Dec. 5, 1961 J. E. HARVEY, JR 3,011,586

FOLD-UP TOWER SECTION

Filed Oct. 7, 1958 3 Sheets-Sheet 1

FIG. 1

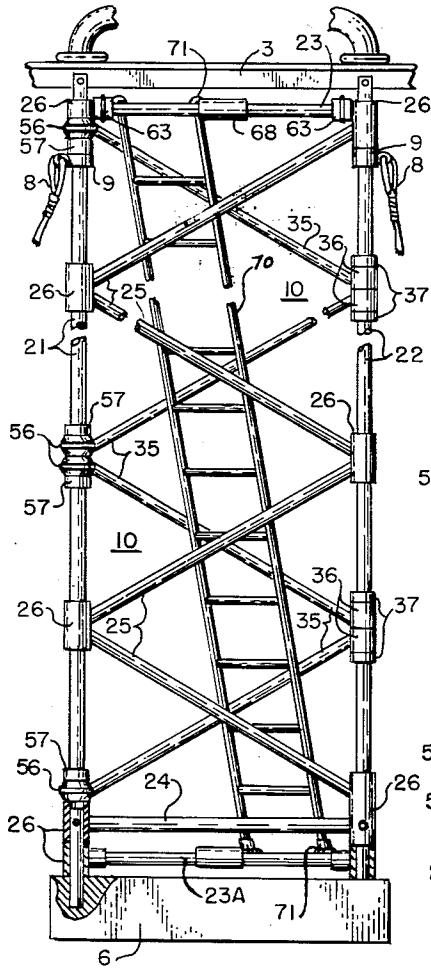


FIG. 2

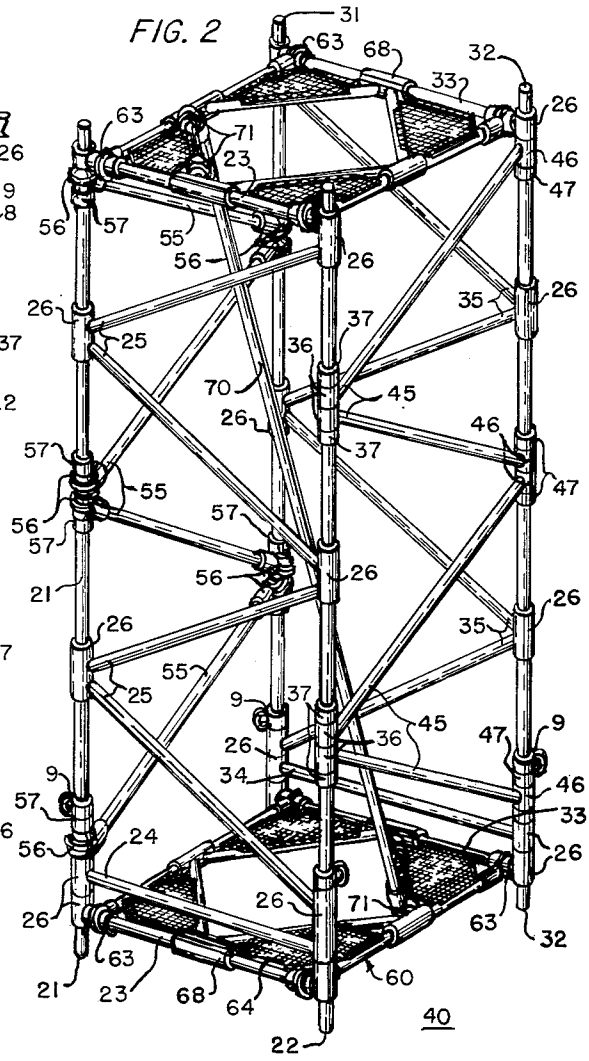
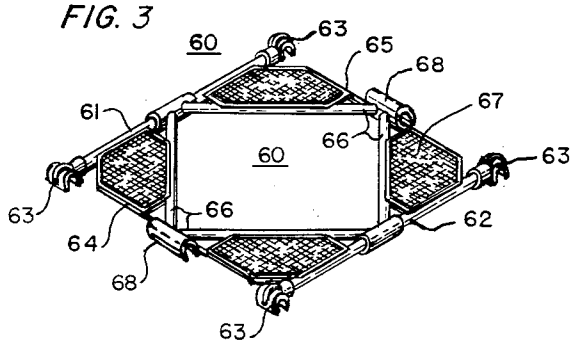


FIG. 3



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FOLD-UP TOWER SECTION

Filed Oct. 7, 1958 3 Sheets-Sheet 2

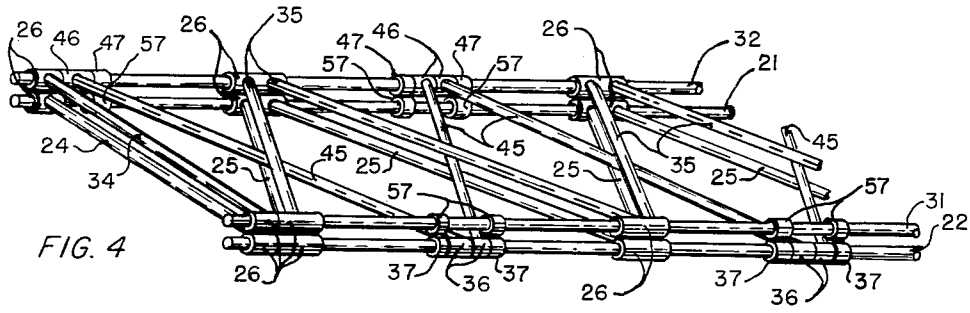

FIG. 4

FIG. 5

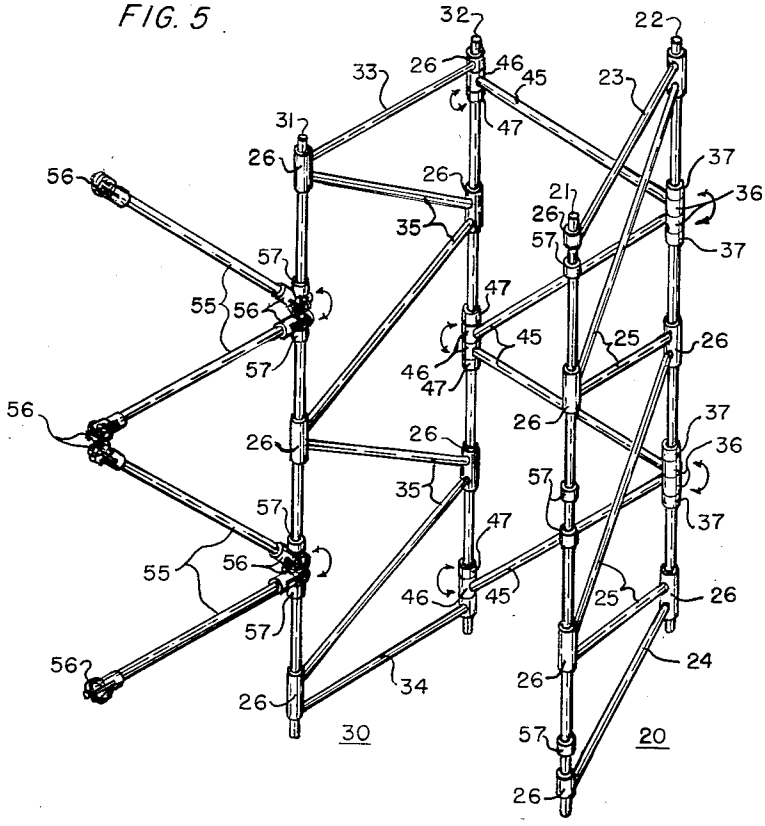

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FIG. 6

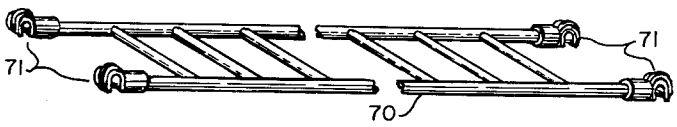


FIG. 7

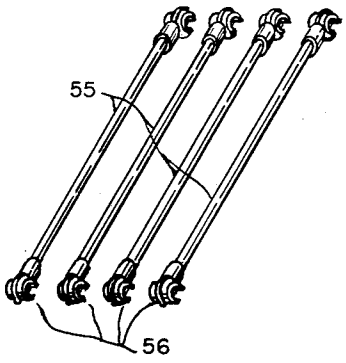


FIG. 8

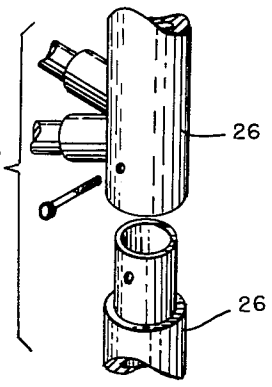


FIG. 9

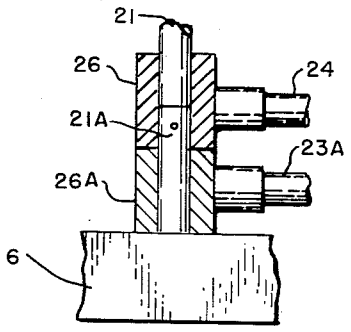


FIG. 11

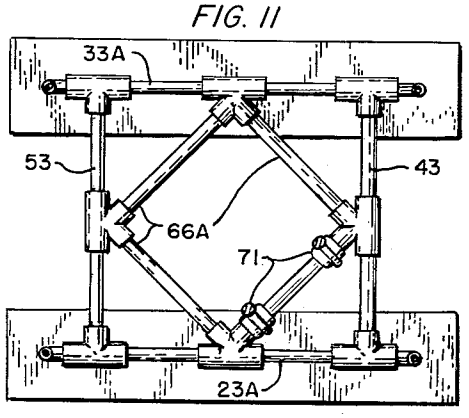
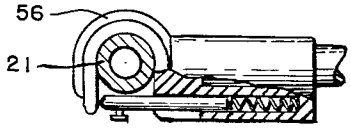


FIG. 10



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United States Patent Office 3,011,586
Patented Dec. 5, 1961

3,011,586

FOLD-UP TOWER SECTION

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Filed Oct. 7, 1958, Ser. No. 766,157
3 Claims. (Cl. 182—115)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by and for the Government for governmental purposes without the payment to me of any royalty thereon.

The invention relates to a portable tower structure for supporting an antenna for very high frequency communication systems.

It more particularly relates to a portable tower structure for supporting an antenna for very high frequency systems as it is related to military utilization.

In the realm of military utilization, communication systems must possess the characteristic of portability. It must be capable of being moved into an area and set up for operation as quickly as possible. It must further be capable of being disassembled and moved to other areas as dictated by the flow of the tides of battle.

It is also essential that maximum performance of such a system be obtained at all times while it is in operation.

Very high frequency communication systems have a range of operation limited substantially by the line of sight distance. The line of sight distance depends on the elevation of the points between which the line of sight is taken. The higher the points are above the surrounding terrain the greater will be the line of sight distance. Consequently, the higher the elevation of the transmitting and receiving antennas, the greater will be the distance over which communication will be possible.

In the past, antennas for portable communication systems of the nature referred to have been raised on masts, maintained in vertical position by the use of guy wires. The magnitude of elevation possible with the use of a mast has been very limited, and this has imposed a limiting effect on the range of communication.

The mast type of antenna support has imposed further complications. Very high frequency antennas require servicing and adjustment while in the elevated position. When the antenna is supported by a mast it has not always been possible to make such adjustments.

The present invention has for an object to provide a tower for supporting a very high frequency antenna in a higher elevated position than possible with a mast type support.

Another object of the invention is to provide a portable tower support for very high frequency antennas that may be quickly moved and erected in any desired position.

Still another object of the invention is to provide a portable tower for supporting a very high frequency antenna in a higher elevated position than possible with a mast type support and at the same time provide for accessibility to the antenna while in its elevated position.

Another object of the invention is to provide a tower section, incorporating features which provide for compactness when disassembled, for ease of handling and erection into a tower structure and for the accessibility to the upper limits thereof.

Other objects of the invention will appear from a consideration of the following description and drawings.

While the invention is particularly designed for the support of very high frequency antennas, it is by no means limited thereto. It may be used for other purposes, as for example, for supporting an observation platform in an elevated position from which the surrounding terrain may be surveyed.

FIG. 1 is an elevational view of a tower structure incorporating a plurality of tower sections.

FIG. 2 is a perspective view of a tower section according to the invention.

FIG. 3 is a perspective view of a platform forming a component of the tower section.

FIG. 4 is a fragmentary perspective view of the sides of the tower section, folded for transportation or storage.

FIG. 5 is a perspective view of the tower section, partially unfolded, showing the manner in which the side members may be folded on each other.

FIG. 6 is a perspective view of a ladder, which also functions in the tower structure as an internal strut member.

FIG. 7 is a perspective view of the removable strut members which, when assembled in the tower section, form a side of the tower section.

FIG. 8 is a detail in partial section showing the ends of the posts and the manner in which they are joined together.

FIG. 9 is a sectional view of a detail of the lower end of the tower posts of the lower tower section and base member.

FIG. 10 is a partial sectional view of a hook type fastening means suitable for connecting the removable struts to other tower members.

FIG. 11 is a plan view of a base member for supporting the lower end of the tower.

FIG. 1 illustrates a tower constructed of a plurality of tower sections **10**, one mounted upon the other to a prescribed height. The broken lines, immediately below the top sleeve **26**, are for the purpose of showing that a plurality of tower sections **10** are used. The top of FIG. 1 is the top of one section **10** and the bottom of FIG. 1 is the bottom of another section **10**. Any number of sections **10** can be inserted between the top and bottom sections **10**. The height of the tower is limited only by the weight supporting strength of the separate tower sections, particularly the members **21**, **22**, **31** and **32**. The posts and strut members may be fabricated from tubular steel or aluminum alloy. The upper ends of the posts **21**, **22**, **31** and **32** of each section **10** are provided with brackets **9**. The brackets **9** are clamped or otherwise fixed to the posts and are provided with apertures for receiving the upper ends of guys **8**. The lower ends of the guys **8** may be connected to anchor means (not shown) buried or otherwise fixed to the ground.

The lower end of the tower section **10** may be seated upon a base member **6** such as is illustrated in FIG. 11. The base member **6** may be constructed as a rectangular frame of timber, providing a large bearing surface in contact with the ground, whereby the weight of the tower will be distributed over as great an area as possible. As shown in FIG. 9, the frame member **6** is further provided with pins which project a short distance into the frame and extend a short distance above the frame. The pins are spaced at appropriate distances to be received by the lower end of the tower section.

A tubular sleeve **26** embraces each of the pins. A spreader member **23A** connects the sleeves **26** and extends between the posts **21** and **22**. Another spreader **33A** connects the other two sleeves and extends between posts **31** and **32**. As illustrated in FIG. 11, the spreaders **23A** and **33A** are embraced by sleeve members connected by spreaders **43** and **53**. The spreaders **23A** and **33A** are further embraced by sleeve members midway between their ends and are joined by diagonal strut members **66A** to sleeves embracing the midpoint of the spreaders **43** and **53**. The spreaders and diagonal struts thus provide a frame work for maintaining the lower ends of the posts **21**, **22** **31** and **32** at their proper spaced positions. The diagonal struts **66A** also provide a means for anchoring the lower end of a ladder **70** to be later described.

The pins extend through the sleeves **26** and a short distance above the sleeve **26** to provide a pin to be received in the sleeve **26**, forming a socket therefor. A transverse tapered aperture may be provided in the sleeve **26** and pin to receive a tapered pin to lock the parts in assembled relation whereby the lower end of the lower tower section is secured to the base member.

The upper ends of the posts **21**, **22**, **31** and **32**, as shown in FIG. 1, engage the lower ends of the posts **21**, **22**, **31** and **32** of the section **10** above. FIG. 8 discloses a detail of the connection including a transverse tapered bore for receiving a slightly tapered pin that may be provided for securing the sections together.

The upper end of the upper tower section **10** mounts platform **3** having spaced means to receive the upper ends of the posts **21**, **22**, **31** and **32**. The platform may be provided with an access opening through the center and the necessary hardware for mounting an antenna thereon. The exact structure of the platform **3** forms no part of the present invention. Any suitable structure for the purpose will suffice.

The desirable features, which enhance the portability of the tower and make it especially suitable to support an antenna, reside in the structure of the individual tower sections **10**, shown in greater detail in FIG. 2.

The tower section **10** is composed of two side members **20** and **30**, each similarly constructed. The sides **20** and **30** each are formed of post members **21**, **22**, **31** and **32**, fabricated from tubular stock. The upper ends of the posts **21** and **22** of side **20** are embraced by tubular sleeves **26** a short distance from the ends thereof. The posts **21** and **22** extend through the sleeves **26** and form pin members to which corresponding posts of other sections may be secured. As shown in FIG. 8 the upper ends of the posts are transversed by a tapered bore for the reception of a tapered pin, for the locking of the sections together in assembled relation.

The tubular sleeves **26** on the posts **21** and **22** are joined together by spreader members **23** extending between and spacing the posts **21** and **22** the required distance.

The posts **21** and **22** are embraced at their lower ends by tubular sleeves **26** which provide sockets for the reception of the tubular posts of the lower section. As shown in FIG. 8, the lower end of the posts **21**, **22** extend approximately half way through the sleeve **26**. The sleeve is provided with a transverse tapered bore to receive a tapered locking pin. The sleeves **26** on the posts **21** and **22** are joined together by spreaders **24** to hold the lower ends in their proper spaced relation.

The posts are embraced between their ends by sleeves **26** welded or otherwise fixed thereto. The sleeves **26** on one post are joined to sleeves on the opposite post by diagonal struts **25**.

The side **30** is similarly constructed, having posts **31** and **32** joined at their ends by spreaders **33** and **34** and by diagonal struts **35** at points between the ends thereof.

The sides thus formed are truss-like members and constitute the first and third sides of the tower section.

A second side of the tower section **40** is formed by diagonally arranged strut members **45**. The posts **22** and **32** are each embraced by sleeves **36** and **46** between collars **37** and **47** arranged at predetermined points between the ends of the posts. The sleeves **36** and **46** are rotatable upon the posts **22** and **32** respectively in the positions between the collars **37** and **47**. The collars **37** and **47** are fixed to the posts by any suitable means as by welding or brazing and operate to prevent longitudinal motion of the sleeves **36** and **46**. The sleeves are joined to the sleeves on the opposite post by a diagonal strut member **45** to form the second side of the tower section. Because the sleeves **46** are rotatable on the posts the first and third sides are foldable as shown in FIG. 5. The side **20** may be folded against one side of the struts **45** and the other side **30** may be folded against the other side of the struts **45** (see FIG. 4).

The fourth side of the tower section is formed by the removable struts **55**. The struts **55** have their ends connected to snap-on hooks that may be of the character shown in FIG. 10. The posts are provided with spaced collars **57** (see FIG. 2) attached thereto as by welding or brazing or the like. The snap-on hooks **56** embrace the posts **21** and **31** at a point between the spaced collars **57**. When in position, the removable struts operate to form the fourth side of the tower section. The collars **57** operate to prevent movement of the snap-on hooks **56** longitudinally of the posts.

The tower section **10** is completed by a top side, designated a landing or platform **60** separately constructed and adapted to "snap-on" in place to give the structure rigidity against shearing forces tending to distort the tower into a diamond shape cross-section.

The platform **60** is shown in detail in FIG. 3. It is composed of a pair of spreader members **61** and **62** each having "snap-on" hooks fixed to the ends thereof. The spreader members **61** and **62** are spaced apart by spreader members **64** and **65** welded or otherwise attached at their ends to the spreader members **61** and **62**. The four spreader members **61**, **62**, **64** and **65** form the outer boundary of the landing and platform **60**. Strut members **66** extend from a point on each of said spreader members **61** and **62** midway between the ends thereof to a point on each of said spreader members **64** and **65** at a point midway between their ends. The struts may be attached to the spreaders in any suitable manner. The struts form the boundaries framing an access opening through the platform **60**.

The space between the spreaders and strut members is spanned by an expanded metal grating, tack welded to the spreaders and the struts to form a flooring for the platform. An additional hook **68** is welded or otherwise attached to the spreaders **64** and **65** and is adapted to engage over the midpoint of the spreader members **23** and **33** of the sides **20** and **30**.

As illustrated in FIG. 2, the hooks on the ends of the spreader members **61** and **62** and the hooks on the spreader members **64** and **65** engage and embrace the spreader members **23** and **33** when the platform is in place and they operate to support the landing in place. The landing, when in place, operates to strengthen the tower section against horizontal shearing forces that would otherwise distort the structure.

As shown in FIGS. 1 and 2, a ladder **70** is provided with snap-on hooks **71** at the ends thereof. The ladder has a length adapted to extend between landings of the tower sections, the snap-on hooks engaging and embracing the struts **66**. The ladder, so arranged, extends diagonally of the tower section and operates as an internal strut to form, with the side of the tower section, a truss-like means. The ladder also provides a means by which the upper-most level of the tower may be reached with comparative ease, whereby the antenna mounted on the upper platform is made accessible while in place.

The tower section as thus far described includes the three folded sides portion, the four removable strut members **55**, a platform **60** and a ladder **70**. The guying means, the upper platform and the base member are separate and in addition to the enumerated parts that make up the tower structure.

The small number of separately handled parts makes for speedy erection and dismantling of the tower structure. The provisions for pivoting the sides **20** and **30** on the struts **45** about the axis of the posts **21** and **31** enable the tower sections to be reduced to a small package which occupies a very small space. This feature enables the tower structure to be stored in a very small space when not in use, and reduces the amount of transportation facilities that would be required to transport the tower from place to place. The ladder, operating as an internal strut member, strengthens the structure without the addition of additional parts to increase the

weight and space requirements. It further functions to provide for ready access to the upper levels of the tower structure as may be required.

Having described my invention and the best mode of constructing the same, what I consider to be my invention is set forth in the following claims.

I claim:

1. A collapsible tower section comprising a first and third side each having a pair of parallel members, transverse parallel members connecting the corresponding ends of said parallel members and diagonal struts connecting said parallel members intermediate said transverse parallel members, a second side comprising diagonal strut members having means hingedly connecting opposite ends thereof to one parallel member of each of said first and third sides thereby permitting said first and third sides to be folded against said second side, a fourth side comprising separately removable diagonal strut members, each strut member having means on the end thereof for releasably embracing the other parallel member of each of said first and third sides and means on said parallel members preventing motion of said means longitudinally of said parallel members, a platform providing a top side for said tower section designed to stiffen said section against horizontal shearing forces comprising a pair of transverse members having means to engage the top transverse parallel members of said first and third sides of said tower section, spreader members extending between said transverse members forming with said transverse members a peripheral boundary for said platform, diagonal strut members connecting the mid-portion of each transverse member to the mid-portion of said spreader members and forming a boundary of an access opening through said platform and grating means extending between said peripheral boundary and said strut members to form a flooring for said top side and slanting ladder means having means at each end thereof for engaging and embracing a strut member of said platforms and a strut member of a platform of a preceding tower section to provide access between levels of said tower section and to internally strengthen the tower structure.

2. A collapsible tower section comprising a first and third side, each formed by a pair of spaced parallel members, transverse members connecting the corresponding ends of said spaced parallel members, and diagonal strut members connecting said spaced parallel members at points between said transverse members, a second side formed of a plurality of diagonal strut members having means on the ends thereof embracing a parallel member of each of said first and third sides and pivoted thereabout to permit the first and third sides to be folded against said second side, a fourth side formed by a plurality of removable diagonal strut members means on the ends thereof for releasably connecting said removable diagonal strut members to the other of said spaced parallel members, a platform comprising spreader members releasably engaging at opposite ends thereof a transverse member of each said first and third sides, side members connecting the corresponding ends of said spreader members, said spreader and side members forming a peripheral boundary of said platform, diagonal gusset members connecting the mid-portion of said spreader members to the mid-portion of said side members, said diagonal gusset members forming a framing for an access opening through said platform, and expanded metal grating connected to said peripheral boundary and said framing to constitute a flooring for said platform and a slanting ladder having means at each end thereof for engaging the diagonal gusset members of said platform and a platform of an adjacent tower section to provide access between the said platforms and to form an internal strut member for said tower section.

3. A portable tower for supporting an antenna comprising a plurality of tower sections, mounted one upon another in a vertical direction to a prescribed height, each tower section comprising a first and third side each formed by a pair of spaced parallel members, transverse members connecting the corresponding ends of said spaced parallel members and diagonal strut members connecting said spaced parallel members at points between said transverse members, a second side formed of a plurality of diagonal strut members having means on the ends thereof for embracing a parallel member of each of said first and third sides and pivoted thereabout to permit the first and third sides to be folded against said second side, a fourth side formed by a plurality of removable diagonal strut members means on the ends thereof for releasably connecting said removable diagonal strut members to the other of said spaced parallel members, a platform located at the top of each tower section and forming the bottom of the succeeding tower section comprising spreader members having means thereon for releasably engaging at opposite ends thereof a transverse member on each of said first and third sides, side members connecting the corresponding ends of said spreader members said spreader and side members forming a peripheral boundary means of said platform, diagonal gusset members connecting the mid-portion of said spreader members to the mid-portion of said side members said diagonal gusset members forming a framing means for an access opening through said platform, and an expanded metal grating connected to and extending between said boundary and framing means to constitute a flooring for said platform and slanting ladder means connected to the gusset members of the platforms of adjacent tower sections to provide access between platforms and to act as an internal strut for said tower.

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