April 1, 1969 J. A. WENGER ET AL 3,435,909

SOUND REFLECTING STRUCTURE

Filed Oct. 23, 1965 Sheet 1 of 5

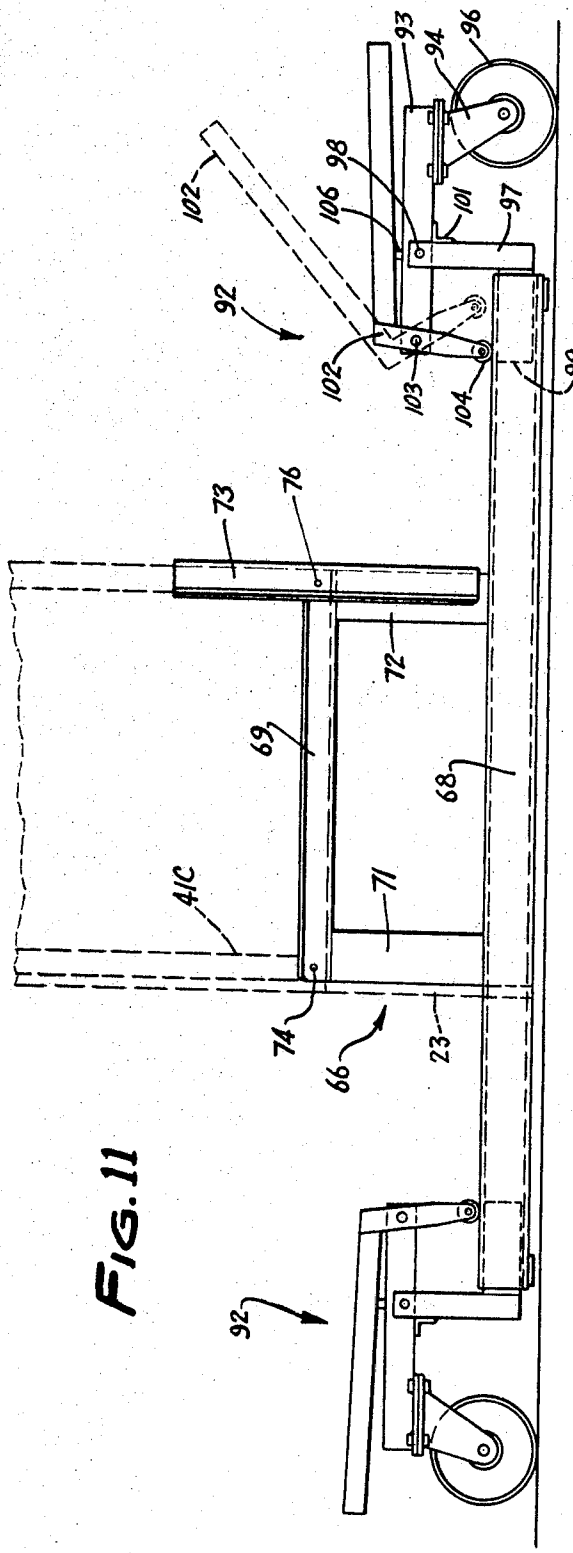

FIG. 11

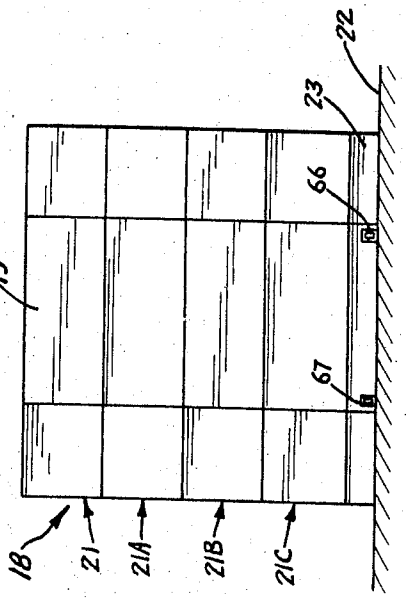

FIG. 2

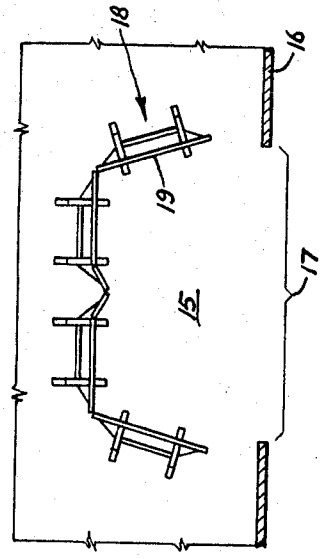

FIG. 1

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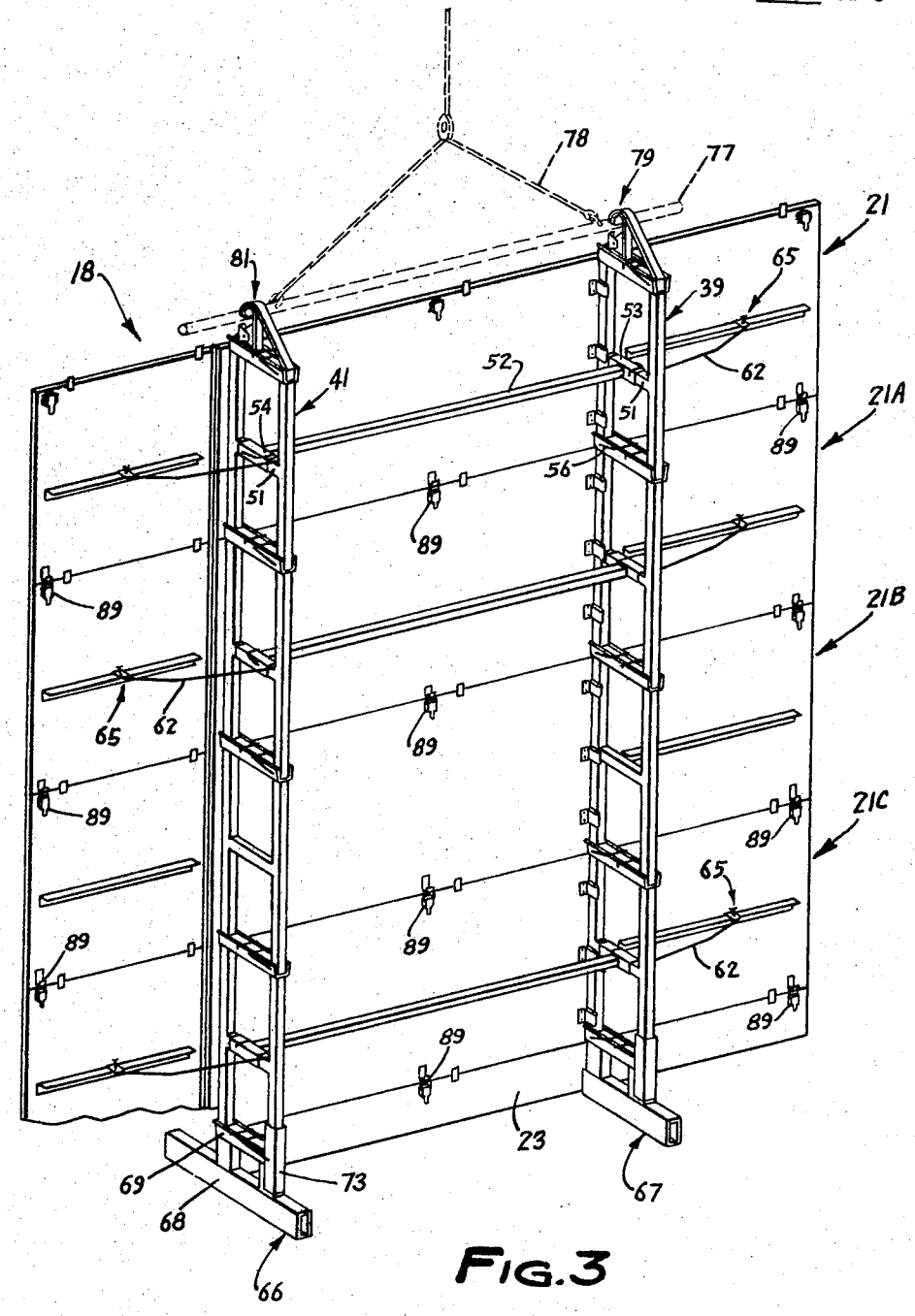

FIG. 3

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SOUND REFLECTING STRUCTURE

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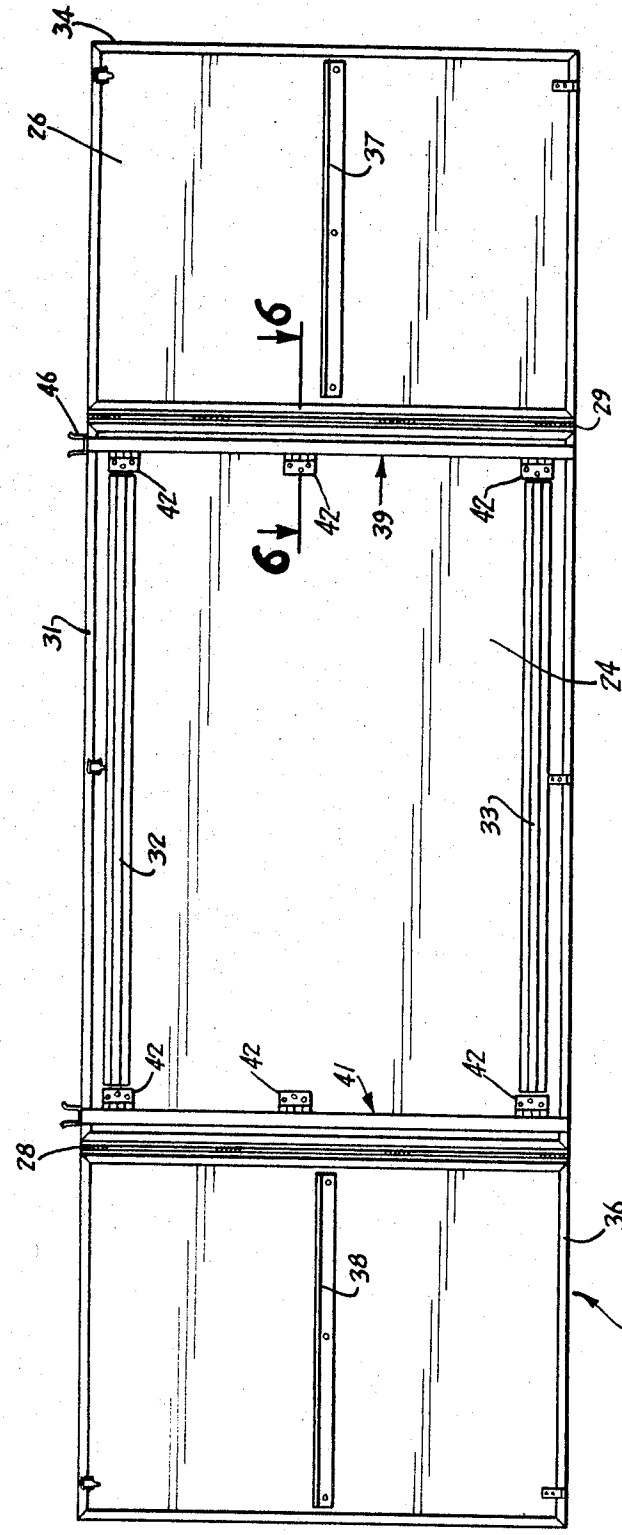

FIG. 4

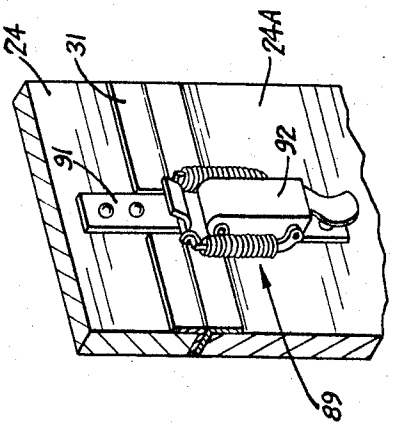

FIG. 10

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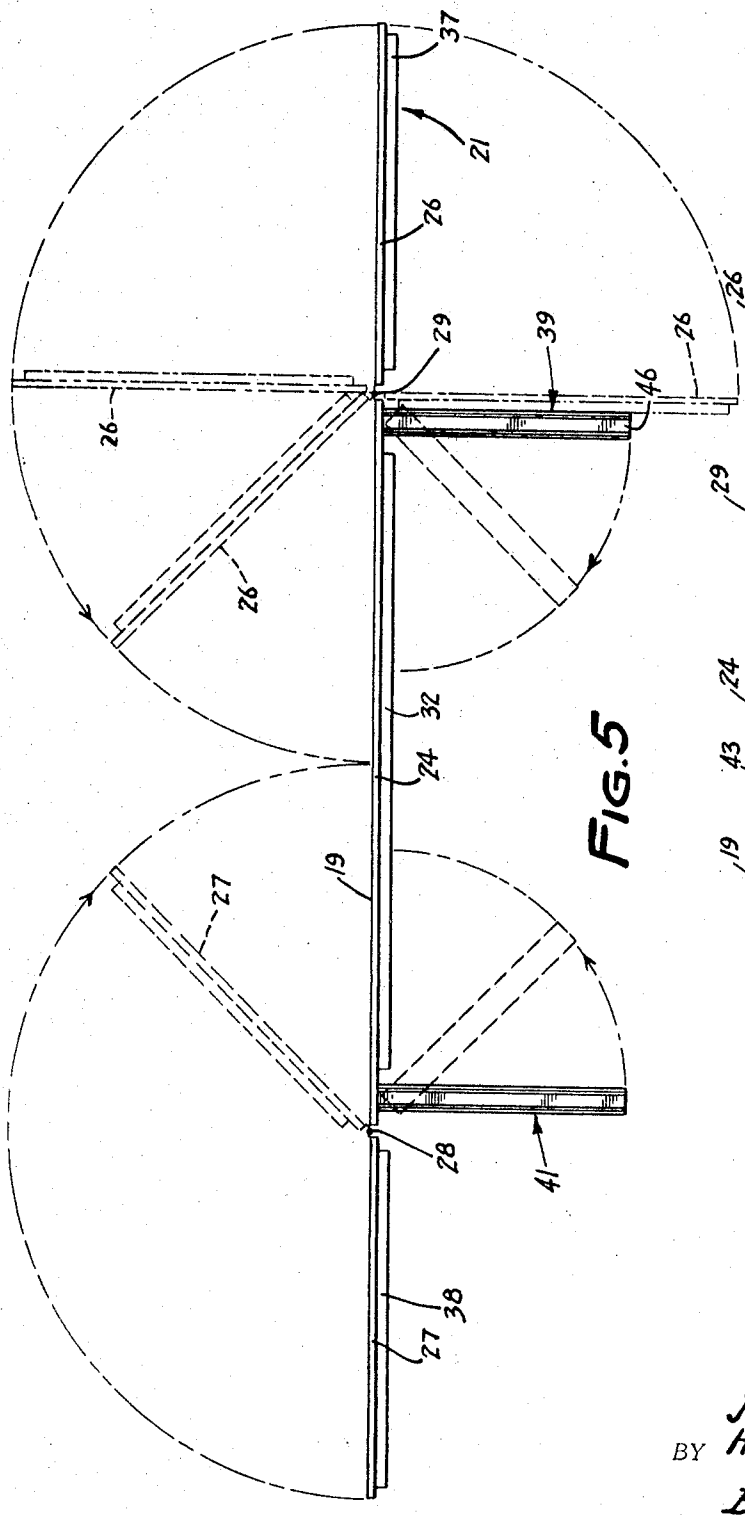

FIG. 5

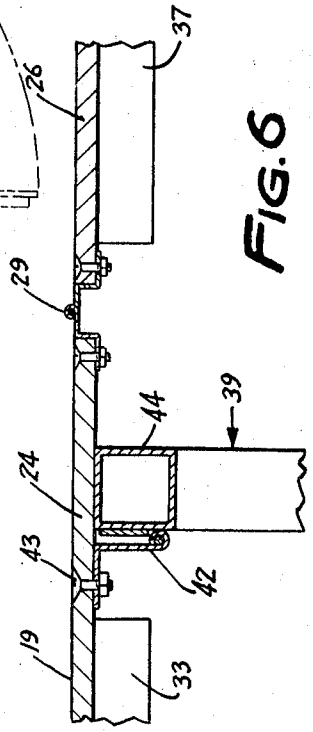

FIG. 6

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SOUND REFLECTING STRUCTURE

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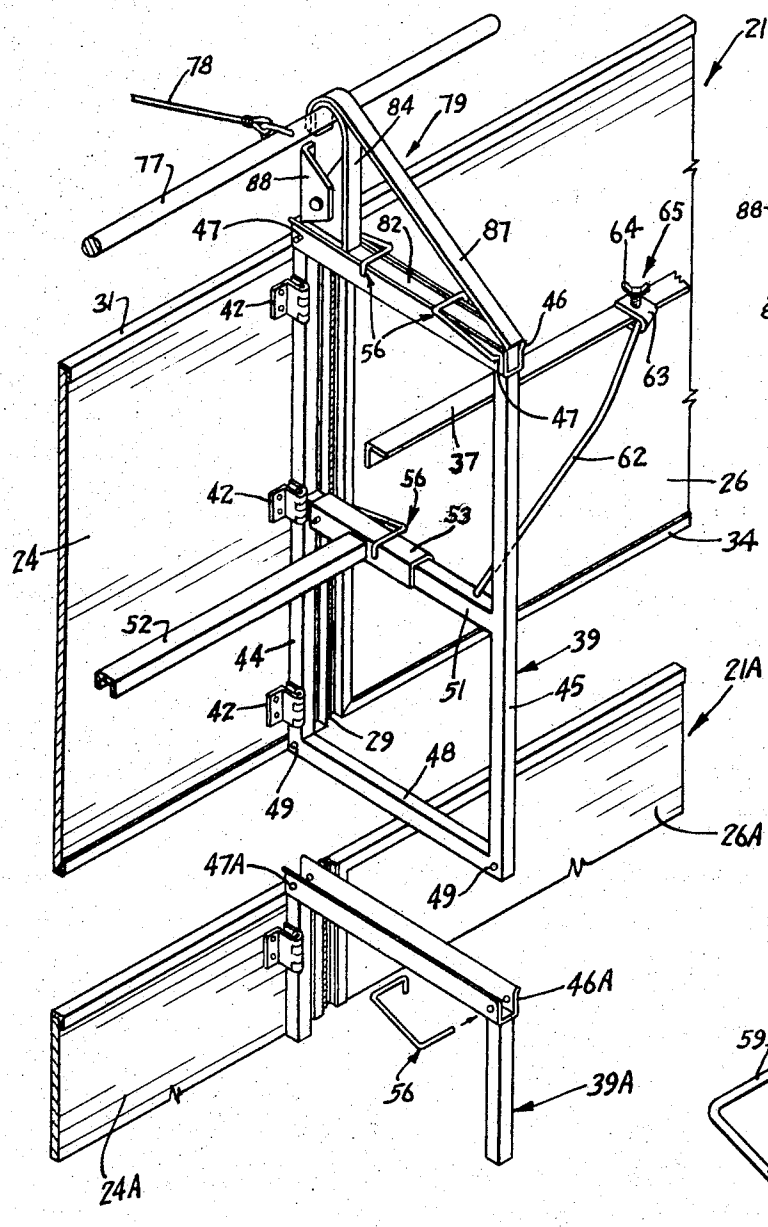

FIG. 7

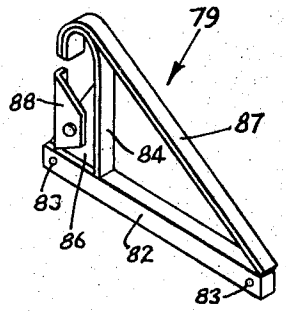

FIG. 9

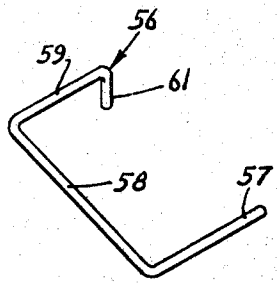

FIG. 8

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3,435,909

SOUND REFLECTING STRUCTURE

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Int. Cl. E04b 1/99
U.S. Cl. 181—30 13 Claims

ABSTRACT OF THE DISCLOSURE

An acoustical tower having a plurality of identical panel units located in side-by-side relation in a generally upright plane. Frame assemblies are pivotally mounted on the back side of each panel to support the tower. The frame assemblies have cooperating structures for securing adjacent portions of the frame assemblies together to build the tower. The relative positions of the frame assemblies are held by a strut which extends between adjacent frame assemblies. The lower frame asemblies are mounted on a support adapted to receive caster hoists used to raise the frame assemblies and panels so that they can be moved to a new location.

This invention relates to an acoustical tower having sound reflecting surfaces for blending sounds of a performing group such as musicians, dramatists, orators or the like and reflecting the sounds out toward an observing audience. More particularly, the invention relates to a movable acoustical wall structure which can be disassembled into module panel units.

Briefly stated, the acoustical upright wall structure of this invention is a movable acoustical tower constructed from a plurality of identical module panel units. The panel units are detachably secured to each other so that the tower can have any desirable height. Each panel unit has adjustable side panels which fold over onto a center panel to protect the sound reflecting faces. Pivotally mounted on the back of each panel unit are folding frame assemblies which provide vertical support for the panel unit. The folding frame assemblies on adjacent panel units are releasably connectable to each other providing upright frames for the acoustical tower. The frame assemblies of the bottom panel unit are secured to supports having horizontal tubular members which rest on the stage floor.

The acoustical tower can be moved on a stage floor by the use of caster hoists connected to the opposite ends of the horizontal tubular members. The towers can be placed relative to each other in numerous floor plan designs, as arcuate and U-shaped, in accordance with the stage and acoustical requirements. The acoustical towers are substantially identical. Each tower has substantially identical module panel units making the towers versatile and usable with a wide variety of arrangements of stage floor plans as well as rugged and stable when erected, economical in cost and effective in use. The sound reflecting surfaces of the panel units are movable and adjustable to simulate a music shell so that all members of the performing group hear each other clearly and distinctly and the sound of the entire ensemble is unified and blended. The sound reflecting surfaces also project a large portion of the blended sound into the audience area.

FIGURE 1 is a floor plan of a stage area equipped with the acoustical towers of this invention;

FIGURE 2 is an enlarged front elevation view of one of the acoustical towers of FIGURE 1;

FIGURE 3 is an enlarged rear elevation view partly broken away of the acoustical tower of FIGURE 2 with parts of each panel unit omitted;

FIGURE 4 is an enlarged rear view of one of the panel units of the acoustical tower of FIGURE 2;

FIGURE 5 is a top view of the panel unit of FIGURE 4;

FIGURE 6 is an enlarged sectional view taken along the line 6—6 of FIGURE 4;

FIGURE 7 is a fragmentary perspective view of adjacent panel unit showing the method of assembly of adjacent panel units;

FIGURE 8 is a perspective view of a locking pin used to connect the panel units together;

FIGURE 9 is a perspective view of a hanger used to connect the top panel unit to a batten of stage rigging;

FIGURE 10 is a perspective view showing one of the releasable clasps holding adjacent panel units together; and

FIGURE 11 is a side view of caster hoists in assembled relation with a horizontal support of the acoustical tower.

Referring to the drawing, there is shown in FIGURE 1, a stage area **15** separated from the audience by an upright wall **16** having a proscenium opening **17** facing the audience. A plurality of identical acoustical towers indicated generally at **18** each constructed according to this invention are located in the stage area **15** in a U-shaped arrangement. The open portion of the U is facing the audience exposing a sound reflecting face **19** of each tower to the audience. Portions of each tower are angularly adjustable to control the reflection and diffusion of sound toward the audience.

As shown in FIGURE 2, upright acoustical tower **18** has four identical module panel units **21**, **21A**, **21B** and **21C** positioned in side-by-side relation on top of each other to form an upright wall having a sound reflecting face **19**. The space between the lower panel **21C** and floor **22** is closed with a filler panel **23** thereby making the face **19** continuous to the floor **22**. The height of the tower **18** may be increased or decreased by mounting additional panel units on top of panel unit **21** or removing one or more of the panel units.

As shown in FIGURES 4 and 5, panel unit **21** has a flat rectangular shaped center panel **24** located between a flat right door or side panel **26** and a flat left door or side panel **27**. Panels **24**, **26** and **27** are formed from sheet material, such as plywood, sheet plastic or the like, having mass or thickness and sound reflecting faces **19** which are smooth and hard to provide optimum sound reflecting characteristics. The face or surface **19** on each panel may be flat, curved, sculptured, or of other non-linear shapes. Hinges **28** and **29** pivotally secure the right side panel **26** and the left side panel **27** to opposite sides of the center panel **24**. The right side panel **26** and left side panel **27** can be adjusted to change the angular position of the sound reflecting faces of side panels **26** and **27** relative to the sound reflecting face of center panel **24**. Hinges **28** and **29** permit the side panels **26** and **27** to be folded forwardly as shown in broken lines in FIGURE 5 to cover the sound reflecting surface **19** on the center panel **24** as well as the sound reflecting surfaces, of side panels **26** and **27**. This protects the sound reflecting faces during transportation and storage of the panel unit.

The peripheral edge of center panel **24** is protected by a metal angle member **31** positioned over the peripheral edge and the back peripheral portion of the panel. Fastening members, as wood screws, bolts, rivets and the like, secure angle member **31** to the center panel. The center panel **24** is longitudinally reinforced by a pair of parallel beams **32** and **33** secured to the back side of the panel. The peripheral edges of the side panels **26** and **27** are protected by angle members **34** and **36**, respectively. Horizontal angles **37** and **38** fastened to the center areas of the side panels **26** and **27** are used in the adjustment of the angular positions of the side panels **26** and **27** with respect to the center panel **24**.

As shown in FIGURES 3, 4 and 5 upright identical frame assemblies indicated generally at **39** and **41** are located adjacent opposite ends of the back side of panel **24**. Hinges **42** pivotally mount the frame assemblies **39** and **41** on the back panel **24**. As shown in FIGURE 5, bolt and nut assemblies **43** secure the hinges **42** to panel **24**. Frame assemblies **39** and **41** are rotatable from a folded position adjacent the back side of the center panel **24** to a position substantially normal to the center panel **24** as shown in FIGURE 3.

The following description is limited to frame assembly **39**. As shown in FIGURE 7, frame assembly **39** is of tubular rectangular construction having a pair of upright sides **44** and **45** connected to a U-shaped member or channel **46** having transverse holes **47** projected through opposite ends of the flanges of the U-shaped member. The bottom wall of channel **46** is in the plane of the top edge of panel **24**. The lower ends of the sides **44** and **45** are integral with a base **48** having a bottom side lying in the plane of the bottom edge of panel **24**. The opposite ends of the base **48** have transverse holes **49** which are in alignment with the holes **47** allowing base **48** to fit into a channel of an adjacent frame assembly and secured together with locking pins **56**. A transverse member **51** extends between and is secured to the mid-portions of the upright sides **44** and **45**.

A strut or brace **52** is used to hold the frame assemblies **39** and **41** substantially perpendicular to the center panel **24**. Secured to the opposite ends of the strut **52** are inverted U-shaped members or channels **53** and **54** positioned about the transverse members **51**. The forward ends of the channels **53** and **54** are located adjacent upright frame sides **44**. Lock pins **56** are used to secure the channels **53** and **54** to the transverse members **51**. As shown in FIGURE 8, lock pin **56** has a straight leg **57** integral with and projected normally from one end of a straight back **58**. Integral with the opposite end of the back **58** is an arm **59** terminating in a normally disposed finger **61**. In use, the leg **57** projects through aligned holes in channel **53** and transverse member **51** to lock the channel and member together. Arm **59** extends over the top of the channel **53** with the finger **61** projected downwardly adjacent the opposite side of the channel. With finger **61** in this position leg **57** is prevented from moving axially out of the aligned holes in the transverse member **51** and channel **53**.

Referring to FIGURE 7, side panel **26** may be angularly adjusted with respect to center panel **24** by the use of a rod **62** pivotally mounted at one end to the transverse member **51** and projected outwardly toward the angle **37**. A connecting member indicated generally at **65** secures the rod to angle **37**. Member **65** is illustrated as a U-shaped clamp **63** secured to the outer end of rod **62** and positioned about the rearward flange of the angle **37**. A thumb screw **34** threaded through one side of the U-shaped clamp **63** is adjustable to hold clamp **63** on angle **37** and thereby fix the angular position of side panel **26** with respect to center panel **24**. Side panel **27** is adjustable with a rod and connecting member identical with rod **62** and connecting member **65**. As shown in FIGURE 5, side panel **26** is adjustable in any angular position in a semicircle starting from about adjacent the frame assembly **39**. Usually panel **26** is adjusted within **45** degrees of the full line position shown in FIGURE 5. Side panel **27** is adjustable in the same manner as panel **26**.

As shown in FIGURE 3, the entire acoustical tower **18** is mounted on and stabilized by a pair of horizontal supports indicated generally at **66** and **67** resting on the stage floor. Horizontal supports **67** and **66** are identical in construction and receive the lower portions or bases of the frame assemblies of bottom module panel unit **21C**. Referring to FIGURE 11, support **66** comprises a longitudinal tubular beam or member **68** having a rectangular cross-section. A horizontal channel **69** extends parallel to beam **68** and is secured at its opposite ends to

downwardly projected legs **71** and **72**. The lower ends of the legs **71** and **72** are secured to the top of beam **68**. Upright channel **73** is secured to the rear side of leg **72** and projects upwardly from channel **69**. The forward end of channel **69** has a transverse hole **74** aligned with the hole in the base of frame assembly **41C**. The mid-portion of channel **73** has a transverse hole **76** positioned to align with a hole in the base of frame assembly **41C**. Lock pins similar to pins **56** are used to secure frame assembly **41C** to the channel **69**. In a similar manner lock pins **56** are used to secure frame assembly **39A** to support **67**.

In the assembly of the acoustical tower the module panel units are removed from a storage truck, which may be a four wheel hand truck storing the panel units in upright positions. Panel unit **21** is elevated by the use of stage rigging which normally includes a horizontal batten **77** secured to cables **78**. The cables may be operably connected to a winch or other power device. The batten **77** is connected to the frame assemblies **39** and **41** by hook structure shown as identical hangers **79** and **81**. Additional panel units are attached to the bottom panel unit by raising panel unit **21** and attaching the adjacent frame assemblies of a new panel unit to the bottom panel unit.

FIGURE 9 shows hanger **79** as having a horizontal base member **82** having transverse holes in the opposite end which align with the holes **47** in frame assembly channel **46**. Lock pins **56** project through the aligned holes securing the base member to the channel. A hook **84** projects upwardly from one end of the base member **82** and is secured to the base member by a gusset **86**. The upright position of the hook **84** is reinforced with a diagonal top member **87** which extends over the downwardly curved portion of hook **84** and to the opposite end of base member **82**. A latch **88** pivotally mounted on the gusset **86** functions to prevent the accidental removal of the batten from the hook. The latch **88** must be depressed or pivoted forwardly before the hook **84** can be removed from the batten.

The module panel units **21–21C** are assembled together placing the base **48** of the frame assemblies **39** and **41** in the adjacent channels **46** and securing these members together with locking pins **56**. Fasteners **89** are used to attach mid-sections of the center panels and end portions of the side panels **26** and **27**. As shown in FIGURE 10, fastener **89** comprises a hook **91** secured to the upper panel **24** and a cooperating lock device **92** secured to the lower panel **24A**. The lock device is operable to releasably attach to the hook **91** and thereby hold adjacent panels in abutting relationship. The tower **18** is completed by placing the filler panel **23** over the members **67** and **68**. As shown in FIGURE 2, filler panel **23** has two hinged side doors and cutouts to receive members **67** and **68** to complete the sound reflecting surface **19** to the floor **22**.

The completed acoustical tower **18** can be moved to different locations on the stage without separating the panel units **21–21C**. Caster hoists, indicated generally at **92** in FIGURE 11, connect to the ends of the tubular members **67** and **68** and operate to raise the entire tower so that the tower can be moved to the desired stage location. Four identical caster hoists are used to move each tower. After the tower is moved to its new location the caster hoists are removed from members **67** and **68** and used to move another tower. The towers can be stored in side-by-side nested relative relation on the stage area. As shown in FIGURE 11, the caster hoists **92** have a height which allows the hoists to move under the lower panel unit of a tower when the filler panel **23** is removed from the tower. This permits the towers to be stored in back-to-back pairs with the frame assemblies overlapped up to the struts **52**. A minimum stage area is utilized when the towers are stored in this manner.

Caster hoist **92** comprises a horizontal beam **93** secured to a downwardly projected yoke **94**. A wheel **96**

is mounted on the yoke for rotation about a transverse axis. A right angle arm **97** projects downwardly from the mid-section of beam **93**. Transverse pivot member **98**, as a pin, pivotally connects the upper end of arm **97** to beam **93**. The horizontal portion **99** of arm **97** has a rectangular cross-sectional shape slightly smaller than the cross-sectional shape of beam **68** so that portion **99** can be telescoped into beam **68**. Portion **99** projects away from wheel **96**. The rear side of arm **97** engages a transverse stop **101** secured to rear side of arm **97** to fix the horizontal position of portion **99**. When arm **97** is coupled to support member **68** the forward portion of beam **93** is located above and in the vertical plane of beam **68**. A bell crank lever **102** pivotally mounted by transverse pivot member **103** to the forward end of beam **93** is used to angularly raise beam **68** thereby lift support member **68** off the stage floor. Lever **102** has a short downwardly projected arm rotatably connected to a small roller **104** which rides on the top of member **68**.

In use with support member **68** resting on the stage floor bell crank lever **102** is raised to the broken line position and the arm portion **99** is inserted into the end of member **68**. Lever **102** is then forced to the horizontal full line position moving roller **104** along the top of member **68**. As roller **104** moves along member **68** hoist beam **93** moves in an upward direction raising member **68** off the floor. Lever **102** is rotated until it engages a stop **106** on top of member **93** positioning roller **104** in an over center location relative to pivot member **103**. This locks the caster hoist in the raised position and frictionally holds extension **99** in engagement with member **68**. Lever **102** moves beam **93** into engagement with stop **101** and applies a rotational force to arm **97**. This distorts extension **99** located in the end of member **68** thereby frictionally holding extension **99** in engagement with member **68**. Support member **68** can be lowered by rotating lever **102** in an upward direction indicated in broken lines.

The preferred embodiment of the invention has been shown and described. It is understood that changes in material, changes in form and design can be made by those skilled in the art without departing from the spirit of the invention. The invention is limited only by the prior art considered with the following claims.

What is claimed is:

1. An acoustical tower comprising a plurality of identical panel units positioned in side-by-side relation in a generally upright plane, each panel unit having a back side and a sound reflecting surface, a plurality of frame assemblies projected from and secured to said back side, means securing adjacent portions of the frame assemblies together, strut means releasably attached to the frame assemblies for holding the frame assemblies generally normal to the panel unit, and support means attached to the frame assemblies of the bottom panel unit for holding the tower in an upright position.

2. The acoustical tower defined in claim **1** wherein each panel unit has a sheet member and at least one sheet unit pivotally connected to one side of the sheet member so that the sheet unit is angularly movable relative to the sheet member and means operably connected to the sheet unit to adjust the angular position of the sheet unit.

3. An acoustical tower comprising a plurality of identical panel units positioned in side-by-side relation in a generally upright plane, each panel unit having a backside and a sound reflecting surface, a plurality of frame assemblies projected from and secured to the back side, means securing adjacent portions of the frame assemblies together comprising a channel member on one frame assembly positioned about a linear portion of an adjacent frame assembly and locking pin means to maintain the channel member in assembled relation with the linear portion and support means attached to the frame assemblies of the bottom panel unit for holding the panel in an upright position.

4. The acoustical tower defined in claim **1** wherein the support means includes a plurality of tubular members and means secured to the tubular members attachable to the frame assemblies of lower panel unit whereby the support means holds the tower in an upright position.

5. The acoustical tower defined in claim **1** including hook means releasably attached to the frame assemblies of the top panel unit connectable with a horizontal batten used to raise the panel unit.

6. The acoustical tower defined in claim **1** including hinge means for pivotally connecting the frame assemblies to the panel units whereby the frame assemblies may be moved to folded positions adjacent the back sides of the panel units.

7. The acoustical tower defined in claim **1** including wheel means connectable with the support means whereby the entire tower can be moved on a stage floor.

8. A sound reflecting panel comprising a sheet member having a back side and a sound reflecting surface, a plurality of frames positioned adjacent the back side of the sheet member for holding the sheet member in a generally upright position, means articularly connecting the frames to the back side of the sheet member for movement from a first position adjacent said back side to a second position substantially normal to said back side, strut means releasably cooperating with the frames for holding said frames in the second position, each of said frames having first means and second means adapted to coact with additional sound reflecting panels to secure adjacent panels together.

9. The panel defined in claim **8** wherein said frames comprise a pair of frame assemblies pivotally connected to opposite end sections of the sheet member, said first means on the frames comprising a channel member on each frame assembly adapted to receive a portion of the frame of an adjacent panel.

10. The panel defined in claim **8** further characterized by sheet units having back sides and sound reflecting surfaces located adjacent opposite ends of the sheet member, means pivotally connecting adjacent edges of the sheet units and the sheet member whereby the sound reflecting surfaces of the sheet units can be angularly disposed with respect to the sound reflecting surface of the sheet member and means connected to the sheet units operable to selectively adjust said angular positions of the sheet units.

11. A sound reflecting panel comprising: a sheet member having a back side in a sound reflecting surface, a plurality of frames positioned adjacent the back side of the sheet member for holding the sheet member in a generally upright position, means articulately connecting the frames to the back side of the sheet member for movement from a first position adjacent said back side to a second position substantially normal to back side, means cooperating with the frames for holding the frames in the second position, each of said frames having first means and second means adapted to coact with additional sound reflecting panels to secure adjacent panels together, a side sheet unit having a sound reflecting surface located adjacent one side of the sheet member, means articulately connecting adjacent portions of the sheet unit and sheet member whereby the sound reflecting surface of the sheet unit can be angularly disposed with respect to the sound reflecting surface of the sheet member and means operably connected to the sheet unit to adjust the angular position of the sheet unit.

12. The acoustical tower defined in claim **3** including strut releasably attached to the frame assemblies for holding the frame assemblies generally normal to the panel unit.

13. The acoustical tower defined in claim **3** including a hinge means pivotally connecting the frame assemblies to the panel units whereby the frame assemblies may be moved to folded positions adjacent the back sides of the panel units.

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U.S. Cl. X.R.

52—70, 71, 143, 144; 160—135, 351; 272—21; 352—3