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COLLAPSIBLE GIRDER

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Fig. 2

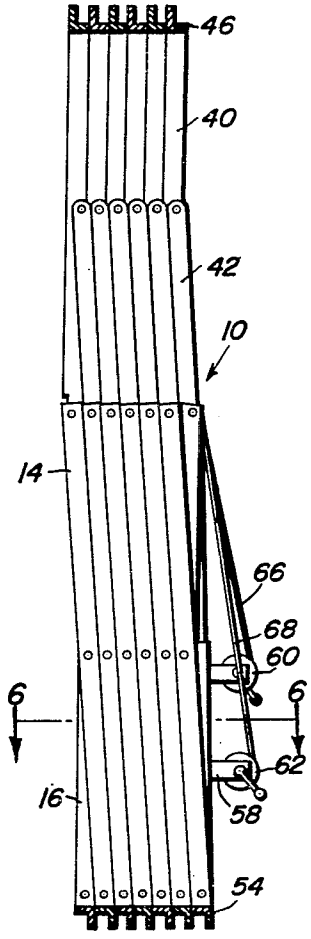


Fig. 3

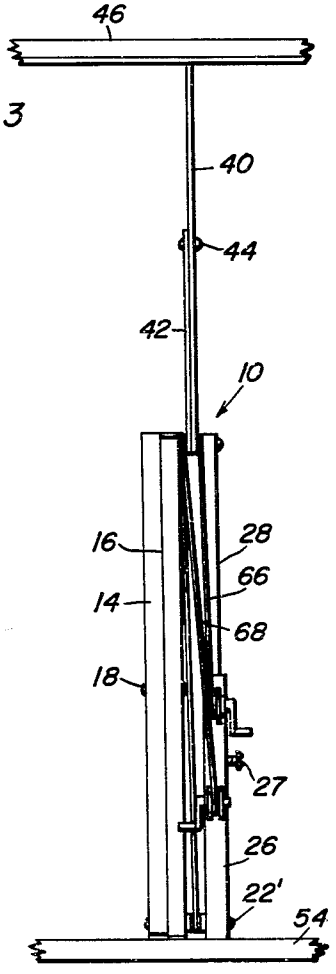
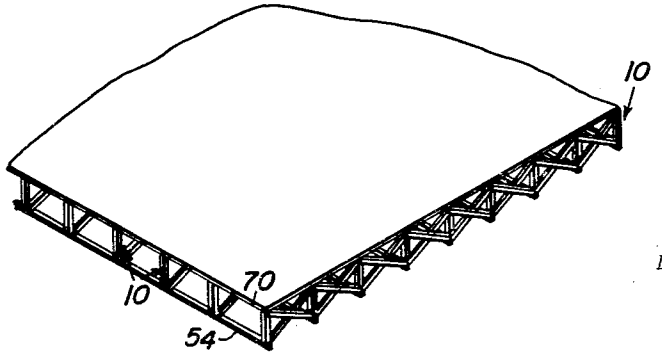


Fig. 1



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Fig. 4

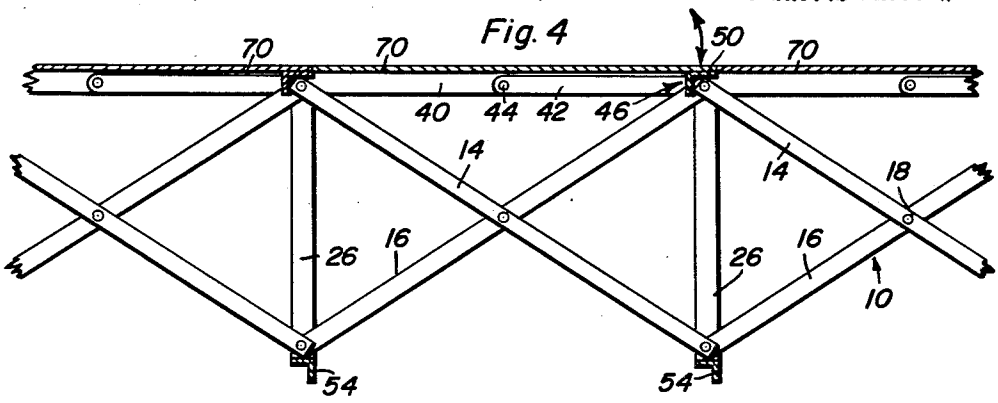


Fig. 5

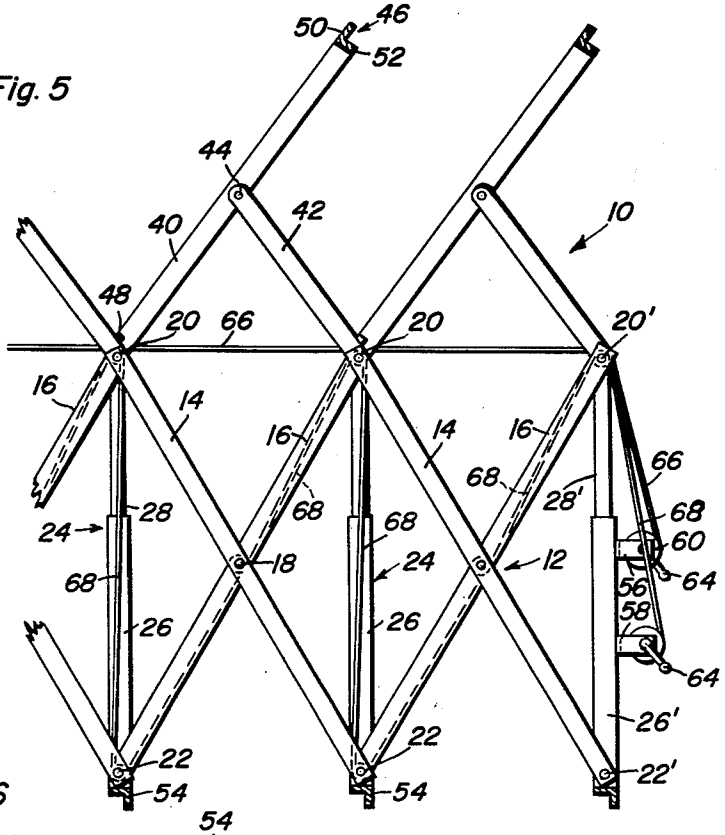
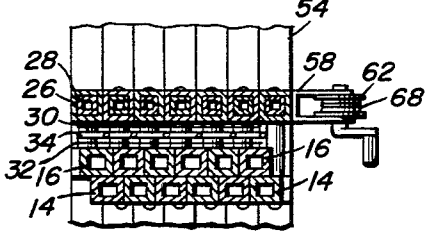


Fig. 6



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Fig. 7

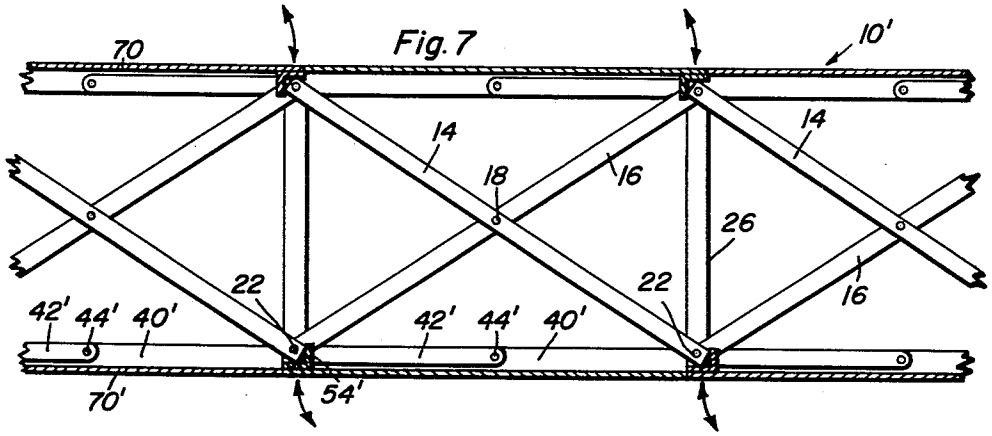


Fig. 8

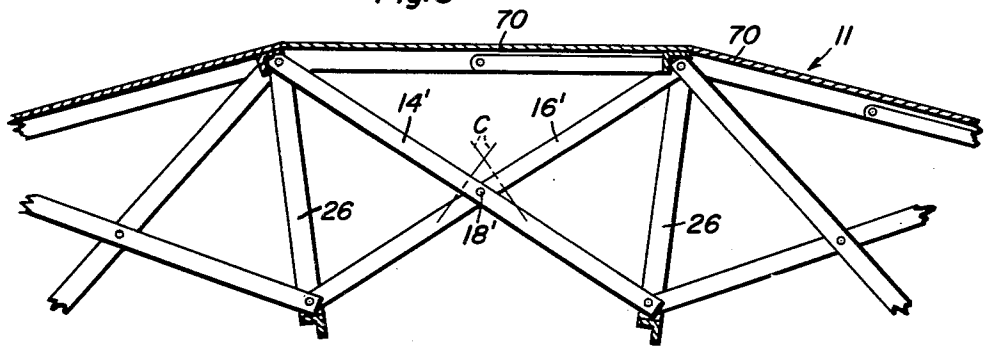
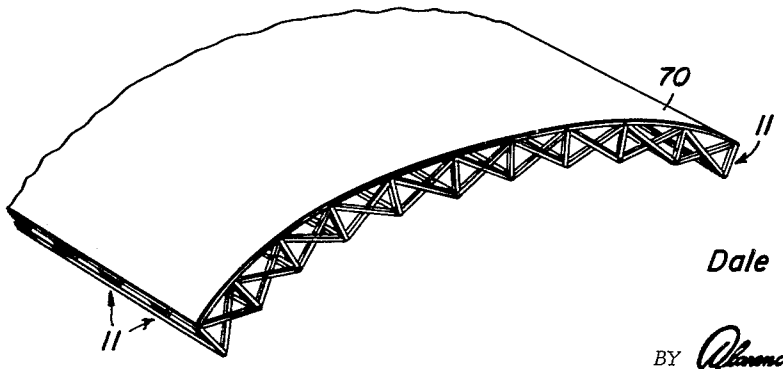


Fig. 9



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United States Patent Office 3,152,347 Patented Oct. 13, 1964

3,152,347

COLLAPSIBLE GIRDER

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5 Claims. (Cl. 14—45)

This invention relates to structural devices, and more particularly to extensible and retractible girder assemblies.

It is a primary object of this invention to provide a girder structure which is so constructed that it may be folded or contracted to a compact package, or it may be extended when desired to any preselected length.

It is another object of the invention to provide a girder structure which has manually operative means thereon for expanding and contracting the girder whenever desired.

It is still another object of the invention to provide a girder structure which is contractible and expandible so that the girder may be contracted for storage or transportation, and may be extended to any desired length when installed for use.

It is another object of the invention to provide a girder structure which has at least one covering surface pivotally connected thereto. This covering surface is pivotally connected to the top of the girder or the bottom thereof, or both the top and the bottom so that when the girder is exended, the covering folds down into a coplanar position perpendicular to the plane of the girder so that it may serve as a flooring or ceiling for the girder structure.

It is still another object of the invention to provide a collapsible girder structure which may be made in either flat or curved form when extended.

Briefly, the invention comprises a girder structure including a lazy tongs type mechanism which is adapted to be extended from its folded position. Connected between the cross members of the lazy tongs are telescoping struts which function as additonal braces. Cable and winch mechanism is provided and the cable is guided by pulleys along the various cross members and struts for collapsing or extending the girder as desired. Also, connected to one edge of the lazy tongs mechanism by pivot means are additional folding levers, some of which may have a transversely extending covering structure attached thereto. The covering structure may function as a ceiling, a floor, a roof, etc.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a perspective view of a plurality of the collapsible struts in the extended position and arranged in side-by-side, parallel relationship;

FIGURE 2 is a front elevational view of a collapsible girder without any covering structure and in a completely folded position;

FIGURE 3 is a right end elevational view of the structure shown in FIGURE 2;

FIGURE 4 is a front view of the girder shown in FIGURE 2 in the fully extended position with an outer covering thereon;

FIGURE 5 is a front elevational view of a girder shown in FIGURES 2 through 4 in a partially extended position;

FIGURE 6 is a cross sectional view taken substantially on the plane of line 6—6 in FIGURE 2;

FIGURE 7 is a view similar to FIGURE 4 but showing a slightly modified form;

FIGURE 8 is a view similar to FIGURE 7 but showing another slightly modified form; and

FIGURE 9 is a perspective view similar to FIGURE 1, but showing a plurality of girders of the type shown in FIGURE 8 assembled in side-by-side relationship.

As shown in FIGURES 2 through 6, the collapsible girder assembly **10** comprises a lazy tongs mechanism **12**. The lazy tongs mechanism comprises a plurality of parallel cross members **14** and a plurality of parallel cross members **16**. In the form shown in FIGURES 1 through 6, the cross members **14** and **16** are of rectangular hollow construction in cross-section and each member **14** crosses a member **16**. The members **14** and **16** are pivotally connected together by pivot pins or rivets **18** which extend through aligned bores at their centers. The upper end of each member **14** is pivotally connected by a pin or rivet **20** to the upper end of an adjacent member **16**. The lower end of each member **14** is pivotally connected to the lower end of an adjacent member **16** by a pin or rivet **22**.

Extending between each pin **20** and **22** is a telescoping strut assembly **24**. Each strut assembly comprises a cylinder **26** slidably receiving a rod **28**. Each telescoping strut assembly **24** is pivotally connected at its upper and lower ends by means of apertures therethrough to the pins **20** and **22** respectively. As shown more clearly in FIGURE 6, each of the pins **20** and **22** also extend through a pair of cylindrical rollers **30** and **32** and a slightly larger washer **34** which separate the rollers. The pins **20** each also extend through a pair of rollers **30** and **32** in the same manner as shown in FIGURE 6, but the washers **34** are omitted and the pivoted ends of the beams **40** and struts **42** are substituted for the washers **34**. As shown in FIGURE 5, the beams **40** and struts **42** are alternately spaced and the lower end of one beam **40** in the lower end of one strut **42** are connected pivotally to each pin **20** between the rollers **30** and **32**. Also, the upper end of each strut **42** is pivotally connected by a pin **44** to the central portion of an adjacent beam **40**. The beams **40** and the struts **42** are preferably formed of flat material. Rigidly fixed to the upper end of each beam **40** by conventional means such as welding, is a cross beam **46** which is L-shaped in cross section and extends perpendicular to the beam **40**. The cross beams **46** may extend an equal distance on each side of the beams **40**, or they may extend only from one side of the beam **40**. One end of each beam **40** is notched as shown at **48** so that when the girder is in the fully extended position as shown in FIGURE 4, the upper flanges of the cross beams **46** may be received in the notches **48**. Also, when the girder is in the fully extended position, the ends of the beams **40** containing pins **20** snugly abut one side of the flanges **52** of the cross beams **46**.

Rigidly secured to the lower end of each cylinder **26** is a joist **54** which is preferably of the same cross sectional shape and length as the cross beams **46**.

The cylinder **26'** at one end of the girder **10** has rigidly fixed thereto in spaced relation two parallel U-shaped brackets **56** and **58**, each of which rotatably supports a cable reel or winding drum **60** or **62**. The axle on each of the winding drums has a manually operatively winding crank **64** fixed thereto. The reel **60** has a girder collapsing cable **66** wound thereon, while the reel **62** has a girder extension cable **68** wound thereon.

The collapsing cable **66** extends from the reel **60** upwardly and over the roller **30** onto the pin **20'** at the upper end of the end rod **28'** and extends horizontally over the top of the remaining rollers **30** to the other end of the girder where it is secured to the pin **20** at that end. The extending cable **68** extends upwardly from the reel **62** and over the end roller **32** on the pin **20'** and then the cable extends diagonally downwardly behind the right

cross member **16** as viewed in FIGURE 5, then the cable loops around a lower roller **32** and extends vertically outwardly again in front of a strut assembly **24**. The extension cable **68** continues on to the left end of the girder by zig-zagging between the rollers **32** as explained above. The extreme left end of the cable **68** is secured to the left end of the girder, and preferably to one of the pins **22** or **20**.

To operate the girder **10** from the collapsed or contracted position shown in FIGURE 2 to the expanded position shown in FIGURE 4, it is only necessary to rotate the handle **64** for the reel **62** in a clockwise direction as viewed in FIGURE 5 so as to wind the extension cable **68** upon the reel. As the cable **68** winds on the reel **62**, it rolls over the upper and lower rollers **32** and thereby applies a compressive force between the upper and lower ends of each telescoping strut assembly **24**. This causes the rod members **28** to be forced within the cylinder members **26** so as to laterally expand the lazy tong assembly comprising the cross members **14** and **16**, as viewed in FIGURE 5. As the extension cable **68** is continued to be wound upon the reel **62**, the girder continues to expand lengthwise until eventually the pins **20** strike the upper ends of the cylinders **26** and the cross beams **46** recede into the notches **48** as viewed in FIGURE 4.

Each of the beam **40** with its attached cross beam **46** may have secured to the upper surface a rectangular covering sheet **70** as shown in FIGURE 4. These sheets extend from the notches **48** to the outer edge of the flanges **50** of the cross beams **46**. The covering sheets may be secured to the beams by conventional means such as welding or screws, not shown. The covering sheets **70** may be secured to the beams **40** and **46** at the factory and folded with the girder assembly, or they may be attached after the girder assembly is extended as illustrated in FIGURE 4. If the covering sheets are installed at the factory, and it is desired to fold the girders as compactly as illustrated in FIGURE 2, then it is apparent that the cross beams **46** and the beams **40** must be recessed on their upper surfaces to receive the thickness of the sheets, or else the thickness of these beams must be reduced by an amount equal to the thicknesses of the sheets. However, it is to be pointed out that even if the sheets **70** are fractory installed on the girder assembly illustrated in FIGURES 2 through 5, it is still possible to fold the complete device into a rather compact unit.

In the form illustrated in FIGURE 7, the structure and arrangement of parts is identical to that shown in FIGURE 4, except that additional structure has been added to the lower edge of the girder assembly. In this form, lower beams **40'** and lower struts **42'** are connected together by pins **44'** and are connected to the girder structure by the pins **22** in the same manner that the upper beams **40** and struts **42** are connected together and to the girder structure. Also, lower covering sheets **70'** are connected to the joists **54'** and lower beams **40'** in the same manner in which the covering **70** is connected to the beams **40** and **46**. The joists **54'** are connected to the free swinging ends of the beams **40'** rather than being connected to the lower end of each cylinder **26** as shown in FIGURE 5. The arrows in FIGURE 7 indicate the direction in which the covering sheets and beams swing when the girder is collapsed.

In the forms of the girder shown in FIGURES 1 through 7, the upper and lower edges of the girders are straight and parallel. However, in the form shown at **11** in FIGURE 8, the upper and lower surfaces are curved. The form shown in FIGURE 8 is constructed the same as that form shown in FIGURE 4. However, in the form shown in FIGURE 8, the cross members **14'** and **16'** are pivotally connected by a pin **18'** which extends through the cross members at a point spaced below the centers C thereof. This causes the lower ends of the cylinders **26** to be closer together than the upper ends thereof thereby giving a curved configuration to the upper

and lower edges of the girder when it is fully extended as shown in FIGURE 8. The form shown in FIGURE 4, the cross members **14** and **16** are connected exactly at their center C by the pins **18**. The form shown in FIGURE 8 may also be covered by the covering sheet **70**.

FIGURE 1 illustrates a plurality of expanded girders of the type shown in FIGURE 4 connected in side-by-side relationship by means of the joists **54**, the cross beams **46** and the covering sheet **70**. The joints between the covering sheets **70** are not shown, since the exact location of these joints is not critical and is merely a matter of choice. However, it is apparent that the joints could be half way between each of the lazy tong assemblies or it could be directly over each girder. In a similar manner, FIGURE 9 illustrates a plurality of girders **11** shown in FIGURE 8 connected in side-by-side relationship. This forms a curved structure which is particularly adapted to be used in the roof construction of hangars and other large buildings.

From the above description, it is readily apparent that my novel girder assemblies may be constructed on a mass production basis, folded to a compact size, for shipping, and thereby easily transported over long distances to the sites where the girders will be used. After the girders have been transported to the building sites, they may be rapidly expanded by the extension cables **68** and reels **62** in a minimum of time and a minimum of effort. No special tools or training of the labor force is required in extending the girders. Since the girders may be shipped with the sheet covering **70** on one or both sides thereof, it is apparent that the girders may be joined in side-by-side relation as shown in FIGURES 1 and 5 for forming large building panels. These panels may be used for roof structures, floor structures, wall panels, bridge structures, etc.

If desired, the cylinders **26** may be locked to the rods **28** by means of set screws **27** which are threaded through the walls of the cylinders **26** and contact the outer surfaces of the rods **28**.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A collapsible and expansible lazy-tongs girder comprising a pair of crossed members, operating means mounted on the lazy tongs girder and connected thereto so as to selectively extend and contract the girder, brace means movably connected between the ends of said crossed members and arranged to contract and extend therewith, said brace means rigidly connecting and locking together said crossed members composing the lazy tongs when the girder is fully extended, said brace means including a beam pivotally connected at one end to the end of one of said crossed members, a strut pivotally connected to a mid-portion of the beam and to the corresponding end of the other of said crossed members.

2. A device as defined in claim 1 wherein said beam has a cross beam connected to its other end, said cross beam extending laterally from said girder when the girder is extended and adapted to connect it to other girders.

3. A device as claimed in claim 2 wherein said beam is formed with a notch at said one end, said notch being in mating engagement with a cross-beam adapted to be connected to an adjacent beam when the girder is in fully extended position to provide a unitary and continuous structure.

4. A device as defined in claim 3 wherein the brace means have covering sheets connected to their outer surfaces.

5. A device as defined in claim 4 wherein a plurality

of said girders are arranged in side-by-side relationship in extended position and said cross bars and sheets are connected by conventional means such as welds to form a hollow panel.

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