit;

FIG. 14 is an exploded perspective view of the five basic components of the building;

FIG. 15 is a horizontal sectional view taken along line 15–15 of FIG. 16;

FIG. 16 is a front elevational view of the building shown in FIG. 15;

FIG. 17 is a side elevational view of the building shown in FIG. 15;

FIG. 18 is a horizontal sectional view showing four enclosing parts attached to the support tower;

FIG. 19 is a front elevational view of the building shown in FIG. 18;

FIG. 20 is a horizontal sectional view showing a floor plan of the building taken along line 20–20 of FIG. 21;

FIG. 21 is a front elevational view of the building shown in FIG. 20;

FIGS. 22, 23 and 24 are horizontal sectional views showing other possible floor plans of the building;

FIG. 25 is a horizontal sectional view showing another floor plan configuration taken along line 25–25 of FIG. 26;

FIG. 26 is a front elevational view of the building shown in FIG. 25;

FIG. 27 is a front elevational view of the building shown in FIG. 28; and

FIG. 28 is a horizontal sectional view showing a floor plan that incorporates a modified enclosing part taken along line 28–28 of FIG. 27.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention is composed of five basic component parts. These parts, as shown in FIG. 14, include: support parts 30; mechanical service unit 31; service line enclosures 32; enclosing units 33; and a vertical circulation unit 34. When properly assembled, these component parts combine to form an integral building unit.

Four identical support parts 30 are joined together to form a multistory tower whose cross-sectional shape is generally cruciform. Notches 35 are formed in the support parts 30 in order to provide a means of passing from one side of the support tower to another at each floor level after the building has been assembled. Bolt connection inserts 37 (FIG. 2) are provided as a means of attaching an enclosing unit 33 to the support tower. Bolt connection inserts 38 and 39 are provided in order to securely attach the support parts 30 to the foundation 40 of the building by means of connection plates 41 (FIG. 3).

A mechanical service unit 31 (FIG. 6) rests on top of the support tower and is fastened to it after the support tower has been erected. This unit contains all heating, ventilating, and air-conditioning units plus other such equipment that is needed for the building and provides such services to the entire building.

Along the outside edges of the support tower are service line enclosures 32 which contain all water pipes, cooling and

heating pipes, sewer pipes, vent pipes, powerlines, telephone and television lines, and other such utility lines that are needed for the building. This service line enclosure **32** connects the mechanical service unit **31** with all housing units of the building and with the outside utilities. An I-beam **44** is positioned in the service line enclosure **32** to give it stability. The utility pipes **45** are attached to the I-beam **44** and the outer wall **46** is then placed on the unit. The service line enclosure **32** is bolted to the outer edges of the support tower using bolt connection inserts **48** (FIG. **7**). The outside utilities are connected to the service line enclosures **32** at ground level and utility service to the entire building is thereby provided. To obtain individual utility service, the fixtures in each enclosing unit **33** are merely plugged into one of the service line enclosures **32** that are adjacent either side of the enclosing unit **33**.

An enclosing unit **33** (FIG. **8**) is attached at each inside corner of the support tower at each level. Four enclosing units **33** normally comprise one level or floor of the building, and a sample floor plan is pictured in FIG. **15**.

The elliptical shapes **49** represent bubble-type window openings in the enclosing units **33**. The notches **35** in the support parts **30** provide a means of entry and exit from one enclosing unit **33** to another. An enclosing sleeve **50** is inserted between the enclosing units **33** shown in FIG. **15** and provides another possible means of entry and exit between two units at the same horizontal level. When an enclosing sleeve **50** is not used, because of the floor plan configuration, window inserts **52** (see FIG. **18**) are placed on the enclosing units **33** which, along with the two outer walls **53** and the roof and floor **54**, will completely enclose the unit after it is attached to the support tower.

The enclosing units **33** are attached to the support tower using bolt sleeves **51** (FIG. **8**) and bolt connection inserts **37** (FIG. **2**) that are provided in each enclosing unit **33** and support part **30**.

It is to be noted that each enclosing unit **33** is cantilevered from two faces of the support parts **30**, such two faces being generally at a right angle (orthogonal) to each other and forming an inside corner.

A vertical circulation unit **34** is composed of an elevator shaft **55**, a stairway **56** surrounding the elevator, entrance platforms **57** at heights corresponding to the levels of the enclosing units **33**, and a protective outer wall **58**. This unit provides the means of entry and exit from any of the various floors of the building to another floor level or to the ground level whichever is desired.

The basic component parts of this building are designed in such a manner as to allow the parts to be mass-produced at a location remote from the building site. The use of such prefabricated parts will tend to reduce not only the cost of the parts themselves but also the cost of construction or assembly of the parts as compared with conventional construction costs. The furnishings and fixtures in each enclosing unit can be factory-installed and the unit also lends itself to the use of preformed electrical and plumbing circuits as well as other preformed units. After the component parts of the building have been completed, they are shipped to the building site.

The assembly of the building proceeds in the following manner. After the foundation **40** has been completed, the support parts **30** with the service line enclosures **32** are tilted up and attached to the foundation and to each other. The mechanical service unit **31** is then placed on top of the support parts **30** and securely attached to them. The enclosing units **33** are then attached to the support parts **30** and to the utility lines in the service line enclosure **32** which run along the outside edges of the support parts **30**. The utilities for each enclosing unit **33** are connected to the service line enclosures **32** by plugging into one of the connections available in the service line enclosure **32**. This allows for quick installation of utilities for each enclosing unit and allows for quick detachment of the utilities if the enclosing unit is desired to be removed or replaced. Utility lines are then connected at ground level with existing utilities, thereby servicing the entire building with utilities. The vertical circulation unit **34** is then tilted up into position and the entrance platforms **57** attached to the appropriate enclosing units **33**.

Another feature of this invention is that the building can be easily disassembled, transported to a new site, and reassembled without damaging any part of the building. It can also be partially disassembled without interfering with other units of the building. Any one of the enclosing units **33** may be removed without removing another enclosing unit **33** on the same level or without removing or affecting a unit on any other level. If the mechanical service unit **31** becomes defective, it can be removed and another unit inserted in its place without dismantling any other part of the building. If a service line enclosure **32** becomes defective, it too can be unbolted and removed and another unit can be inserted without affecting other units of the building. The service line enclosures **32** could be constructed and attached in short sections, thereby making the job of repair and replacement of the service lines easier to accomplish. If one section of the service line enclosure **32** was defective, it could be removed and another section easily inserted in its place in a very short period of time.

Another feature of this invention is the variety of possible floor plans that can be obtained. The floor plans shown in FIGS. **15** and **18** are just two of the possible floor plans using four enclosing units **33** at each level of the building. This choice of floor plans need not be the same for the whole building. The first floor could have a floor plan as shown in FIG. **15** and the second floor plan could be as shown in FIG. **18**. The third floor plan could be different yet from either of the first two floor plans or it could repeat the first or second floor plan, as desired. This provides a great number of possible external configurations that the building might acquire. Aside from the external variety of configurations possible, the external texture and color of the enclosing units could be varied to suit the individual taste of the occupant or owner.

Even though there is a large variety of external configurations possible using this building, the number of possible internal variations within each enclosing unit is even greater. The internal texture or color of the enclosing units would be a matter of individual tastes and could be changed at any time. Replacement of internal fixtures, such as the bathroom or kitchen fixtures, could be varied to suit the individual occupant. The floor arrangement, furnishings, window openings, balconies, etc., could be arranged in an almost infinite number of ways to provide an unlimited variety of internal appearances for each building unit.

FIGS. **20—24** show yet other possible design configurations that are possible using still the basic component parts of this invention but using only three of the enclosing units **33** at each vertical level, instead of four as previously shown in FIGS. **15** and **18**. Other variations can be obtained by using more than four of the support parts **30**, and two such variations are shown in FIGS. **25—28**. The building in FIGS. **27** and **28** requires seven support parts **30** and uses (in addition to the above-described enclosing unit **33**) a modified enclosing unit **60** that has only one outer wall instead of the two outer walls that the other enclosing units **33** have. The modified enclosing unit **60** could be attached to one, two or all three of the support parts **30** that are adjacent to it. The building in FIGS. **25** and **26** also requires six support parts **30** but does not require a vertical circulation unit **34** because a staircase **61** and an elevator **63** are situated in the center of the building.

Referring to FIGS. **25** and **28**, it will be observed that the basic arrangement of the support parts **30** is a T (as viewed in plan or in horizontal section). In each of such FIGS., two T's are so arranged that the arms of one T are parallel to the arms of the other, whereas the stems of the T's are coplanar and extend in opposite directions from each other. Thus, for example, in FIG. **25** the leftmost part **30** is the stem of one T and extends toward the left, whereas the rightmost part **30** is the stem of the other T and extends toward the right. Such arrangement is to be compared with other FIGS. of the

drawings, for example FIG. 4, wherein two stems (such as the support parts 30 shown at the left and right in FIG. 4) extend in opposite directions from the same pair of arms (the top and bottom support parts, FIG. 4) instead of from parallel arms. In the FIG. 4 arrangement, one additional stem is added to the T (the basic unit of FIGS. 25 and 28) to thus form the cross or cruciform arrangement referred to at the beginning of this description.

The foundation 40 shown in FIG. 2 is a standard foundation. The support parts 30 could rest instead on four pilings, thereby obviating the need of a standard foundation 40 for the building. The support parts 30 in FIG. 1 are shown to be four stories high for convenience only. The height of the support part 30 can be varied, depending upon the number of floors desired in the building.

The air space 62 between vertical enclosing units 33 (FIG. 16) could serve two functions. First, it insulates one unit from the units above or below it, thereby providing adequate sound insulation between vertical units. Secondly, the space could also be used for the plumbing and wiring connections between the enclosing units 33 and the service line enclosures 32. Such an arrangement would make the utility service connections between the enclosing units 33 and the service line enclosures 32 almost wholly accessible for repair or replacement, if necessary.

The foregoing detailed description is to be clearly understood as given by way of illustration and example only, the spirit and scope of this invention being limited solely by the appended claims.

I claim:

1. A building having a plurality of stories, which comprises:
a support tower which is shaped generally as a T in horizontal section,
whereby the stem of said tee is arranged generally at a right angle to each arm thereof,
a multiplicity of enclosure modules connected to said support tower and at different levels of the building,
there being a plurality of enclosure modules at each level of the building,
each such enclosure module being cantilevered from said stem of the tee and also from one arm thereof, and
means to effect vertical circulation of people between different levels of the building.

2. The invention as claimed in claim 1, in which said support tower is purely a structural support element, and does not contain said vertical circulation means.

3. The invention as claimed in claim 1, in which each of said enclosure modules extends outwardly from said support tower a substantial distance past the outer edge of at least one of said stem and said arm.

4. The invention as claimed in claim 1, in which each of said enclosure modules is spaced vertically from the enclosure modules on other levels of the building, whereby to minimize sound transmission between enclosure modules.

5. The invention as claimed in claim 1, in which each of said enclosure modules is generally rectangular and has a generally horizontal upper or ceiling portion, a generally horizontal bottom or floor portion, and two adjacent vertical wall portions, said adjacent wall portions intersecting each other at a corner which is diagonally opposite the corner formed between said stem and said arm.

6. The invention as claimed in claim 5, in which the remaining two adjacent portions of said modules are open.

7. The invention as claimed in claim 1, in which an elongated service module is connected to said support tower and parallel thereto, said service module containing conduits and pipes for said building.

8. The invention as claimed in claim 7, in which said service module is connected to and extends adjacent the outer edge of one of said stem and said arm.

9. The invention as claimed in claim 1, in which a service unit is mounted on said support tower at the upper end thereof, said service unit containing the air temperature-regulating apparatus employed in said building.

10. The invention as claimed in claim 1, in which an elongated service module is connected to said support tower and parallel thereto, said service module containing conduits and pipes for said building, and in which a service unit is mounted on said support tower at the upper end thereof, said service unit containing the air temperature-regulating apparatus employed in said building, said service module being connected to said service unit.

11. The invention as claimed in claim 1, in which horizontal circulation means are provided to permit circulation of people between different ones of said enclosure modules at each level of the building.

12. The invention as claimed in claim 10, in which said horizontal circulation means includes openings provided in said support tower at each level of the building and at least sufficiently large to permit people to walk therethrough.

13. The invention as claimed in claim 1, in which another support stem is provided on said support tower in general alignment with said first-mentioned stem and on the opposite side of said arms from said first-mentioned stem, said other support stem having additional enclosure modules connected thereto in cantilevered relationship.

14. The invention as claimed in claim 13, in which said support tower is generally cruciform in cross-sectional shape.

15. The invention as claimed in claim 1, in which a second T-sectioned support tower is mounted adjacent said first-mentioned tower and cooperates therewith in forming a single building, said second tower having enclosure modules connected thereto in cantilevered relationship.

16. The invention as claimed in claim 1, in which means are provided to removably secure each of said enclosure modules to said support tower in cantilevered relationship, whereby said enclosure module may be readily removed when desired.

17. The invention as claimed in claim 1, in which said means to effect vertical circulation is a vertical circulation unit separate from said support tower but removably supported thereby, said unit comprising the stairs employed in the building.

18. A plural-story building capable of being rapidly erected from factory-made modules, and capable of being rapidly disassembled either partially or completely and without substantial damage to the various modules, said building comprising:
an elongated vertical tower which carries substantially all of the loads of the building,
said tower being generally T-shaped in horizontal section whereby a plurality of inside corners are defined by orthogonally related portions of the tower,
a multiplicity of generally rectangular enclosure modules mounted at different levels of the tower,
each of said enclosure modules being located at least partially in one of said inside corners,
means to effect horizontal circulation of people between different ones of said enclosure modules on each level of the building,
means to effect vertical circulation of people between difficult levels of the building, and
service means to connect to said modules the pipes and conduits necessary for supplying water and electricity to said modules.

19. The invention as claimed in claim 18, in which the means to mount each of said enclosure modules to said tower includes means to removably connect in cantilevered relationship one side of such enclosure module to one of said orthogonally related tower portions which form the corner in which such enclosure module is located, and means to removably connect in cantilevered relationship one adjacent side of such enclosure module to the other of said orthogonally related tower portions forming said corner.

20. The invention as claimed in claim 19, in which said one side and said one adjacent side of such enclosure module are generally at a right angle to each other and fit against said

orthogonally related tower portions, said one side and said one adjacent side being open, the two remaining sides of said enclosure module being closed, and in which said orthogonally related tower portions are notched to permit people to walk through said open sides of such module to a module adjacent thereto.

21. The invention as claimed in claim **18**, in which said horizontal circulation means includes openings provided in said support tower at different levels thereof and at least sufficiently large to permit people to walk therethrough.

22. The invention as claimed in claim **18**, in which said support tower has an additional wing causing the same to be cruciform in horizontal section, in which at least three of said enclosure modules are mounted in cantilevered relationship to said tower at each level of the building, and in which said horizontal circulation means includes openings provided in said support tower at different levels thereof and sufficiently large to permit horizontal movement of people therethrough between adjacent enclosure modules.

23. The invention as claimed in claim **18**, in which said means to effect vertical circulation is an elongated vertical circulation module separate from said support tower but parallel thereto and supported thereby, said vertical circulation module comprising stairs and elevator means, and in which said service means comprises an elongated vertical service module containing pipes and electrical conduits, said service module being connected to an outer edge of one of said orthogonally related tower portions.

24. The invention as claimed in claim **23**, in which a service unit is mounted at the upper end of said tower and is connected to said elongated vertical service module, said service unit containing the heating and air-conditioning elements of the building.

25. The invention as claimed in claim **24**, in which said means to effect horizontal circulation of people comprises openings in said orthogonally related portions of said tower.

26. The invention as claimed in claim **18**, in which said vertical tower does not contain rooms or stairways and is formed of a plurality of corresponding support elements each of which is an elongated rectangle, one edge of each support element being provided with a plurality of corresponding large notches, each of such notches forming an access opening for horizontal movement of people between the enclosure modules at each story of the building, such notched edges of each support element being connected to the notched edges of adjacent support elements.

27. A plural-story modular building capable of production in a factory, which comprises:

at least three corresponding elongated rectangular support elements which are not enclosures and which are arranged in vertical relationship on a foundation means,

each such support element being at a right angle to at least one other support element,

each of said support elements having large vertically spaced rectangular notches along one edge thereof,

said notched edges of said support elements being adjacent each other whereby the resulting support tower is substantially T-shaped in horizontal section,

said notches cooperating with each other to form access openings whereby horizontal circulation of people may be effected therethrough,

a multiplicity of enclosure modules connected to said support tower at different levels thereof,

there being a plurality of enclosure modules at each level of the building,

each of said enclosure modules being rectangular and having upper and lower walls and two adjacent sidewalls,

the remaining two sides of each of said enclosure modules being open,

means to connect each of said enclosure modules to said tower at an inside corner formed between one arm of the T and the stem thereof,

the relationship being such that said enclosure module is turned with its open sides facing said notched support elements,

said enclosure modules being connected to said support elements in cantilevered relationship,

an elongated vertical circulation module separate from said support tower but supported thereby in parallel relationship relative thereto,

said vertical circulation module containing stair and elevator means for vertical movement of people between different floors of the building, and

an elongated vertical service module connected to said support tower along an edge thereof remote from the adjacent notched edges thereof,

said service module containing pipe and conduit means for transmission of electricity and water to the various enclosure modules.

28. The invention as claimed in claim **27**, in which a service unit is mounted at the upper end of said support tower, and in which an additional elongated service module is provided and extends horizontally from said service unit along the upper edge of one of said support elements to said first-mentioned service module.

29. The invention as claimed in claim **28** in which an additional corresponding support element is secured to said three support elements in alignment with the stem of the T, whereby a cruciform shape results.

30. A building, which comprises:

an upwardly extending support structure which is shaped generally as a T in horizontal section,

said support structure resting on a foundation in the ground,

a plurality of generally rectangular enclosure modules each having top and bottom generally horizontal walls,

each such enclosure module also having two adjacent vertical outer walls which meet each other at a vertical corner edge,

each such enclosure module also having two adjacent open sides respectively opposite said vertical outer walls,

means to cantilever said enclosure modules from said support structure respectively in the inside corners formed between the stem of said T and each arm thereof,

said vertical corner edges being remote from said inside corners,

said open sides being adjacent said stem and said arms,

means to effect horizontal circulation of people between said enclosure modules, and

means to provide access to said enclosure modules from the ground.

31. The invention as claimed in claim **30**, in which said horizontal circulation means includes openings through said support structure and at least sufficiently large to permit people to walk therethrough.