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Townsend et al.

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[54] **MODULAR, PREFABRICATED, INTEGRATED COMMUNICATIONS RELAY TOWER**

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[51] Int. Cl. **H04b 7/14**

[58] Field of Search **325/1, 8, 14, 15, 325/120, 121, 128-130, 354, 355; 343/832, 872, 874, 875, 878, 879, 890, 896, 898, 891; 52/73, 187, 245, 247, 300**

[56]

References Cited

UNITED STATES PATENTS

126,356	4/1872	Ward	343/874
2,162,675	6/1939	Lingo	343/875
3,375,523	3/1968	Laibson	343/878
2,229,949	1/1941	Wells	343/874

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[57]

ABSTRACT

An integrated, modular, prefabricated communications relay tower, comprising a plurality of tubular modules prefabricated in a shop facility with the necessary accessory devices therein and assembled in end-to-end relationship at the site of the relay tower to provide a complete integrated, modular relay tower with the necessary accessory devices and electronic equipment therein.

12 Claims, 7 Drawing Figures

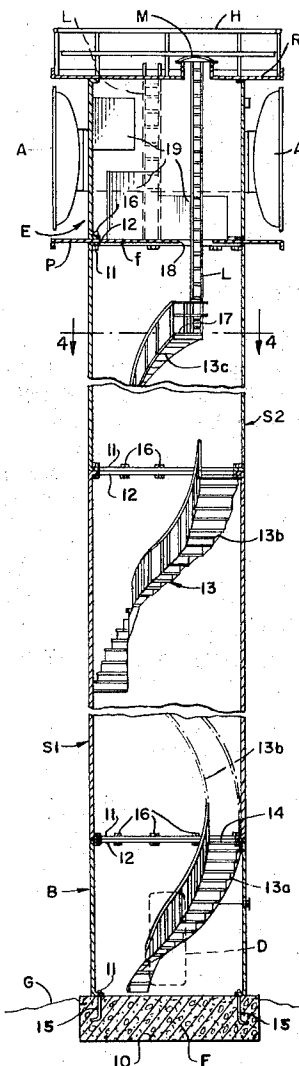


FIG. 1.

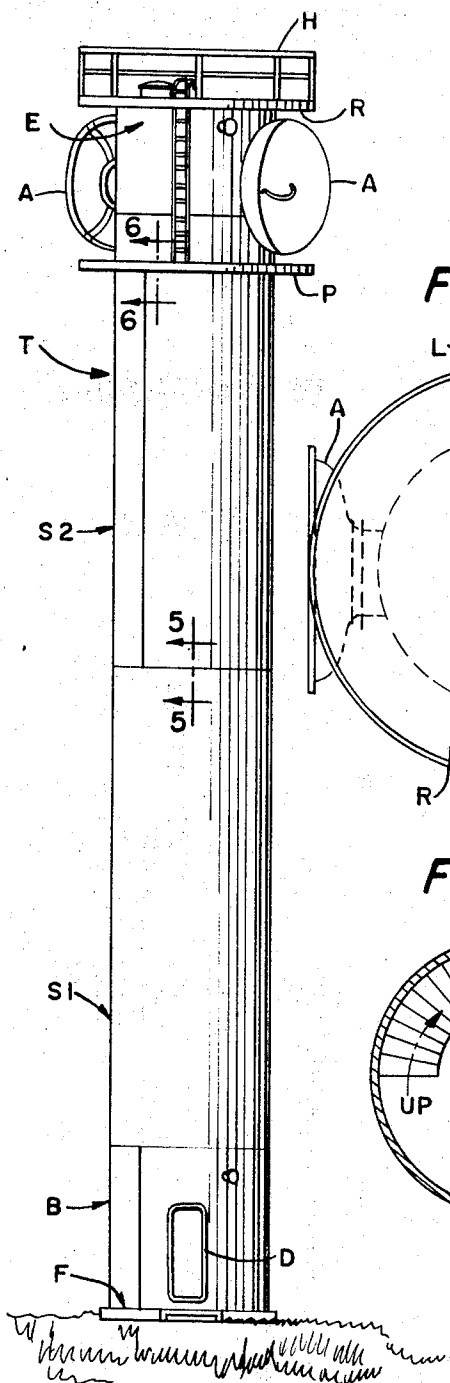


FIG. 2.

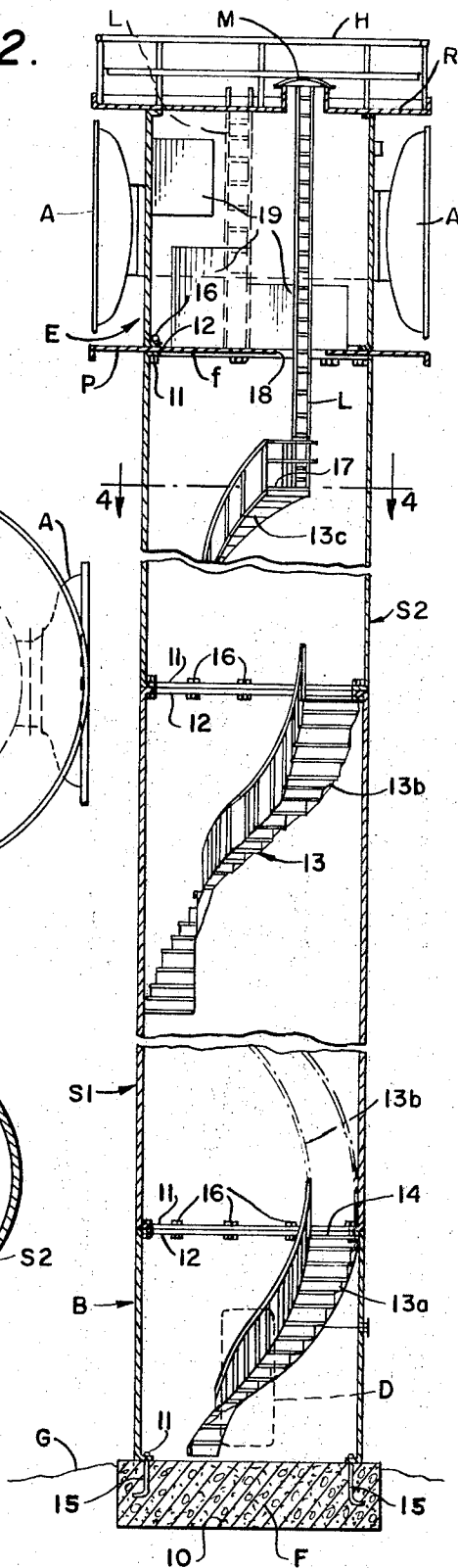


FIG. 3.

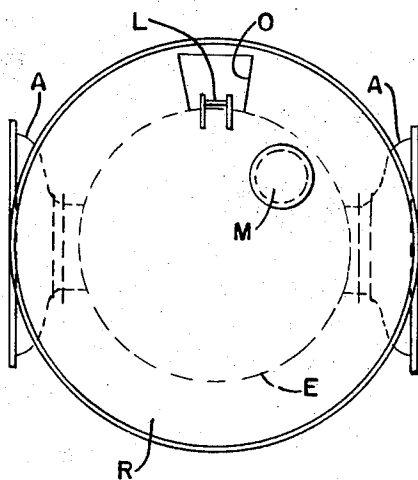


FIG. 4.

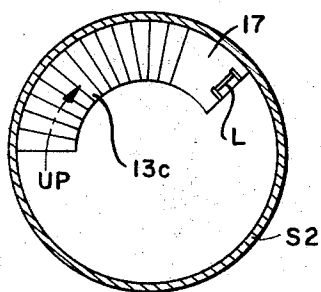


FIG. 5.

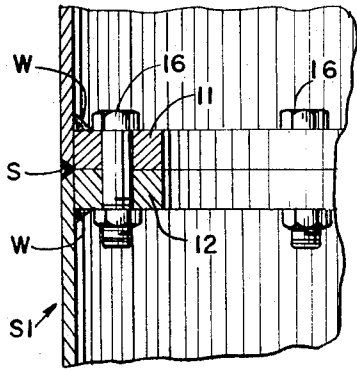


FIG. 6.

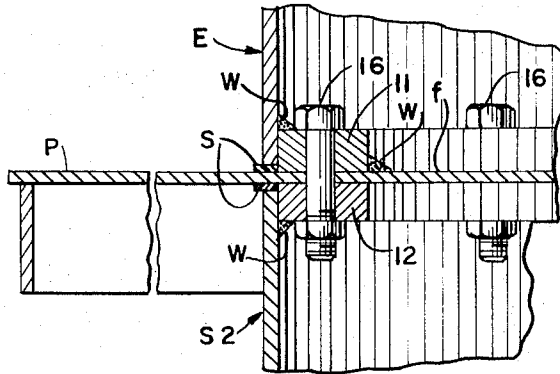
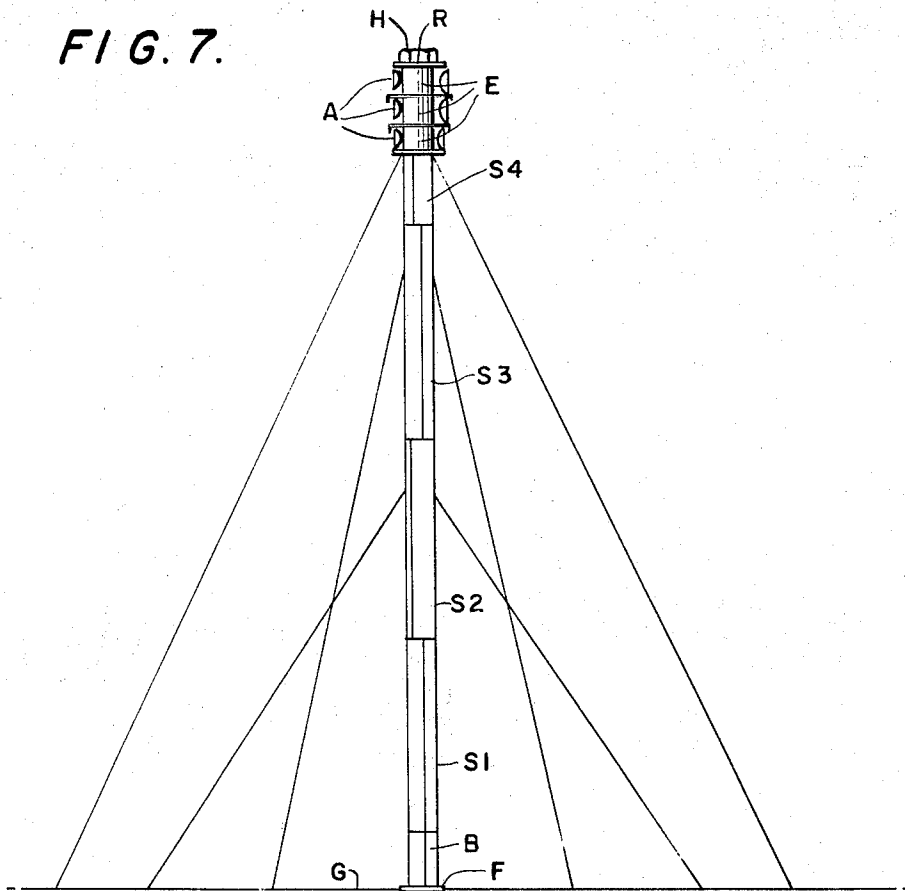


FIG. 7.



MODULAR, PREFABRICATED, INTEGRATED COMMUNICATIONS RELAY TOWER

BACKGROUND OF THE INVENTION

This invention relates to relay towers for communication signals such as head end installations for television or cable television, microwave relay receiving and transmission installations, or any other electronic, electromagnetic, or light wave communications system.

Prior art electric communications signal relay towers are generally of the type having an open grid work tower or support structure with antenna means mounted at the top of the support structure. Such open grid work towers are both expensive and difficult to construct and maintain and must be securely guyed with a plurality of guy cables or the like to prevent excessive movement or sway or even collapse of such towers due to wind loadings and the like thereon. These prior art open grid work towers are susceptible to vandalism since they are readily climbed, and the guy cables securing the towers may be readily cut by vandals. Further, the electronic equipment used in conjunction with such relay towers is usually confined within a small building adjacent the base of the tower, and these buildings may be easily broken into and the equipment therein damaged or destroyed. Moreover, the guy lines or cables attached to the conventional open grid work type tower are one of the greatest destroyers of bird life, since birds cannot see the guy wires or cables and fly into them and are killed.

Further, during the past ten years the size of communications transmitters and receivers has been substantially reduced. This equipment is now almost totally transistorized and consequently the space required in a structure to contain the equipment is less than one-third of the space required to do the same thing 10 years ago. Further, periscopic antennae employing plane reflectors are prohibited in many cases by a recent Federal Communications Commission ruling; and accordingly, microwave installations using wave guides from a building containing electronic equipment at the base of a tower to antennae such as parabolic dishes on the top of the tower will be required. With conventional systems, these wave guides are excessively long and are exposed to the elements and accordingly are subject to power losses, damage from vandalism and carelessness, and failure due to the elements.

The present invention provides a structure which substantially eliminates the above problems found in conventional communications relay towers. In accordance with the present invention, a tower including prefabricated support modules and at least one prefabricated equipment room module at the top thereof in which all electronic equipment is contained, practically eliminates vandalism of the equipment since access to the interior of the tower is prevented by a locked door at the base thereof, and the tower of the present invention is not easily climbed on the outside thereof. Further, the tower of the present invention has a pleasing appearance that makes it readily acceptable in even populated areas, and microwave guides are short due to the close proximity of electronic equipment and antennae. Accordingly, power losses are at a minimum, and the danger of damage or deterioration of the wave guide is practically eliminated.

With the present invention, complex or multiple towers may be eliminated in CATV systems which use mul-

iple microwave dishes since multiple dishes or parabolic reflectors may be mounted to a single tower according to the present invention. The relay tower of the present invention also has much greater stability for mounting microwave dishes or parabolic reflectors than any conventional tower, and the tower provides minimum exposure of equipment and personnel to weather and the like.

Further, since CATV receiving antennae can be more rigidly mounted with the tower of the present invention and have higher gain and utilize very short transmission lines, both reliability and performance are substantially increased. Additionally, with the present invention, due to the modular concept of the tower construction, the tower can be easily expanded and increased in height as desired, and the maintenance of the relay tower according to the present invention is considerably less than an open type tower with the conventional building at the base thereof as in the prior art. Moreover, the relay tower according to the present invention is grounded, thus providing maximum lightning protection, and the tower is less subject to fire damage, adverse weather conditions or gun fire than conventional towers and requires less land than a guyed, open grid work type tower, which is particularly important in high land cost areas or on mountain peaks.

Still further, the relay tower of the present invention serves as a shield against unwanted signals or radiation, and the outside surfaces of the tower can be used to advantage for shielding in receiving antenna systems.

In particular, in accordance with the present invention, a modular, prefabricated, tubular relay tower for television signals or other electromagnetic signals or the like is provided, wherein at least one tubular support module is provided, said module being completely prefabricated in a shop facility and then shipped to the site of installation of the tower, and said module having flange means at each end thereof designed to meet with complementary flange means at the end of other modules such that at the final installation site, all connections are made between adjacent modules by bolts extended through the flanges. A prefabricated equipment room module containing the necessary electronic equipment therein, such as amplifiers, receivers, transmitters, and the like, is secured on top of the support modules, thus resulting in an integrated, prefabricated relay tower.

The modules can be made in varying lengths and diameters and each of these modules is outfitted in the shop facility or manufacturing plant with doors, inside spiral stairways or ladders, and such other hardware as required to admit or carry support equipment for the electronic system. Additionally, the equipment room module has a roof and floor closing the opposite ends thereof, and has essentially the same plan dimension as the structural modules and usually is of less length than the structural modules. However, the modules, and particularly the equipment room modules can be of varying geometric configurations, and the equipment room modules usually will be mounted at the top of the support modules although they could be connected at various height locations on the tower in alternating relationship with support modules, if desired. The electronic equipment is mounted inside the equipment room modules prior to the equipment room modules being lifted on top of the support structure modules, and means are provided through the walls thereof for

the passage of cables and light ports and the like there-through. The floor of each equipment room module extends beyond the exterior walls thereof a sufficient distance to provide a working platform for outside installation or maintenance of antennae.

In accordance with the invention, the various modules are designed so that the heaviest one of them can be lifted and placed at the final site by crane or helicopter, and the modules are completely finished in the fabricating shop or facility, including all coats of paint. If obstruction painting is not required by the FAA, modules may be fabricated of "weathering" steel and all or part of the painting omitted.

The tower in accordance with the invention has minimum deflection and negligible twist, resulting in maximum stability for microwave parabolas, and several microwave parabolas or dishes may be mounted on an integrated structure without undue loading thereon.

A further important consideration with the present invention is that no guy wires are required for an installed tower, thus resulting in minimum land requirements. In the case of exceptionally high towers, guy supports may be used for additional reliability.

A further advantage of the present invention is that the modular tower can be disassembled and moved to another site with relative ease, if desired.

OBJECTS OF THE INVENTION

It is an object of this invention to provide a relay tower for electric communications signals and the like, which is of prefabricated module construction with the modules of the tower constructed in a shop facility and then assembled in situ at the site of installation of the tower.

Another object of the present invention is to provide a prefabricated, modular, tubular relay tower for electric communications signals and the like which does not require guy wires or cables to impart stability thereto.

A still further object of the present invention is to provide a relay tower for television signals and the like which includes a plurality of tubular, prefabricated support modules and at least one tubular prefabricated equipment room module supported on the top of the support module, said modules all being preassembled in a shop facility and then shipped to the site of installation of the tower and installed.

A still further object of the present invention is to provide a tubular, prefabricated modular relay tower for television signals and the like, wherein a plurality of equipment room modules and parabolic reflectors may be supported in either alternating or adjacent manner on a plurality of tubular support modules and with all equipment contained within the tower itself.

A still further object of the invention is to provide a prefabricated, tubular, modular relay tower for television signals and the like, wherein the modules of the tower may be easily disassembled and the tower shipped to another site for installation, as desired, and wherein the height of the tower may be readily changed simply by adding or removing modules, as desired.

A still further object of the invention is to provide a tubular relay tower for television signals and the like, which has all necessary electronic equipment therein and which is resistant to vandalism, fire, wind and lightning and which requires substantially less maintenance than conventional, open type relay towers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in elevation of a relay tower in accordance with the present invention;

5 FIG. 2 is an enlarged sectional view in elevation, with portions thereof broken away, of the tower shown in FIG. 1;

FIG. 3 is a plan view looking down on top of the tower of FIG. 2;

10 FIG. 4 is a sectional view along the line 4-4 in FIG. 2;

FIG. 5 is an enlarged, fragmentary, detailed sectional view taken along line 5-5 of FIG. 1, showing the manner in which adjacent modules are secured together;

15 FIG. 6 is a view similar to FIG. 5, taken along line 6-6 in FIG. 1 and showing the manner in which the equipment room module is connected with an adjacent support module; and

20 FIG. 7 is a view in elevation of a second form of relay tower in accordance with the present invention, wherein the tower is very high and has a plurality of equipment room modules at the top thereof.

DETAILED DESCRIPTION OF THE INVENTION

25 In the drawings, wherein like reference numerals indicate like parts throughout the several views, a relay tower for television signals and the like is indicated generally at T in FIG. 1 and comprises a tubular base module B, a pair of tubular support modules S1 and S2 secured together at their adjacent ends in vertical stacked relationship on the base module, and a tubular equipment room module E secured at the top of support module S2. The base B is only about one-third as long as the support modules and is on a suitable foundation F. A doorway D is in the side of the base module B for gaining access to the interior of the tower T, and a plurality of parabolic reflectors or antennae A are secured on the outside of the equipment room module E.

30 The equipment room module E has a floor f (FIG. 2) which is extended outwardly beyond the sides thereof to define an annular work platform P extending outwardly from the base of the equipment room module at the juncture of the equipment room module with the adjacent support module S2 to provide a platform on which workmen may stand to install and maintain antennae or other equipment on the outside of the equipment room module.

40 The equipment room module also has a roof R thereon of substantially the same plan dimension as the floor f, and work platform P, and a hand rail H extends around the roof R to prevent a person working on the roof from falling therefrom.

45 In FIGS. 2 through 6, further details of the construction of the tower T are seen, and the foundation F comprises concrete or the like recessed into a suitable excavation 10 in the ground G.

50 The base module B is generally cylindrical in configuration and comprises a plurality of steel plates welded or otherwise suitably secured together in a shop facility, and including all coats of paint and the like thereon and then shipped to the site of installation of the tower T.

55 The base module B has an annular inwardly directed ring flange 11 at the lower end thereof and a similar inwardly directed ring flange 12 at the upper end thereof. As previously noted, a doorway D is provided in the side wall of base module B, and a portion 13a of a spiral

staircase 13 is also prefabricated and connected inside the base support module as by welding or bolts or the like. The portion of the spiral staircase 13 in base module B may have a platform 14 at the top thereof or the staircase may simply continue upwardly into alignment with a continuing portion 13b of the spiral staircase 13 in a super-adjacent support module S1. The base module B is suitably secured to the foundation F by means of a plurality of anchor bolts 15 or the like extended through flange 11 and into the concrete foundation F.

The super-adjacent support module S1 is similarly completely prefabricated and constructed of steel plates welded or otherwise suitably secured together, and including all coats of paint and all accessory devices therein, in a shop facility and shipped to the site of installation of the tower T. The support module S1 also has an inwardly turned annular ring flange 11 at the lower end thereof and a similar ring flange 12 at the upper end thereof, and a portion 13b of the spiral staircase 13 secured therein. The portion 13b of the spiral staircase is suitably connected such as by welding or bolts or the like to the inside of the support module S1 in the shop facility and positioned in alignment with the portion 13a in the base module B. The support module S1 and base module B are secured together at their adjacent ends by means of bolts 16 or the like extended through the adjacent mating ring flanges 11 and 12.

A still further support module S2 is secured to the top of the previously described support module S1 and is similarly prefabricated and constructed in a shop facility. The uppermost support module S2 has a portion 13c of the spiral staircase 13 therein suitably secured to the inside of the support module S2 by bolts or welding or the like and is in alignment with the portion 13b in the subadjacent support module S1. The portion 13c of the spiral staircase terminates at its upper end below the upper end of the support module S2 in a small, rectangular, horizontal platform 17, and a ladder L extends upwardly from the platform 17 through a suitable opening 18 in a floor *f* of the equipment room module E. The two support modules S1 and S2 are secured together by means of a plurality of bolts 16 or the like extended through the adjacent mating ring flanges 11 and 12 on the adjacent ends thereof.

The equipment room module E is likewise completely prefabricated and constructed in a shop facility, including painting thereof, if required, and including provision of brackets (not shown) on the outside thereof for mounting thereto of the antennae A, and openings (not shown) through the side walls for suitable conduits and the like to connect the antennae with suitable electronic equipment 19, such as a receiver, an amplifier, and a transmitter, inside the equipment room module. The floor or bottom *f*, roof R, ladder L and flanges 11 and 12 are all also suitably welded or bolted or otherwise connected to the equipment room module in the shop facility, and a suitable manhole means or the like M is provided in the roof R for providing access from the interior of the module to the top of roof R. The equipment room module E is secured to the top of module S2 by means of bolts 16 extended through flanges 11 and 12 and floor *f*, which is clamped between the flanges.

As seen in FIGS. 2 and 3, the roof R extends outwardly beyond the sides of the equipment room module substantially the same distance as the work platform P, and an opening O is provided in the marginal edge por-

tion of the roof R in alignment with a ladder L on the outside thereof so that a person is able to climb downwardly from the roof onto the work platform P for maintenance or the like on the antennae A.

As seen best in FIGS. 5 and 6, the flanges 11 and 12 are welded to the ends of the modules as at W, and suitable weatherstripping or sealing means S is provided at all joints. Also, the floor *f* is welded to the bottom of flange 11 on the equipment room module E.

In constructing the relay tower T, each of the modules comprising the tower is first completely fabricated in a shop facility and then shipped to the site of installation of the tower. A foundation F is constructed at the site of installation, and the base module B is positioned on the foundation F and suitably secured thereto as by means of anchor bolts or the like. A support module S1 is then lifted onto the top of the base module by means of a crane or helicopter or the like (not shown), and the base module and support module are suitably secured together by means of bolts 16 extended through mating abutting flanges 11 and 12 on the adjacent ends of the support module and base module. Depending upon the height of the tower T, one or more additional support modules S2 are then lifted onto the top of the support module S1 and bolted thereto by means of bolts 16 extended through the mating abutting flanges 11 and 12 on the adjacent ends thereof, with the stair portions 13a, 13b and 13c in the respective modules disposed in aligned relationship with one another.

An equipment room module E is also constructed in a shop facility and shipped to the site of installation of the tower. The antennae A and necessary electronic equipment 19 are installed in the module E on the ground and operatively connected together. The equipment room module is then lifted onto the top of the top support module S2 and bolted thereto by means of bolts 16 extended through mating abutting flanges 11 and 12 on the adjacent ends of the equipment room module and support module.

In a typical installation, base support module B has a height of approximately 10 feet and a diameter of approximately 10 feet, and each of the support modules S1 and S2 has a height of approximately 30 feet and a diameter of approximately 10 feet. The equipment room module E also has a height of approximately 10 feet and a diameter of approximately 10 feet, and the work platform P and roof R extend outwardly beyond the sides of the equipment room module approximately 2-1/2 feet. The portion 13c of the spiral staircase in the upper most module S2 terminates approximately 6 feet 8 inches below the upper end of the support module S2, and the floor of bottom *f* and roof R on the equipment room module comprise 1/4 inch thick steel plate. In this size and configuration, no additional supports or guy wires or the like are necessary.

A modified tower T' is seen in FIG. 7 and comprises a plurality of support modules S1, S2, S3 and S4 secured together in end-to-end vertical relationship on top of a base support module B on a foundation F. A plurality of equipment room modules E are secured on the top of the support modules with each equipment room module having a plurality of antennae A on the outside thereof. Due to the extremely large height of the tower T' in FIG. 7, guy cables or the like are attached to the tower T' to aid the tower in resisting applied wind loads and the like.

Although particular configurations of the relay tower have been shown and described herein, the geometric configuration of the support modules and equipment room modules may be varied and need not be cylindrical as shown, and one or more support modules may be provided with one or more equipment room modules supported thereon, or the equipment room modules may be positioned in alternating relationship with the support modules, as desired.

While a spiral staircase has been shown and described for climbing the tower, any suitable means may be provided for travelling between the top and bottom of the tower, such as a ladder, or elevator or the like, and the tower can vary in height up to several hundred feet.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents, are therefore intended to be embraced by those claims.

What is claimed is:

1. A modular, prefabricated, cylindrical, vertically upwardly extending relay tower for television signals and the like, said tower having a height in the range of from about 80 feet up to several hundred feet, means securing the tower to a foundation, said tower comprising a plurality of substantially similar, cylindrical prefabricated modules having attachment means within their respective opposite ends and secured together interiorly thereof at adjacent ends in vertically stacked, end-to-end relationship, means fixed in said tower for ascending and descending the tower, a substantially flat floor within a topmost cylindrical module of said tower, means securing said floor between adjacent ends of said topmost module and a subadjacent module of said tower, opening means in the floor allowing access to and from the top module, an integral, marginal portion of said floor extending outwardly and beyond adjacent outer sides of said topmost module and comprising an annular work platform exteriorly of said tower, a roof secured on top of said topmost module of said tower, including an integral marginal edge thereof extending outwardly beyond the outer sides of the topmost module and of such width as to form a protective overhang, antenna means secured to said topmost module externally thereof beneath said overhang and above said platform, and electronic equipment stored and secured within said top module and operatively connected with said antenna means.

2. A modular, prefabricated relay tower as in claim 1, wherein each module has a radially inturned annular

flange on each end thereof, and adjacent modules are secured together by bolts or the like extending through the adjacent flanges of adjacent modules.

3. A modular, prefabricated relay tower as in claim 1, wherein the modules include at least one prefabricated support module and a prefabricated equipment room module secured in situ on the top thereof, and said electronic equipment being secured in the equipment room module.

4. A modular, prefabricated relay tower as in claim 3, wherein the equipment room module has at least a receiver, an amplifier and a transmitter preassembled therein.

5. A modular, prefabricated relay tower as in claim 4, wherein the equipment room module includes a top and bottom closing the ends of the equipment room module, said bottom comprising said floor.

6. A modular, prefabricated relay tower as in claim 2, wherein the modules each comprise a plurality of plates welded or otherwise secured together in a shop facility to form a cylinder.

7. A modular, prefabricated relay tower as in claim 3, wherein the equipment room module is the topmost module in said tower, and said roof is secured on top thereof, an opening through said roof for gaining access to the roof from inside said equipment room module, an upstanding railing around said roof, and a ladder extending from said roof to said platform to gain access from the roof to the platform.

8. A modular, prefabricated relay tower as in claim 3, wherein a plurality of support modules are secured together in vertical, end-to-end relationship, and the means for ascending and descending the tower comprises a stair means preassembled in each support module, the stair means in each support module aligned with the stair means in an adjacent support module.

9. A modular, prefabricated relay tower as in claim 8, wherein the stair means comprises a spiral staircase, and a door means is in the side of the bottom of the tower for gaining access to the interior of the tower and to the staircase.

10. A modular, prefabricated relay tower as in claim 3, wherein the antenna means comprises at least one parabolic reflector secured to the outside of the equipment room module.

11. A modular, prefabricated relay tower as in claim 10, wherein a plurality of equipment room modules are assembled together in end-to-end relationship on the top of a plurality of vertically stacked support modules, and guy cables are connected to the tower to aid in resisting wind force and the like acting on the tower.

12. A modular, prefabricated relay tower as in claim 7, wherein all of said modules have the same diameter, and the tower has a smooth, substantially uniform exterior surface.

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