

United States Patent

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[45]	Patented	July 20, 1971
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[54] PREFABRICATED SERVICE MODULE FOR A DWELLING UNIT
33 Claims, 14 Drawing Figs.

[52] U.S. Cl..... 52/27,
52/79, 52/182, 52/236

[51] Int. Cl. 32/19, 32/182, 32/236
A47k 3/16.

[50] **Field of Search**..... E04h 1/12
52/27, 34,
35, 79, 182, 185, 220, 236, 234, 173

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ABSTRACT: A prefabricated service module for a dwelling unit. A center wall has a stairway extending upwardly along one side thereof having space beneath it for a water heater and a powder room. A floor portion extends laterally from the middle of the other side which serves as a floor for a bathroom and a ceiling for a kitchen. The kitchen appliances are arranged along the center wall in the kitchen space and the bathroom fixtures along the center wall in the bathroom space. The utility systems, such as heating ducts, vent ducts, electric supply, water and sewer systems are provided in the center wall. The entire structure can be completely prefabricated and can even include all of the appliances, plumbing fixtures and the like, so that it can be fully tested out at the point of its manufacture, and thereafter transported to the site of the building into which it is to be incorporated.

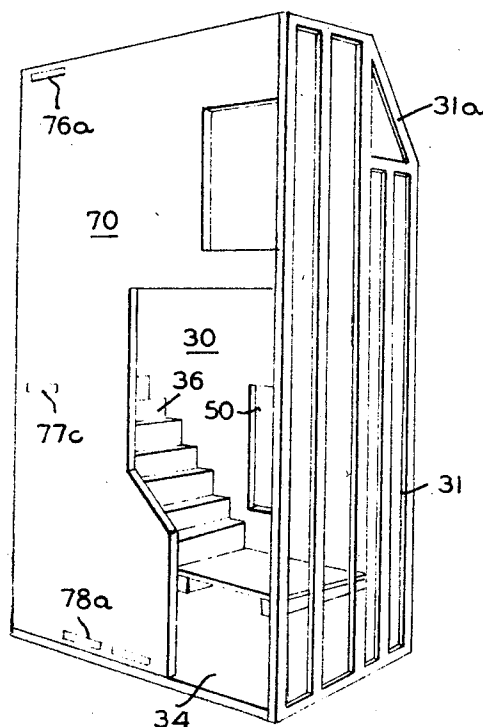


FIG. 1

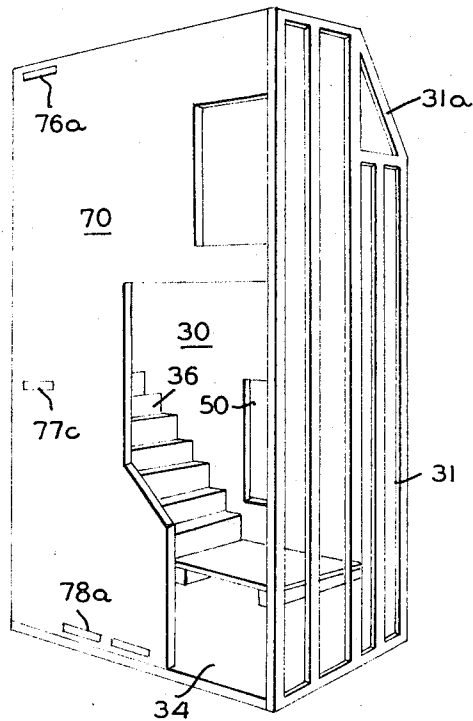
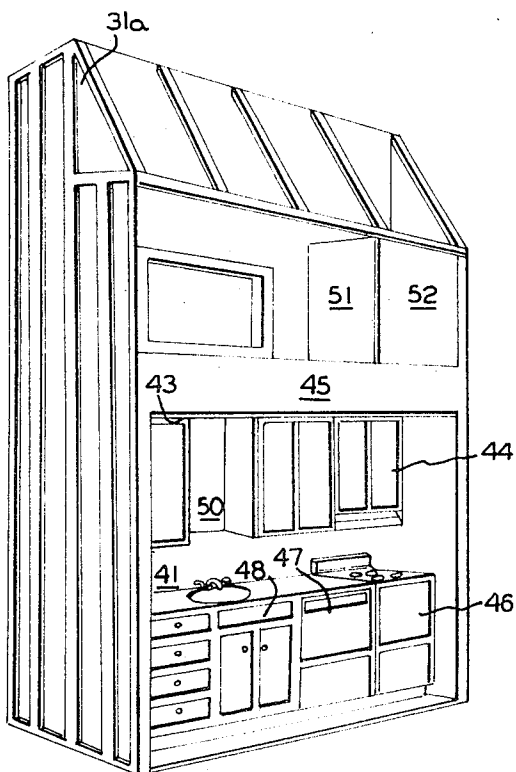


FIG. 2



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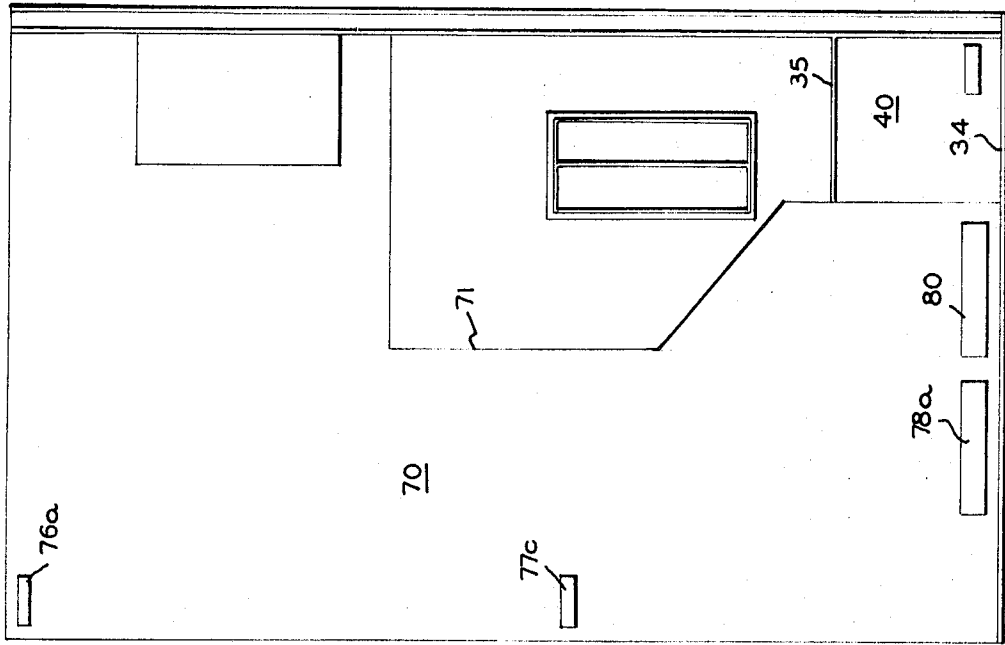


FIG. 4

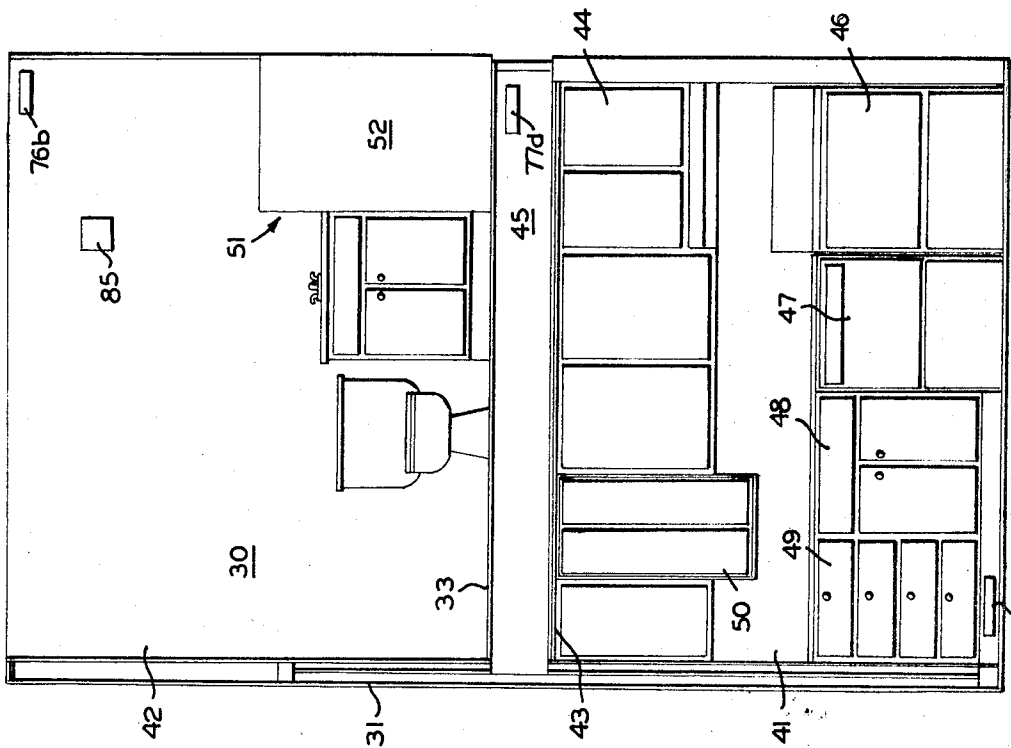


FIG. 3

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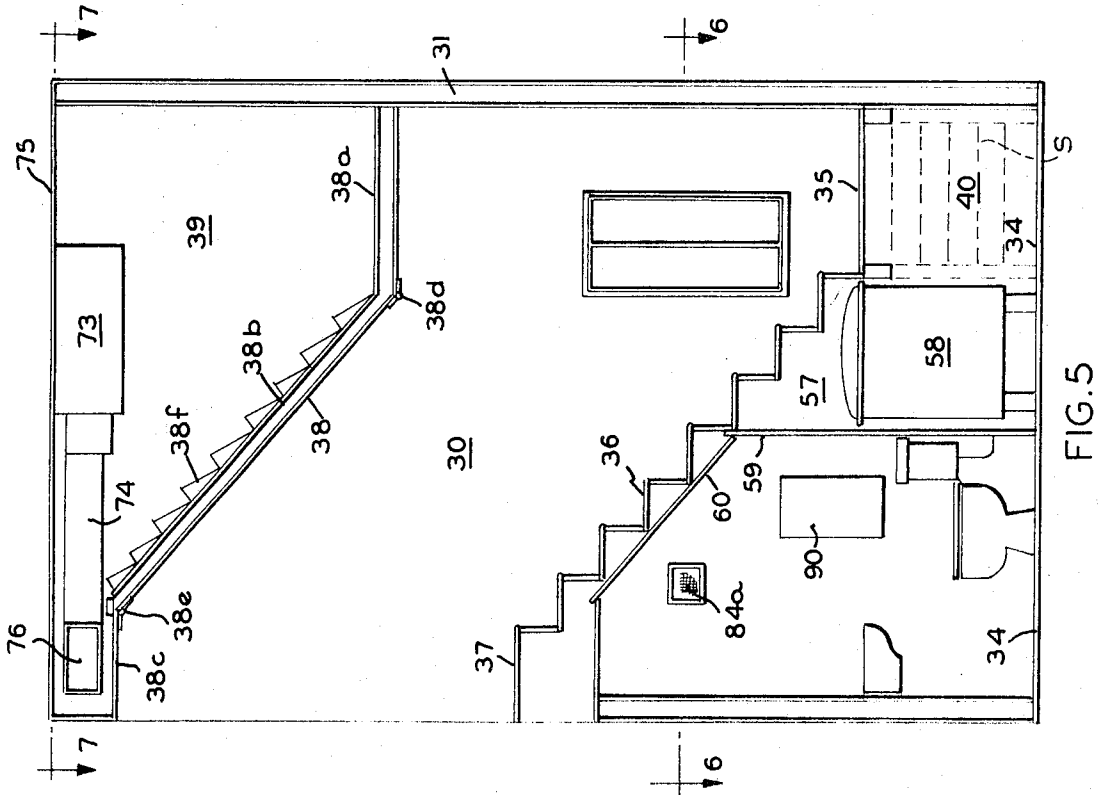


FIG. 5

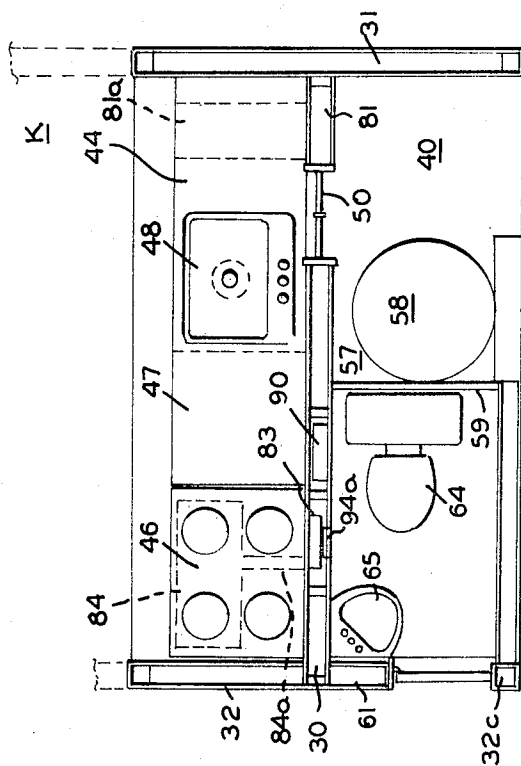


FIG. 6

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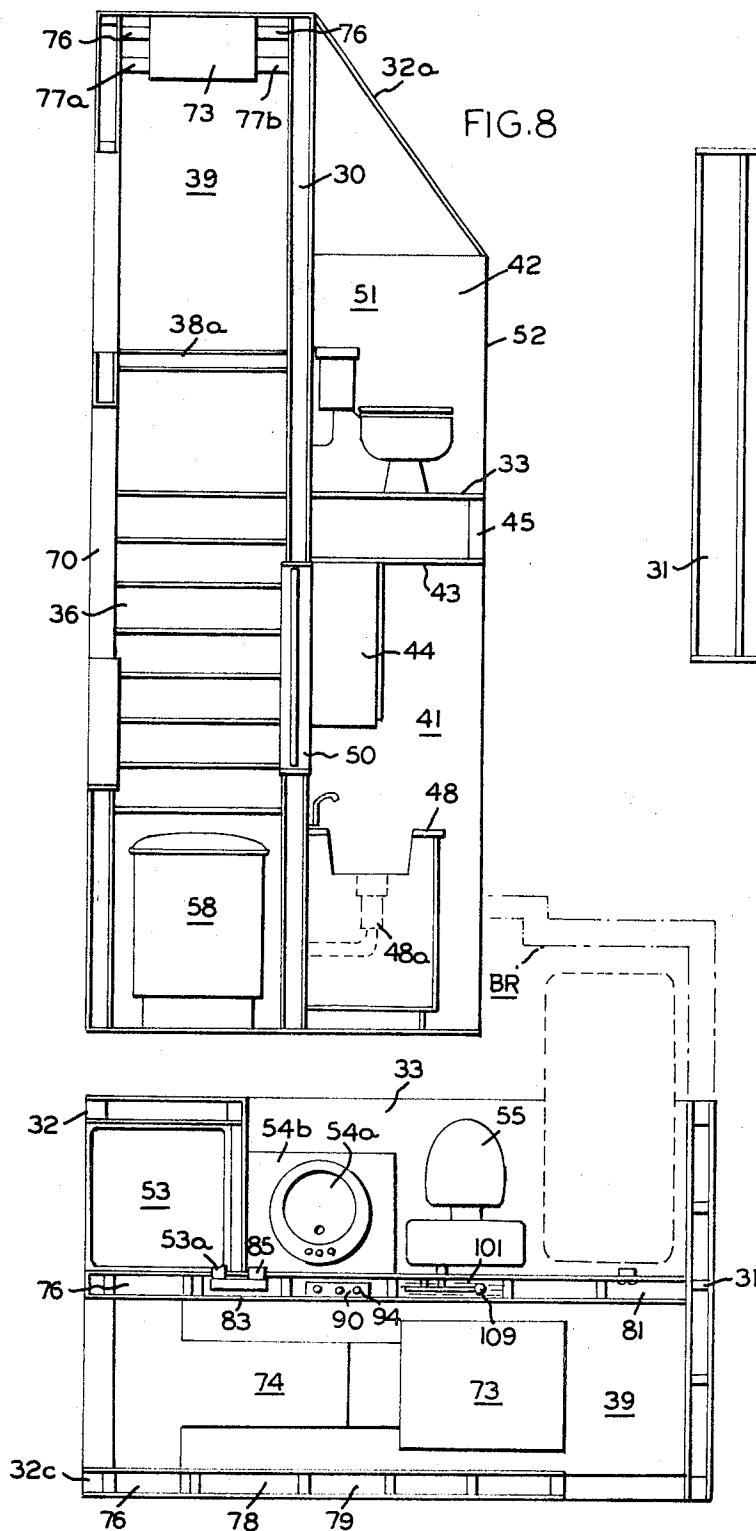


FIG. 7

FIG. 8

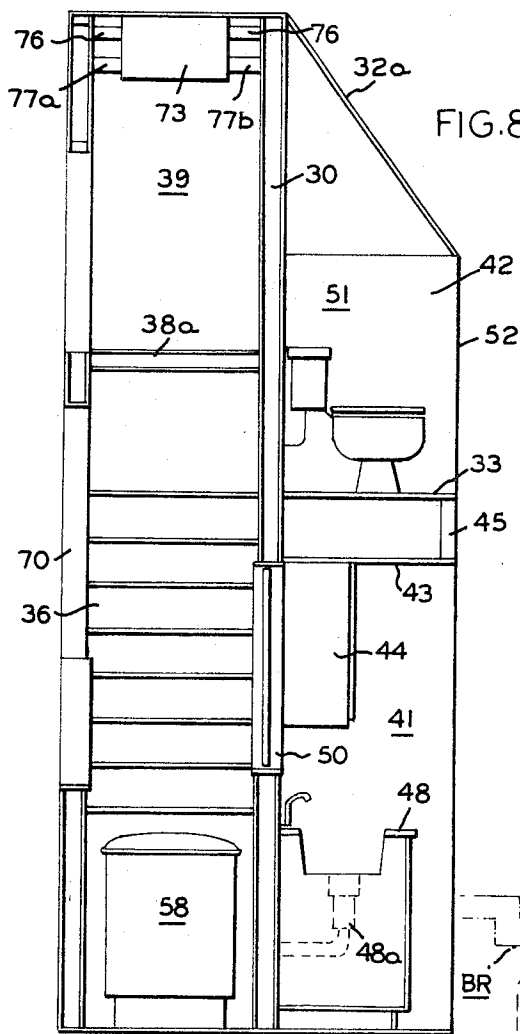


FIG. 9

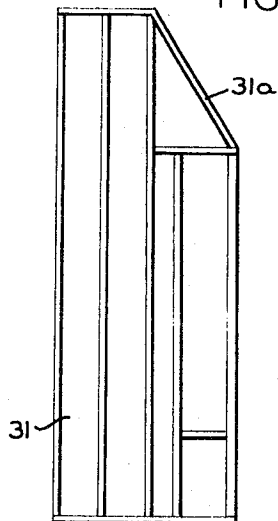
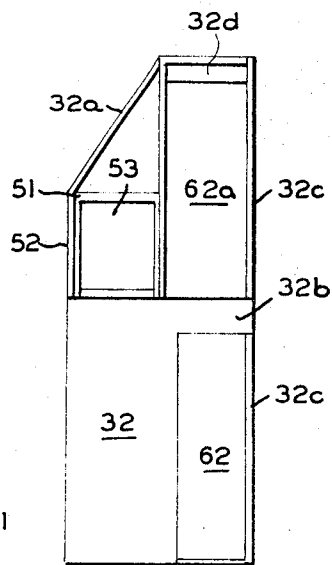


FIG. 10



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FIG. 11

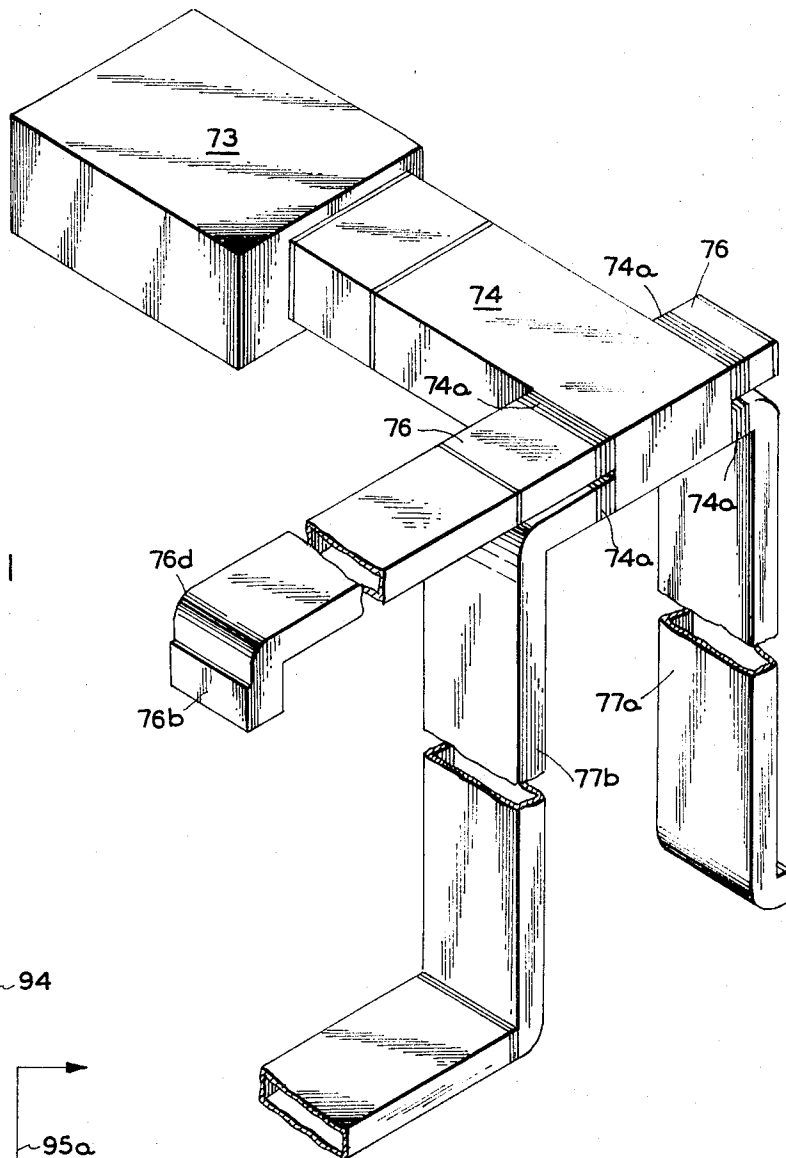
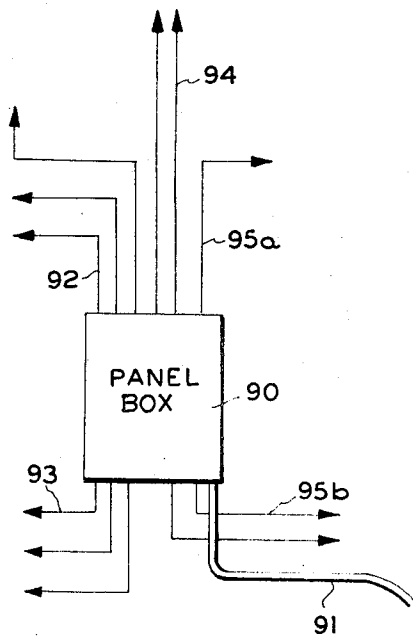


FIG. 12

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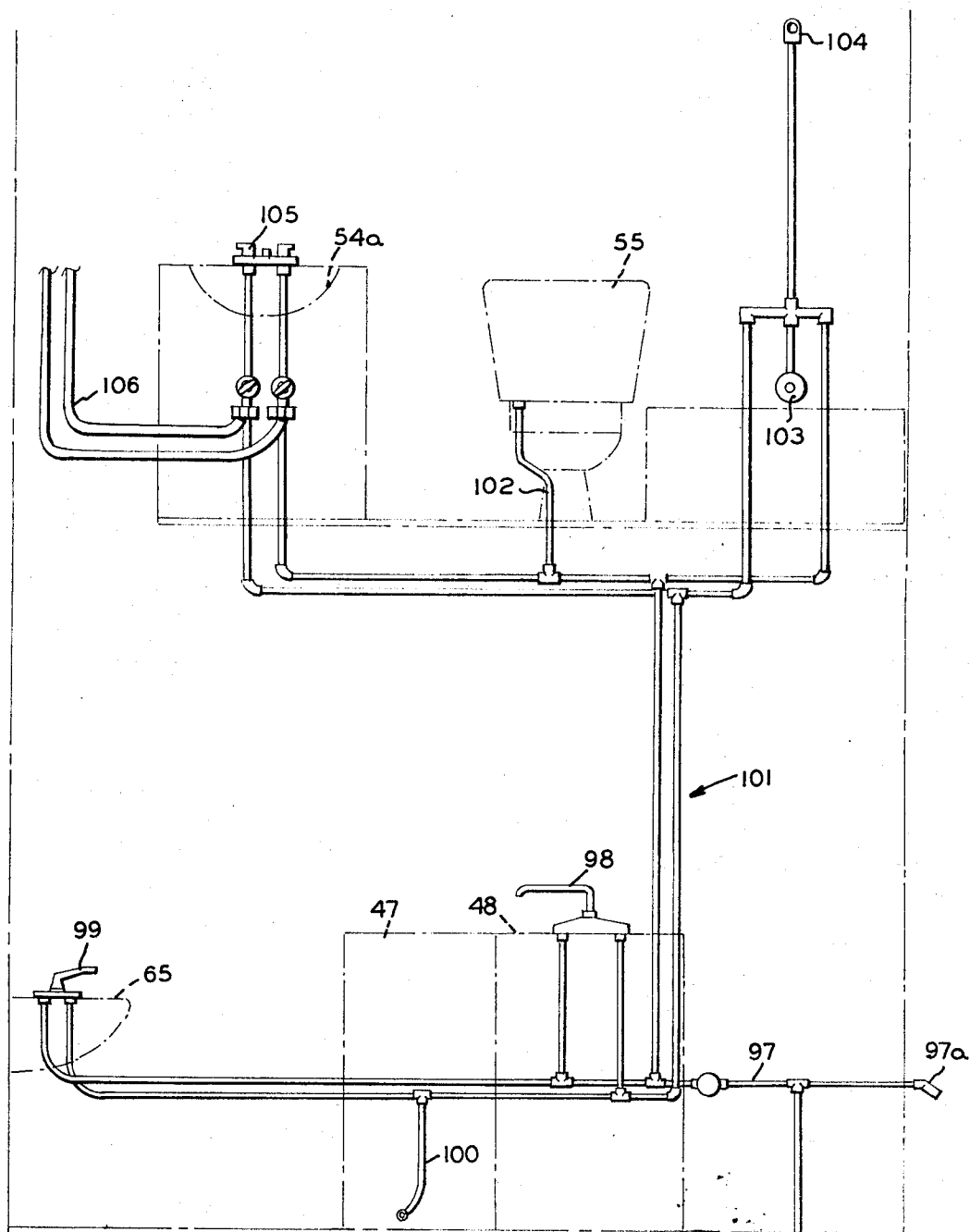


FIG. 13

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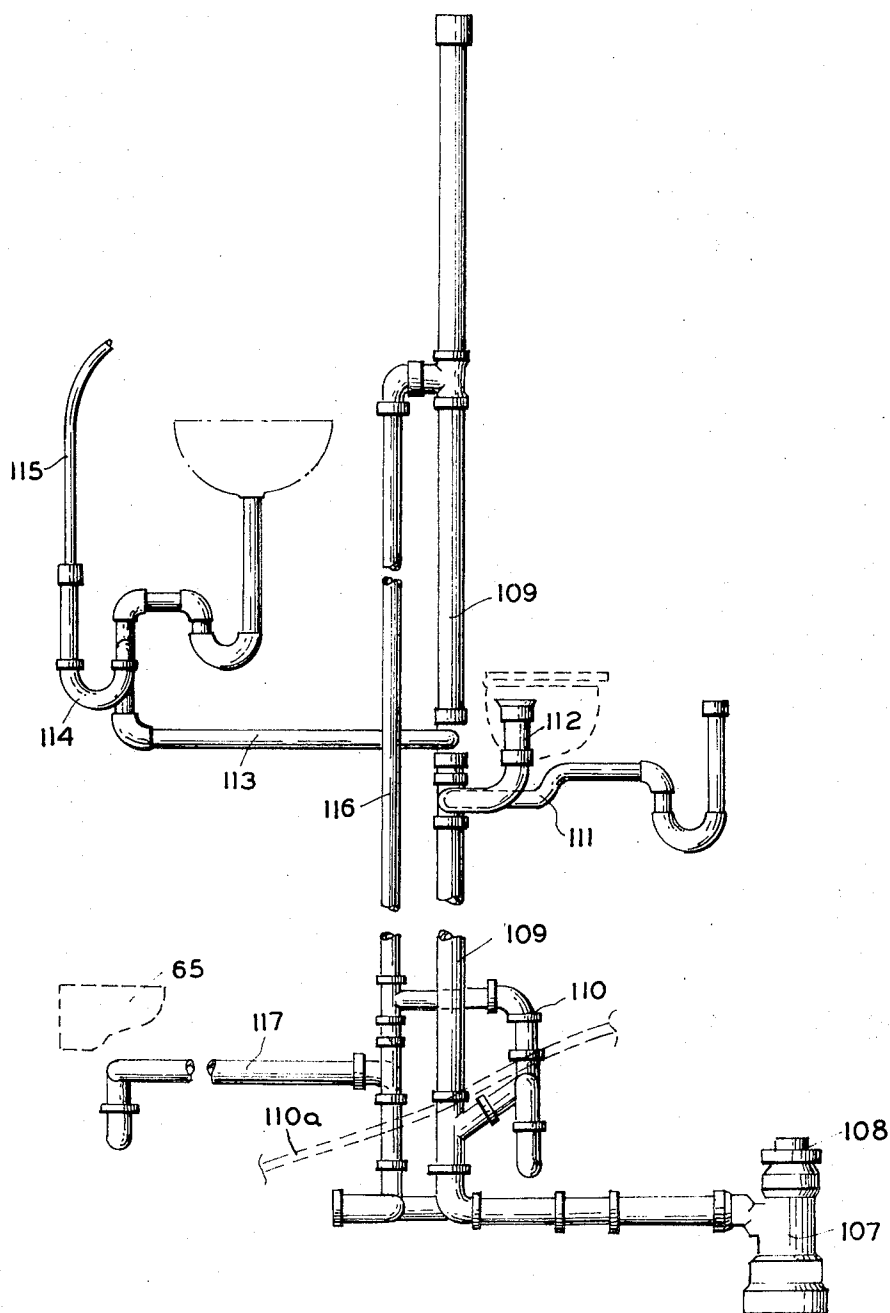


FIG. 14

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PREFABRICATED SERVICE MODULE FOR A DWELLING UNIT

This invention relates to a prefabricated service module for a dwelling unit, and more particularly relates to a service module which contains all of the services and utilities necessary for a complete dwelling unit and which is compact in form and which can be easily fabricated, yet will permit a wide variety of dwelling units to be built with the unit as a core.

Prefabricated portions of dwelling units which contain certain of the services or utilities necessary for the dwelling unit have long been of interest, but in recent years such units have become of greater interest because of the two factors of rapidly increasing population with the resultant demand for housing which can be erected rapidly, and the necessity of producing quality housing at lower cost. The prior art has developed some such units, principally bathroom or bathroom and kitchen units in which all of the plumbing has been incorporated in the module which can then be placed in the dwelling as it is being assembled. There have even been attempts to incorporate kitchens in such modules.

However, several problems have been encountered which have prevented widespread acceptance of such modules by the housing industry. Perhaps foremost among them is the problem of compliance with building codes for various jurisdictions. It is not difficult to develop a service module if the requirements of the building codes are ignored. Of course, such modules cannot be used except in those areas not covered by such codes.

The second problem is to keep the size of the module down so that it can be transported from the prefabrication point to the building site. This is a relatively easy problem to overcome with modules which are no more than one room or two rooms back to back. However, such modules usually include only a bathroom, or a bathroom and kitchen, and are mostly for apartment-type dwellings. Core units which are to serve for two-story dwellings, such as the so-called townhouse-type dwelling or even single family dwellings, of course present much more difficult problems because of the limits of the width and height of loads which can be transported over public highways.

The third problem is that of ease and consequent low cost of assembly. These factors are essential to a successful module, yet they must not be obtained at the expense of weakening the overall module or making it less flexible in use.

It is an object of the present invention to provide a service and utility module for a dwelling unit which overcomes the drawbacks of all of the prior art modules, yet which can be fabricated easily and inexpensively in conformity with building codes, has a size which enables it to be trucked easily to a construction site, and which is laid out so that it permits great flexibility in the design of the dwelling unit in which it is to be incorporated.

This object is accomplished by the providing of a structure which has a center wall with a stairway extending upwardly along one side thereof having space beneath it for a water heater and a powder room, and a floor portion extending laterally from the middle of the otherside which serves as a floor for a bathroom and a ceiling for a kitchen. The kitchen appliances are arranged along the center wall in the kitchen space and the bathroom fixtures along the center wall in the bathroom space. The utility systems, such as heating ducts, vent ducts, electric supply, water and sewer systems are provided in the center wall and are arranged in the recited order starting at the end of the service module at which the upper end of the stairs is located. The systems are arranged generally vertically with the horizontally extending branches extending through spaces available behind the appliances and within the center wall. The appliances requiring venting are all arranged along the portion of the center wall where the vent system is located, and the appliances and fixtures requiring water and drainage are, with a few exceptions, arranged along the por-

tion of the center wall near the water supply and sewer systems. The entire structure can be completely prefabricated and can even include all of the appliances, plumbing fixtures and the like, so that it can be fully tested out at the point of its manufacture, and thereafter transported to the site of the building into which it is to be incorporated.

Other and further features of the invention will become apparent from the following description taken with the accompanying drawings, in which:

FIG. 1 is a perspective view of one end and one side of the prefabricated service module for a dwelling unit according to the present invention;

FIG. 2 is a perspective view of the other side and end of the prefabricated service module;

FIG. 3 is a side elevation view of the prefabricated service module taken from the side shown in FIG. 2;

FIG. 4 is a side elevation view of the prefabricated service module taken from the side shown in FIG. 1;

FIG. 5 is a side elevation view of the service module as shown in FIG. 4 with the near sidewall removed;

FIG. 6 is a sectional plan view taken along section line 6-6 of FIG. 5, with the stairs removed to expose the space beneath them;

FIG. 7 is a sectional plan view taken on section line 7-7 of FIG. 5;

FIG. 8 is a sectional end elevation view taken along section line 8-8 of FIG. 3;

FIG. 9 is an end elevation view of the one end of the prefabricated service module as shown in FIG. 5;

FIG. 10 is an end elevation view of the other end of the prefabricated service module as shown in FIG. 5;

FIG. 11 is a schematic view of the air circulation system for heating and cooling air for the prefabricated service module;

FIG. 12 is a schematic view of the electrical system for the prefabricated service module;

FIG. 13 is a schematic view of the water supply system for the prefabricated service module; and

FIG. 14 is a schematic view of the drainage and sewage system for the prefabricated service module.

The basic structure of the prefabricated service module comprises a framed center wall 30 having studs therein with spaces therebetween which is shown in section in FIGS. 6, 7 and 8, and the opposite sides of which are shown in FIGS. 3 and 5. It is preferred that the studs extend the entire height of the wall to provide unobstructed spaces for the entire height of the wall.

Extending transversely to one end of the center wall 30 is a full transverse end wall 31, also shown in section in FIGS. 6 and 7, and the vertical section of which is shown in FIGS. 3 and 5. At the other end of the center wall 30 is a partial transverse end wall 32 which extends from the center wall 30 transversely thereof in only one direction. This is shown in section in FIGS. 6 and 7, and in elevation in FIGS. 3 and 10. Also, this partial transverse end wall extends for only one half the height of the full transverse end wall. The upper end of the full transverse end wall is cut off as at 31a in FIGS. 1 and 9, and above the partial transverse end wall 32 is a framing 32a, shown clearly in FIG. 10, which extends from the top of a washer-dryer side panel 32, described in more detail hereinafter, at an angle parallel to the cutoff corner 31a of the full transverse wall 31. The purpose of the cutoff portion and the angle frame piece will be explained hereinafter.

Extending horizontally from the center wall 30 from a point about half the height thereof is an upper floor panel 33. This upper floor panel 33 extends only in the direction in which the partial transverse end wall 32 extends, and substantially fills the space between the top edge of the partial transverse end wall 32 and the full transverse wall 31, and serves as a floor for the upper story of the service module. Extending laterally from the middle of the height of the center wall 30 and in the opposite direction from the upper floor panel 33 and on the same end of the service module as the partial transverse end wall is a horizontal door frame member 32b, and depending

from the free edge thereof is a vertical door frame member 32c, the edge of the partial transverse end wall 32 and the door frame members 32b and 32c defining a door space 62, all as shown most clearly in FIG. 10.

A bottom floor panel 34 is secured to the bottom edge of the center wall 30, the full transverse end wall 31, the partial transverse end wall 32, and the bottom end of the vertical door frame member 32c, and serves as a flooring for the service module. Extending upwardly from the free end of the horizontal door frame member 32b is a further vertical door frame member 32c, and extending across the top of the frame member 32c to the top corner of the center wall 30 is a further horizontal door frame member 32d, these elements together defining an upper doorlike opening 62a, clearly shown in FIG. 10.

In the corner defined by the inner surface of the center wall 30 and that of the full transverse end wall 31 on one side of the service module, as shown in FIG. 1, there is removably positioned a lower stair landing 35, which is spaced above the bottom floor panel 34 a distance of about three or four steps. Extending upwardly, to the left in FIG. 5, is a stairway 36 having at its upper end a top or upper stair landing 37 which is on a level with the bottom edge of the door opening 62 defined by the door frame members 32c, 32d, and the center wall 30. Spaced above the lower stair landing, stairs, and upper stair landing is a stair ceiling generally indicated at 38 in FIG. 5, and having a lower horizontal portion 38a, and upwardly inclined portion 38b, and a horizontal upper portion 38c, these portions being parallel to the lower stair landing 35, the stairs 36 and the upper stair landing 37, respectively. It is preferred that upwardly inclined portion 38b has steps 38f or the like on the top side and is hinged at the lower end thereof to lower horizontal portion 38a by a hinge 38d, and the upper end is removably attached to the upper horizontal portion by latch means 38e, so that when the latch means is unlatched, the inclined portion 38b can be dropped with the free end resting on the upper stair landing 37 and the steps 38f give access to the space 39 above the stair ceiling.

It will thus be seen that there has been defined on the one side of the center wall 30 a stairwell having above it an enclosed space 39 and having below the lower stair landing a further space 40, and having beneath the stairs a still further space, which will be described more in detail hereinafter. On the other side of the center wall 30 there has been defined a lower space 41, hereinafter referred to as the kitchen space, and an upper space 42, which will hereinafter be referred to as the bath space.

Referring first to the space 41, which is shown in detail in FIGS. 3, 6 and 8, it will be seen that it has a false ceiling 43 spaced downwardly from the upper floor panel 33 a short distance, and it is preferred to provide a plurality of cabinets 44 depending from the false ceiling 43 along center wall 30, although such cabinets can be added later. The space between the free edges of the upper floor panel 33 and the false ceiling 43 is filled by a cover panel 45. In the preferred embodiment, there are spaced along the bottom floor panel beginning at the partial transverse end wall 32 a combination range and oven 46, next to which is a dishwasher 47 which is against the end of the combination range and oven 46. Immediately next to the dishwasher is a kitchen sink 48 having a garbage disposal 48a therein. Between the kitchen sink 48 and the full transverse end wall 31 is a stack of drawers 49. Optionally, louvered doors 50 can be provided in the center wall 30 between two of the cabinets 44 near the full transverse end wall 31, these louvered doors opening into the stairwell, as shown in FIGS. 1 and 5. Utility connections for these items are an essential part of the unit and will be described hereinafter.

In the bath space 42 above the kitchen space 41, as shown in FIGS. 3, 7 and 8, there is provided at the end immediately above the range 46 a washer-dryer end panel 51 projecting upwardly from the upper floor panel 33 at a point spaced inwardly from the free end of the space 42, and on the outer edge of the upper floor panel 33 is a washer-dryer side panel

52. In a preferred embodiment, a combination washer and dryer 53 is positioned on the upper floor panel within the space defined by the center wall 30 and the washer-dryer end and side panels 51 and 52, and these panels extend upwardly a height somewhat above the top level of the washer-dryer 53. Additional panels (not shown) are provided and shipped with the service module to the construction site and are there placed on the top edges of panels 51 and 52 to enclose the washer-dryer space and separate it from the remainder of space 42.

In a preferred embodiment, a vanity 54 having a lavatory 54a therein is positioned in the corner of the space defined by the center wall 30 and the washer-dryer end panel 51. Immediately next to the vanity is a commode 55, and between the commode 55 and the full transverse end wall 31 is space 56 to accommodate one end of a bathtub B indicated in dotted lines. It will be seen that the bathtub B is to be positioned in this space with the water supply and drain end adjacent the center wall 30. The bathtub is not included in the service module because it would project outwardly therefrom beyond the edge of the upper floor panel 33. It is installed in the service module after the dwelling has been built around the service module.

An outer side wall 70 covers the opposite side of the service module, as shown in FIGS. 1 and 4, and has a large stairwell opening at 71 therein which opens out of the lower stair landing 35 and also extends part way up the stairs 36, the top edge being substantially level with the lower horizontal portion 38a of the stair ceiling.

In the space beneath the stairs 36, as shown in FIGS. 5 and 8, there is a water heater space 57 immediately adjacent the space 40 beneath the lower stair landing 35, and accommodated in the space 57 is a water heater 58, preferably an electric water heater. The edge of the water heater space 57 toward the upper end of the stairs is closed by a back wall panel 59 for a powder room, and extending upwardly along the bottom of the stairs is a powder room ceiling 60, the upper end of which extends horizontally at a position spaced below the top stair landing 37. A powder room front wall 61 extends outwardly from the edge of the center wall 30 a short distance, and there is defined between the free edge thereof and the vertical door frame member 32c (FIG. 10) the door space 62 for the powder room. It will thus be seen that the powder room is defined by the spaced center wall 30 and the outer sidewall 70, the backwall panel 59, the ceiling 60, and the front wall 62. A door 63 is hung on the door frame member 32c. In a preferred embodiment, there is provided within the powder room against the backwall panel 59 a commode 64, and in the corner between the center wall 30 and the front wall 61 a lavatory 65.

The space 39 above the stair ceiling 38 is provided to accommodate an air-temperature-changing system, and in a preferred embodiment such a heating system, e.g. a furnace 73, preferably an electric furnace, has a heating air supply duct 74 extending toward the space between the upper horizontal portion 38c of the stair ceiling and the top of the service module. The furnace and supply duct are preferably suspended from a top panel 75 covering the space 39. It will be understood that the furnace is a forced air furnace, the intake end of which opens into the space 39, and the output of which is forced into the supply duct 74 from which the heating air is circulated through a duct system to be described hereinafter. It will be further understood that in addition to a furnace, which of course is an air-heating means, there can be provided an air-conditioning unit which will cool the air at appropriate seasons of the year. This can be combined with the furnace 73, and since such units are well known, a combined unit is not illustrated here. Should such an air-conditioning unit be provided, it will of course, be necessary to provide appropriate cooling surfaces and remote compressor unit, as well as a drain for water extracted from the air passing through the unit. The compressor connections can be easily extended down through the space between the surfaces of the full trans-

verse end wall 31 or outer sidewall 70 and through space 40 to the outside of the dwelling. The drain can be extended to the drainage system.

It will thus be seen that there has been provided in the service module appropriate spaces for all of the appliances, plumbing fixtures, and the heating system which require connections to service systems of more than one type. For example, the commodes require a water supply connection as well as a sewage or drainage connection. The kitchen range requires special power connection as well as an exhaust ventilation means. The dishwasher requires a water supply connection as well as drainage connections and electric power, while the kitchen sink requires both water supply connection and drainage. The various systems are provided in the service module with connections at the appropriate spaces for the various appliances. In the preferred embodiment, the appliances etc. are actually positioned in the spaces and connected to the service systems. These systems will now be described.

Referring to FIG. 11, extending transversely from the end of the supply duct 74 from the furnace 73 are transverse supply ducts 76, the one ends of which are connected to the supply duct 74 by antivibration canvas connections 74a. Also connected to the end of supply ducts 74 through antivibration canvas connections 74a are downwardly extending air supply ducts 77a and 77b, which extend down through the first studding space in the outer sidewall 70 and center wall 30 along the door space at the top of the stairs 36. The air supply ducts 77a and 77b then extend laterally outwardly through openings 77c in the outer sidewall 70 as well as 77d in the cover panel 45 covering the space between the upper floor panel 33 and the false ceiling 43 in the kitchen space.

Also provided are openings 76a in the upper left-hand corner of the outer sidewall 70 (see FIG. 4) and 76b in the upper center wall 30 (see FIG. 3) which open out of the laterally extending ducts 76. It will be understood that these openings can either be connected directly to heating air outlets, or can be connected to further duct work for heating rooms which are not immediately adjacent to the service module. All the ends of the ducts are located above the level of the point at which the ceiling of any adjacent rooms will come into contact with the service module, and any heating air outlets appropriately extended downwardly therefrom, for example by an appropriate elbow 76d, as shown in FIG. 11.

The space 39 above the stair ceiling acts as a main return air-collecting chamber, access to which is gained through the space occupied by upwardly inclined ceiling portion 38b shown in FIG. 5. Opening into this space 39 are return air paths 78 and 79 extending upwardly through the outer sidewall panel 70 in the studding space immediately next to the air supply duct 77a. These return air ducts extend upwardly from the bottom of the outer sidewall 70, having an air return opening 78a at the lower end thereof. Additional air return opening 80 is also provided in outer sidewall 70 opening into the space 57 for accommodating the water heater. A further air return path 81 extends upwardly through the studding space in center wall 30 at the end thereof adjacent the full transverse end wall 31, from the space 40 beneath the lower stair landing 45 into the space 39 above the stair ceiling. Extending into the space 40 beneath the lower stair landing 35 through the center wall is also a duct 81a from the panel at the bottom of the drawers 49 in the kitchen space 41. This provides a return for the kitchen space.

It will thus be seen that a complete circulation system for the heated or cooled air is provided, the studding spaces within certain of the walls providing room for the air supply ducts as well as the air return ducts, and the space around the water heater also being connected to the circulating air system.

An air exhaust or vent system is also provided for the various spaces and appliances which require them. The vent stack 83 (see FIGS. 6 and 7) extends upwardly through the center wall 30 in the studding space next to the downwardly extend-

ing air supply duct 77b, the vent stack 83 extending just above the level of the range top 46 in the kitchen upwardly through the top panel 75. A kitchen exhaust fan duct connection is provided in wall 30 from the vent stack 83 at a level just below the bottom of cabinets 44. In the preferred embodiment there is mounted below wall cabinets 44 above the range 46 an exhaust hood, shown schematically at 84 in FIG. 6, having an exhaust fan (not shown) and an exhaust pipe 84z connected to the duct connection, so that the exhaust fan discharges into the vent stack 83 which is immediately behind the range in the center wall 30. A further exhaust fan duct connection is positioned in wall 30 beneath the top stair landing 37 and opens into the powder room. In a preferred embodiment exhaust fan 84 is mounted in the wall and coupled to this connection so that it discharges into the vent stack 83 which is also adjacent thereto in the center wall 30. The bath space 42 also has an exhaust fan duct connection therein for an exhaust fan shown at 85 in FIGS. 3 and 7, which also vents into the vent stack 83, which is immediately adjacent thereto. An exhaust duct connection 53a for the washer and dryer 53 is provided which opens into the vent stack in the center wall 30, which is immediately adjacent to the space for the washer and dryer 53. It will thus be seen that exhaust duct connections for all of the appliances which require exhaust vents are positioned along wall 30 immediately adjacent the space in which the vent stack 83 extends upwardly through the center wall 30, and the appliances themselves are positioned in the service module for easy connection to these exhaust duct connections.

As shown in FIG. 12, the electrical circuit includes a panel box 90 which fits behind a panel 90a in the powder room, shown in FIG. 5, in the studding space next to the vent stack 83. Extending into the panel box is a power line 91 which is to extend to connect to the power supply from outside the dwelling. Schematically represented as extending upwardly through the same studding space are wires 92 for such things as the exhaust hood fan 84, the washer and dryer 53, the vent fan 85 for the bath space 42, and the vent fan 84a for the powder room. Wires 93 are representative of the power supply leads for such things as the range 46, dishwasher 47, and the water heater 58. The leads 94 are representative of the power leads for the furnace and the furnace controls. Leads 95a and 95b are representative of the leads for the various lighting fixtures and power outlets throughout the module as well as the remainder of the dwelling around the module. All of the leads extend to the spaces for the various appliances to be supplied with power and where necessary extend laterally through available laterally extending spaces, such as the space between floor panel 33 and false ceiling 43, or behind the dishwasher 47 and range 46. In the preferred embodiment, the leads are connected to the actual appliances. It will be noted that the basic pattern of the leads is vertical within the studding space, only the ends of the leads extending outwardly of the space. In this way, this studding space is made use of for most of the electric power supply circuits in the module.

The water supply system, as shown in FIG. 13, includes the connection to the water supply main, shown at 96, and the pipes which lead to the water heater 58 from the main supply pipe 97. The connection to the water heater is not visible in FIG. 12, the water heater being in front of the portion of the system as shown. A hose bib 97a can be connected to the main supply line to extend through the full transverse end wall 31 to the outside of the dwelling.

Extending off the main supply and appropriately connected with the hot water heater are cold water lines for connection to the faucets at the kitchen sink 48 and for connection to the faucets at the lavatory 65 in the powder room. These are laterally extending pipes and are in the space behind the kitchen sink 48. In the preferred embodiment the kitchen sink faucets 98 and the lavatory faucets 99 will be connected to these lines. Appropriate lines from the hot water heater also extend to the faucets 98 and 99, and a branch 100 is provided for connection to the water inlet for the dishwasher 47, and which in the preferred embodiment is actually connected to the dishwasher 47.

Appropriate hot and cold water lines 101 extend vertically through the space between the studs adjacent the space containing the electrical supply, and at the top thereof, in the space between the upper floor panel 33 and the false ceiling 43, extend laterally. A branch 102 extends to the location of the commode 55 in the bath space 42, and appropriate lines extend to the valves for a tub faucet 103 and the shower head 104. Further branches extend to the faucets 105 for the lavatory 54a in the bathroom vanity 54. Washer hoses 106 extend from hose bibs 106a beneath the vanity for the lavatory 54a to the space for the washer and dryer 53 for connection to the washer and dryer.

It will be seen that the only pipes extending from the lower portion of the service module to the upper portion are pipes 101, which utilize a studding space not occupied by any other system, and where the pipes extend vertically in the remainder of the system, for example to the bathtub faucet and the shower head, they are also utilizing studding space or other space not utilized by other systems. The pipes to the bathtub faucet and shower head utilize the studding space above the louvered doors 50. An additional branch, not shown, carries cold water to the commode 64 in the powder room.

The sewage and drainage system, as schematically shown in FIG. 14, as a connection 107 for connecting to the outside sewer system, the connection having an access head 108 thereat. A horizontally extending header extends to the foot of a vertical main vent and collection pipe 109, to the lower end portion of which is connected the drain 110 for the kitchen sink 48. Also associated with this drain system 110 is a drain line 110a extending from the drain outlet of the dishwasher 47 to the garbage disposal 48a.

At the level of the upper floor panel 33, the main vent and collection pipe 109 has connected thereto the drain pipe system 111 for the bathtub and the drain 112 for the commode 55. Also connected at this point is the drain system 113 which serves the bathroom sink 54a, and the drain 114 for the washer-dryer. Connected to the drain condensate therefrom.

Immediately adjacent the main vent and collection pipe 109 is a secondary drain and vent pipe 116 into which the drain system 110 for the kitchen sink has connected a vent pipe. Also branching from this secondary vertical pipe 116 is a pipe 117 to the drain for the lavatory 65 in the powder room. Connected to the main horizontal pipe 107a is the drain 118 for the commode 64 in the powder room. It is noted that the secondary pipe 116 connects into the main pipe above the connection for the drain systems 111 for the bathtub, 112 for the bathroom commode, and 113 and 114 for the bathroom sink and washer-dryer. This enables venting of the kitchen sink and the powder room lavatory independently of the main collection pipe 109 below the connection for the upstairs plumbing fixtures. The top of the main pipe 109 opens to a vent at the top of the system.

All of the vertical pipes extend upwardly through the studding space allowed for the water supply and plumbing system, while the horizontal pipes extend through spaces otherwise unoccupied. The horizontal pipes and the upstairs portion of the system extend through the space beneath the upper floor panel 33 and above the false ceiling 43, while the laterally extending pipe to the lavatory in the powder room extends through the studding spaces below the point where the vent 83 and the air supply ducts 77b terminate.

In the space between upper floor panel 33 and false ceiling 43 can be provided connections, not shown, in the water supply and drainage systems for connection to a remote half bath.

It will be seen that the entire service module is arranged so that it can be completely prefabricated in a large assembled building, and, in its preferred embodiment, with all appliances, plumbing fixtures, etc., in place, all of the systems, appliances and fixtures are connected to each other, and the entire appliance and plumbing system can be checked out. The thus prefabricated service module can then be transported to the site where it is to be assembled into a dwelling.

It is within the scope of the present invention, however, to provide the service module without the various appliances, plumbing fixtures, etc. in place, i.e. to provide the structural elements, such as the walls, stairway, and the like, and the service systems, such as the air duct system, the vent system, the electrical system, and the water supply and plumbing system, and appropriate connections to enable the various appliances and plumbing fixtures, etc. to be placed in the service module and connected up at the building site. Obviously, the service module could also be provided with some of the appliances and plumbing fixtures and not others.

It is also within the scope of the present invention to omit from the structural elements the full transverse end wall 31 and the outer sidewall 70 covering the stair space, these structural elements being provided by existing or later built walls at the building site. Likewise the bottom floor panel and the top panel 75 can also be omitted and supplied by the builder at the building site, provided that none of the fixtures or appliances which are supported by these panels are provided. However, if any of these structural elements are omitted, it will of course be necessary to provide appropriate bracing to give strength and rigidity to the service module to enable it to be handled during transportation and incorporation into the building structure at the site.

Because the service module is a two-story structure, it is necessary to take certain steps in the transportation in order to comply with the height limitations for loads which can be transported on public highways. In actual practice, a special trailer is provided in which the service module can be tilted toward the outer sidewall 70 so that the entire module is at an angle to the vertical and the cutoff portion 31a of the full transverse end wall 31 is substantially horizontal. With conventional dimensions for a two-story structure, when the structure is thus tilted, it does not exceed the height limitations normally set for hauling of loads on public highways.

With respect to width limitations for transport on public highways, it has been found that the dimension of the module from end to end can be made as small as 9 feet 6 inches, which is small enough to enable it to be carried with its long dimension transverse to the direction of movement. Several modules can thus be partially overlapped in the tilted position for transportation on a trailer.

When the prefabricated service module reaches the site of the dwelling, it is placed in position on an already prepared slab or other foundation in which appropriate electrical, water supply and drainage connections are available.

The module is positioned so that these services can be connected to the corresponding systems in the module, and thereafter a dwelling structure is built around the service module. It will be understood that several steps S, seen in phantom lines in FIG. 5, must be added in front of the lower stair landing 35. These can be arranged so as to be directed outwardly away from the stair landing, the steps thus being at right angles to the stairs 36, or a further extension of the lower stair landing can be added and the steps directed in the opposite direction from the stairs 36. A living room of any reasonable dimension can be built in the direction away from the stair landing, and a corridor is provided along the end of the service module toward which the door 63 to the powder room opens. On the other side of the service module, a kitchen K, also shown in phantom lines, can be built extending away from the service module a short distance, in the case of an apartment-type kitchen, or a relatively great distance for a single family dwelling where a large kitchen-dining area is desired. On the upper level of the dwelling, the bath space 42 can be extended as at BR a smaller or greater distance as desired, the dimension in the direction away from the service module being sufficient in every instance to accommodate the full length of the bathtub B. Again, a corridor must be provided along the end of the service module toward which the washer-dryer opens, and the door at the top of the stairs 36 opens. One or more bedroom spaces can be provided in the direction extending away from the service module from the

outer sidewall 70. Appropriate extensions can be placed on the heating duct system and the electrical system to provide heated and cooled air to such rooms and to provide electrical power through conventional outlet. The service module can thus be a center or core for wide variety of floor plans, and can be used in duplex apartments, townhouse-type structures, or single family units. The entire module can be made in a mirror image to the module shown, i.e. the stairs can go up from left to right as seen in FIG. 1, and the other parts appropriately repositioned, although always being in the same relative position. This makes possible an even greater variety of floor plans for the space around the module.

A number of advantages will be immediately apparent from the foregoing description of the service module. The obvious advantages of being able to prefabricate such a service module in a large building structure and the benefits which flow from such a possibility need little description. However, the benefit of being able to completely test out already installed appliances and systems such as plumbing, hot water supply, and electrical systems are not quite so obvious. The difficulties with subcontractors installing such systems in dwelling at the site are well known, and these disadvantages are completely overcome in the preferred embodiment of the present invention in which the systems are complete and ready to operate at the time the service module arrives at the site.

Particular advantages of the structure are many. In the first place, the lower stair landing 35 is made so as to be removable, thereby providing access to the space beneath this landing and the lower portion of the stairs for servicing of the water heater, and to enable workmen initially to make the connections of the systems of the module to the connections on the foundation or slab. This space also serves as a collecting chamber for return air. Because the space around the water heater is connected to the space 40 beneath the lower stair landing, it also becomes part of the return air system, thus promoting circulation through this space to avoid buildup of heat around the water heater.

The arrangement is such that it must be moved into position generally horizontally across a foundation or slab. This makes it desirable to place all of the slab connections in a pit in the slab so that they do not project above the level of the slab. This avoids damaging them during positioning of the module on the slab, and also provides a drainage pit for the overflow from the water heater. In addition, it provides additional space for the plumbing.

The positioning of the dishwasher relative to the sink makes possible the provision of a space behind the dishwasher which is interconnected with the space beneath the lower stair landing 35. This makes it possible to pull the main power line from the main electrical panel into the space beneath the lower stair landing after positioning the service module on the slab. This is a considerable cost saver, avoiding the necessity of an intermediate junction box under the lower stair landing.

The position of the sink and dishwasher in the kitchen space is further required by the drainage and vent stack locations, which are limited in the plan position by the maximum horizontal distance from the lavatory in the powder room to the vent stack as established by the National Plumbing Code. The vent stack cannot be moved any further away than it is positioned and still comply with the code. Likewise, the lavatory cannot be moved because it would be too far under the sloping ceiling 60 beneath the stairs 36. Thus these two portions of the module are interrelated and their positions fixed.

The horizontal plan arrangement of the stove, vent hood therefor, and the dryer and exhaust fans on the first and second floor is interrelated to the vertical arrangement of the vent duct. The vent duct must be in the position as shown, and the other elements in their relative positions so that it can serve as a common exhaust for the appliances and fans. The common vertical stud space is utilized for both the vent system and the heating and air-conditioning duct, the vent widening below the end of the heating and air-conditioning at the level of the upper floor panel in order to connect with the exhaust hood from the range.

The use of the antivibration canvas connections between the supply air duct from the furnace and the air supply ducts in the various walls and panels accomplishes three results. It permits the air supply duct 74 to be rigidly connected to the furnace for preassembly and positive alignment in handling. Secondly, it serves as a physical absorption isolator to reduce the transmission of sound by conduction through the ducts in the different rooms in the dwelling unit. Thirdly, it functions to make possible correction of minor misalignment of the air handling unit, i.e. the furnace, etc., and the sidewalls of the center wall 30 and the outer sidewall 70 to permit the furnace unit and supply duct to slide into space between the two assembled walls.

The module also permits the use of balloon framing, which reduces the shrinkage factor parallel to the grain of the wood because the framing extends from the bottom of the first floor to the top of the second floor. This, of course, is made possible by the fact that the walls can be assembled in the horizontal position and then raised during the prefabrication. Strength is further added by the use of attaching the dry wall covering for the various walls with adhesives in continuous two-story pieces. This increases the necessary rigidity of the entire module during transportation and positioning operations.

I claim:

1. A service module for a dwelling unit, comprising a center wall having spaces within it, a stairway extending upwardly along one side of the center wall and having the top ending adjacent one end of said center wall, a stair ceiling along the one side of the center wall above the stairway and defining a space above the stair ceiling for accommodation of an air-temperature-changing system, a floor panel extending laterally from the other side of the center wall at about the level of the top of said stairway and defining with said center wall a space above the floor panel for a bath and a space below the floor panel for a kitchen, at least a part of an air duct system extending from said space above said stair ceiling downwardly through said center wall adjacent said one end of said center wall and extending laterally at least in the direction of said floor panel beneath said floor panel, a vent system extending upwardly through said center wall adjacent said air duct system and having exhaust duct connections for an exhaust fan opening into said kitchen space, and the bath space generally along the line of said vent system, an electrical system extending generally upwardly through said center wall adjacent the vent system and having leads extending upwardly to said space above said stair ceiling for connection to an electric air-temperature-changing system, leads extending into said kitchen space at least for a kitchen range, leads extending into the space beneath said stairs for an electric hot water heater, and leads for electrical outlets, a water supply system extending generally upwardly in the center wall in the space adjacent the electrical system and having connections opening into the space beneath the stairway for connection to a hot water heater, connections opening into said kitchen space for connection to a kitchen sink, and connections opening into said bath space for connection to a lavatory, a commode and a tub shower, and a drainage system in said space with said water supply system and having a vent stack extending to the top of the center wall and drainage connections extending into said bath space for a commode, a lavatory and a tub, and a drainage connection extending into said kitchen for a sink.

2. A service module as claimed in claim 1 in which said vent system has a further exhaust duct connection opening into the space beneath said stairway for an exhaust fan, said water supply system has further connections opening into the space beneath said stairway for a commode and a lavatory, and said drainage system has a further connection opening into said space beneath said stairway for a commode.

3. A service module as claimed in claim 1 in which said vent system has a further exhaust duct connection opening into said bath space adjacent said one end of said center wall for connection to a clothes dryer vent, said water supply system has connections opening into said bath space adjacent said one end of said center wall for connection to a clothes washer,

said electrical system has a lead extending to the bath space adjacent said one end of said center wall for connection to a clothes washer and dryer, and said drainage system has a connection extending to the bath space adjacent said one end of said center wall for connection to a clothes washer.

4. A service module as claimed in claim 1 in which said water supply system further has a connection extending into said kitchen space for connection to a dishwasher, said electrical supply system has a lead extending into said kitchen space for connection to a dishwasher, and said drainage system has a connection extending into said kitchen space for connection to a dishwasher, and said drainage system has a connection extending into said kitchen space for connection to a dishwasher.

5. A service module for a dwelling unit, comprising a center wall having studs with wall panels on opposite faces thereof with spaces between the studs, a stairway extending upwardly along one side of the center wall and having the top ending adjacent one end of said center wall, a stair ceiling along one side of the center wall above the stairway and defining a space above the stairway and defining a space above the stair ceiling for accommodation of an air-temperature-changing system, an upper floor panel extending laterally from the other side of the center wall at about the level of the top of said stairway and defining with said center wall a space above the upper floor panel for a bath, a false ceiling spaced downwardly from said upper floor panel and defining with said upper floor panel a false ceiling space and with said center wall a space below the false ceiling for a kitchen, a face panel between the free edges of said upper floor panel and said false ceiling, at least a part of an air duct system extending from said space above said stair ceiling downwardly through the first stud space at said one end of said center wall and extending laterally through said false ceiling space and opening through said face panel, a vent system extending upwardly through said center wall in the stud space next adjacent the stud space in which said air duct system is positioned, said vent system having exhaust duct connections for an exhaust fan opening into said kitchen space and said bath space generally along the line of said stud space in which it is positioned, an electrical system extending generally upwardly through said center wall in the stud space next adjacent the stud space in which said vent system is positioned, and having leads extending upwardly to the space above said stair ceiling for connection to an electric air-temperature-changing system, leads extending into said kitchen space adjacent said one end of said center wall for a kitchen range, leads extending into the space beneath the lower end of said stairs for an electric hot heater, and leads for electrical outlets, a water supply system extending generally upwardly in the center wall in the stud space next adjacent the space in which said electrical system is located, said water supply system having connections opening into the space beneath the stairway for connection to a hot water heater, connections opening into the kitchen space for connection to a kitchen sink adjacent said stud space in which said water supply system is located, and connections opening into said bath space for connection to a lavatory, a commode and a tub shower, and a drainage system in said stud space with said water supply system and having a vent stack extending to the top of the center wall and drainage connections extending into said bath space for a commode, a lavatory and a tub, and a drainage connection extending into said kitchen for a sink.

6. A service module as claimed in claim 5 in which said stairway has the lower end thereof spaced inwardly from said other end of said center wall and spaced above the bottom of the center wall, and a stair landing removably mounted on said center wall and extending from the bottom of the stairway to said other end of said center wall, whereby access can be gained to the space under said stairway by removal of the stair landing.

7. A service module as claimed in claim 5 further comprising a powder room wall portion extending from said one end of said center wall beneath the top of said stairway and having

a powder room door therein, a backwall panel extending downwardly from beneath said stairway defining the backwall of the powder room, and said vent system has a further exhaust duct connection opening into the space beneath said stairway for an exhaust fan for said powder room, said water supply system has further connections opening into the space beneath said stairway in the corner between said center wall and said powder room wall portion for a lavatory, and through said backwall panel for a commode, and said drainage system has a further connection opening through said backwall panel for a commode.

8. A service module as claimed in claim 7 further comprising an outer sidewall over the side of the stairway remote from said center wall and enclosing said stairway and defining with said center wall stairway and backwall a powder room space beneath said stairs.

9. A service module as claimed in claim 8 further comprising a bottom floor panel attached to the bottom of said center wall and the bottom of said outer sidewall and forming a bottom for said service module.

10. A service module as claimed in claim 9 further comprising a lavatory in the corner of said powder room space defined by said center wall and said powder room wall portion and connected to said water supply connections and said commode connection to said drainage system.

11. A service module as claimed in claim 5 in which said vent system has a further exhaust duct connection opening into said bath space adjacent said one end of said center wall for connection to a clothes dryer vent, said water supply system has connections opening into said bath space adjacent said one end of said center wall for connection to a clothes washer, said electrical system has a lead extending into the bath space adjacent said one end of said center wall for connection to a clothes dryer, and said drainage system has a connection extending to the bath space adjacent said one end of said center wall for connection to a clothes washer.

12. A service module as claimed in claim 11 further comprising a washer-dryer end panel extending away from said center wall along said upper floor panel and a washer-dryer side panel extending from said washer-dryer end panel along the free edge of said upper floor panel to the said one end thereof to define with said washer-dryer rear panel a washer-dryer space into which said connections for a washer and dryer open.

13. A service module as claimed in claim 12 further comprising a combination clothes washer and dryer in said washer-dryer space coupled to said washer and dryer connections to the water supply system, the electrical system, the drainage system and the vent system.

14. A service module as claimed in claim 5 in which said water supply system further has a connection extending into said kitchen space for connection to a dishwasher, said electrical supply system has a lead extending into said kitchen space for connection to a dishwasher, and said drainage system has a connection extending into said kitchen for connection to a dishwasher.

15. A service module as claimed in claim 14 further comprising a bottom floor panel attached to the bottom of said center wall and forming a bottom for said service module.

16. A service module as claimed in claim 15 further comprising an electric kitchen range in said kitchen space adjacent said one end of said center wall and against said center wall and connected to the range connection to said electrical supply system, an exhaust fan above said range and connected to the duct connection in said vent system which opens into said kitchen space, a dishwasher on said floor panel next to said kitchen range and against said center wall and connected to the dishwasher connections of said water supply system, said electrical system and said drainage system, and a kitchen sink on said center wall next to said dishwasher and connected to the sink connections of said water supply system and said drainage system.

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17. A service module as claimed in claim 16 further comprising a cabinet in which said kitchen sink is mounted, and further cabinets mounted along said center wall and on the bottom surface of the false ceiling at least over said range, said dishwasher and said sink.

18. A service module as claimed in claim 5 further comprising a bottom floor panel attached to the bottom of said center wall and forming a bottom for said service module.

19. A service module as claimed in claim 18 further comprising an electric kitchen range in said kitchen space adjacent said one end of said center wall and against said center wall and connected to the range connection of said electrical supply system, an exhaust fan above said range and connected to the duct connection in said vent system which opens into said kitchen space, and a kitchen sink on said center wall connected to the sink connections of said water supply system and said drainage system.

20. A service module as claimed in claim 18 further comprising cabinets mounted along said center wall and on the bottom of said false ceiling.

21. A service module as claimed in claim 18 further comprising an electric kitchen range in said kitchen space adjacent said one end of said center wall and against said center wall and connected to the range connection of said electrical supply system, an exhaust fan above said range and connected to the duct connection in said vent system which opens into said kitchen space, a kitchen sink on said center wall connected to the sink connections of said water supply system and said drainage system, and cabinets mounted along said center wall and on the bottom of said false ceiling at least over said range and sink.

22. A service module as claimed in claim 5 further comprising means on the opposite ends of said center wall and connected to said center wall and said upper floor panel for imparting rigidity to said service module.

23. A service module as claimed in claim 5 further comprising a full transverse end wall on the other end of said center wall and extending transversely thereof and extending the full height of said center wall and being attached to the upper floor panel, and a partial transverse end wall on the one end of said center wall and extending transversely thereof, said partial transverse end wall extending from the bottom of the center wall to the upper floor panel and extending transversely of the center wall only in the direction of the upper floor panel and to the free edge of the upper floor panel.

24. A service module as claimed in claim 23 further comprising a bottom floor panel attached to the bottom of said center wall and said transverse end walls and forming a bottom for said module.

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25. A service module as claimed in claim 23 further comprising an outer sidewall over the side of the stairway remote from said center wall and enclosing said stairway and defining with said stairway and said center wall a space beneath said stairway, said outer sidewall having an opening therein for access to the lower end of said stairway.

26. A service module as claimed in claim 25 further comprising a bottom floor panel attached to the bottom of said center wall and said transverse end panels and said outer side panel and forming a bottom for said module.

27. A service module as claimed in claim 23 further comprising a top panel attached to the top of said center wall and to the top of said full transverse end wall and serving as a top for said service module.

28. A service module as claimed in claim 27 further comprising an outer sidewall over the side of the stairway remote from said center wall and depending from the free edge of said top panel and attached to the free edge of said full transverse end panel and enclosing the space above said stair ceiling and enclosing said stairway.

29. A service module as claimed in claim 28 in which said stair ceiling has an upwardly inclined portion extending parallel to the steps on said stairway, said upwardly inclined portion being hinged at the lower end to the remainder of said stair ceiling and being pivotable downwardly to provide access to the space above the stair ceiling.

30. A service module as claimed in claim 29 further comprising an air-temperature-changing system mounted in said space above said stair ceiling coupled to said air duct system, said service module including air return passages extending into said space above said stair ceiling.

31. A service module as claimed in claim 30 in which said center wall has a further stud space adjacent said other end extending from said space beneath said stairway upwardly to said space above said stair ceiling, and said outer sidewall has stud spaces therein extending upwardly into said space above said stair ceiling and having openings into said stud spaces from the side facing away from said stairway.

32. A service module as claimed in claim 5 further comprising an electric water heater in the space beneath said stairway coupled to said water heater connection of said water supply system and said electrical system.

33. A service module as claimed in claim 5 further comprising a lavatory in said bath space against said center wall and connected to the lavatory connections of said water supply system and said drainage system, and a commode next to said lavatory and connected to the commode connections of said water supply system and said drainage system.

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