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INTERLOCK MECHANISM FOR MULTIPLE SECTION STRUCTURES

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FIG. 1

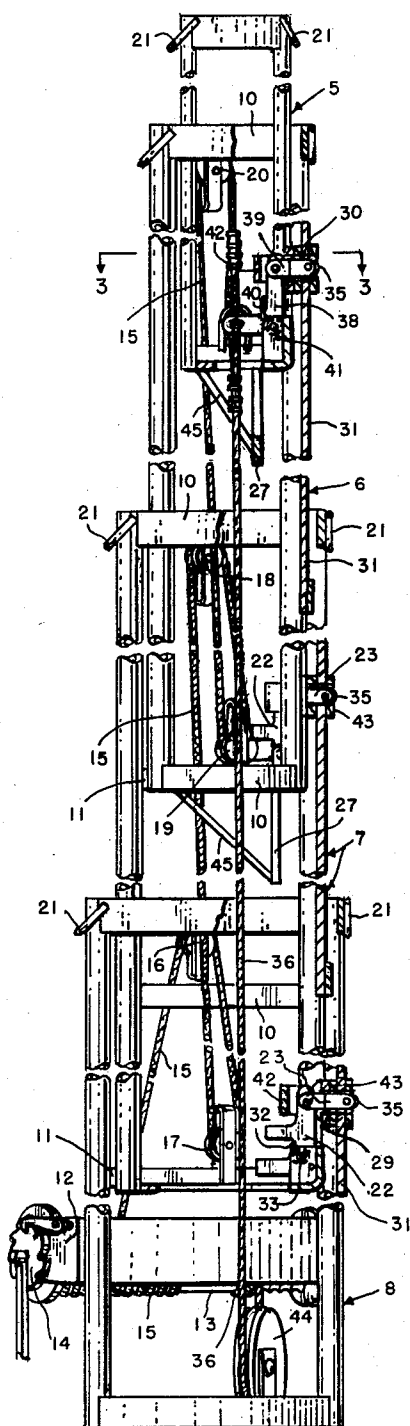


FIG. 2

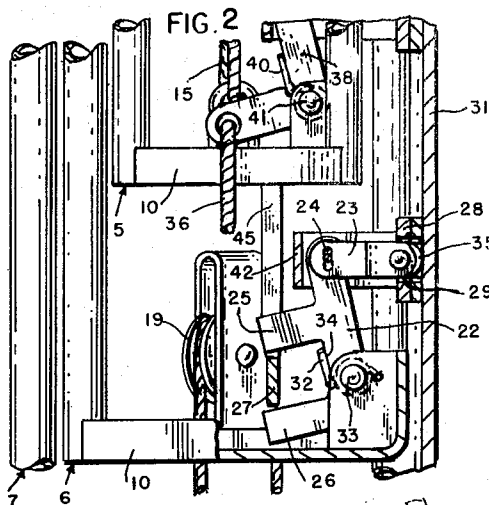
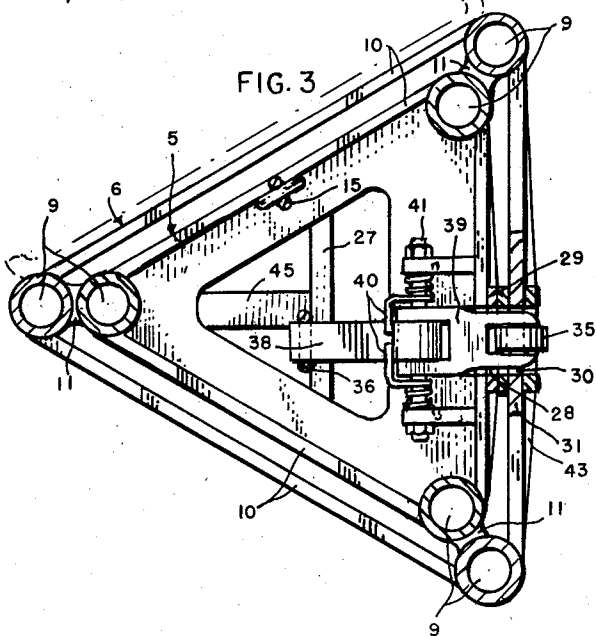


FIG. 3



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INTERLOCK MECHANISM FOR MULTIPLE SECTION STRUCTURES

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8 Claims. (Cl. 189—14)

(Granted under Title 35, U.S. Code (1952), sec. 266)

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

This invention relates to means for automatically interlocking and disengaging the sections of multiple section structures and is particularly suited to the elevating type of structure where the sections are manipulated entirely from ground level.

The invention is directed to the provision of a positive acting mechanism for automatically locking together the sections of an extensible structure as they become extended, and to unlock the sections when they are retracted. The use of the invention in telescoping structures renders them highly versatile, safe and reliable in operation.

The invention is herein presented in connection with a telescoping mast such as may be used for carrying an antenna or other device which must be elevated. The sections are raised by a cable which is operated from the ground by means of a hand winch or other suitable means which may be power driven.

The cable is threaded from the winch to a pulley at the upper end of the base section and from there to a pulley at the bottom of the first movable section and thence to the top and bottom of successive upper sections and is anchored to the bottom of the top section. Each section is provided with means to guy it in extended position. A more detailed description will appear hereinafter.

A specially constructed interlock mechanism sequentially locks the mast sections in their extended position. The mechanism comprises a bolt actuating lever pivoted upon each mast section. The lever carries a bolt and has rigid therewith a pair of arms extending therefrom. Upon upward movement of the sections one of the arms is engaged by an actuator bar rigid with the lower end of the adjacent mast section. This bar rotates the lever and thus imposes an outward thrust on the bolt. When the sections are fully extended the bolt is thrust into an aperture in the next lower section to thereby interlock the two sections. At the same time the bar is released and the next section is raised and locked in position in the same manner.

When retracting the sections the actuating bar successively engages the other rigid arm on the levers to withdraw the bolts and thus unlock the sections. A complete description of this mechanism will follow.

A primary object of the invention is to provide an interlocking system for use in multiple section extensible structures to greatly facilitate manipulation thereof from ground level.

A further object of the invention is to provide, in an extensible structure, automatic means for sequentially interlocking and disengaging its sections.

A further object of the invention is to provide in an articulated structure wherein at least a portion of the force required for extending the sections is used to actuate an interlocking member.

A further object of the invention is to provide an inter-

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locking device which is very rugged, effective and efficient.

Other objects and features of the invention will more fully appear in the following description and will be particularly pointed out in the claims.

To provide a better understanding of the invention a particular embodiment thereof will be described and illustrated in the accompanying drawings wherein—

Fig. 1 is an elevational view of a mast structure embodying the invention shown partially in section and with portions broken away.

Fig. 2 is detail view of the interlocking mechanism and Fig. 3 is a horizontal cross-section on line 3—3, Fig. 1 showing only two of the mast sections.

The mast as illustrated is composed of a plurality of triangular shaped telescoping sections 5, 6, 7 and a base section 8. The sections are of skeleton construction so designed as to provide maximum strength with minimum weight. The invention, however, contemplates the use of any suitable structure for the sections which may be round, square, tubular or other suitable shape. The mast sections shown have tubular vertical corner posts 9 interconnected by cross bars 10 welded or otherwise secured thereto.

Desirably guides 11 are provided at the top and bottom of each section, the bottom guides being attached outside and the top guides being attached on the inside of each section there being only top guides on the base section 8 and bottom guides on the top section 5. The guides 11 stabilize and maintain alignment of the sections. To elevate the sections a cable and pulley system is provided. The lifting power is provided by a hand operated winch 12 secured to and having its rotatable drum 13 mounted in suitable bearings. To guard against accidental lowering of the sections a pawl and ratchet mechanism 14 is provided.

A supply of cable 15 preferably of the stranded metal type is received in grooves on the drum periphery. In Fig. 1, the mast is shown extended and most of the lifting cable wound upon the drum. Another section of cable is supplied which extends from the drum to the base of the uppermost section 5 and functions in a manner to be described.

The lifting cable 15 is continuous and passes from the drum to a pulley 16 secured to the upper end of the base section 8. The cable then proceeds downward to a pulley 17 at the bottom of the section 7 and thence upward to a pulley 18 at the top of the section 6; thence downward to a pulley 19 at the base of section 7 and thence upward to a pulley 20 at the top of section 6 and from there downward and is anchored to the bottom of section 5. Suitable guy wire attaching means are provided at the top of each mast section. As shown such means are heavy wire loops 21 welded to the corner posts.

In their extended position the mast sections are locked together by a novel interlocking mechanism shown best in Figs. 2 and 3. The interlocks are successively actuated into locking position by the sections as they become extended.

Each interlock mechanism comprises a bolt actuating lever 22 having a bolt 23 pivoted thereto. The levers are of special construction and are fulcrumed at their lower ends upon a fixed pivot adjacent the lower end of each section 6 and 7. The bolt 23 is pivoted in a vertically elongated hole 24 to the upper end of the lever 22. As will appear hereinafter the bolt moves in a substantially straight horizontal path. The elongated hole thus provides the necessary freedom of movement therefor as the bolt is moved into and out of locking position by the lever 22.

The lever has projecting laterally therefrom a pair of arms, an upper arm 25 and a lower arm 26. These arms coact with actuating bars 27 secured to the bottom end of

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sections 5 and 6 of the mast to provide sequential operation of the mast sections in a manner to be described. The bolt member slides horizontally in an aperture 23 formed in a cross member 29. The latter is rigidly secured to the mast section.

The function of the bolt members 23 is to move into apertures 30 in tracks 31 rigidly secured to and extending vertically throughout substantially the full length of movable sections 5, 6, 7 and base section 8.

The tracks 31 receive the thrust of the bolt 23 which rides thereon as the sections are given relative motion and as each section reaches its extended position the bolt is thrust into the aperture 30 to interlock the two sections. The thrust of the bolt is obtained from two sources. Springs 32 on the lever pivots 33 have one end anchored and their other end bearing at 34 upon the lever. The springs 32 act to prevent disengagement due to vibration, swaying of mast, force of winds and temperature variations. The second source of thrust arises from the lifting tension in the cable during their extension. This thrust results from engagement of the bars 27 under the arm 25 of lever 22 tending to impart clockwise rotation thereto as shown in Fig. 2.

If desired an anti-friction roll 35 may be rotatably mounted in the outer end of bolt 23. The arm 26 is engaged by the bar 27 in its downward travel and acts to withdraw the bolts 23 from the aperture 30 in the track 31 sequentially as the sections are retracted. A more complete description of the operation of the invention will appear hereinafter.

As above suggested means may be provided for positively retracting the mast sections, it will be noted that the winch drum 13 carries not only the lift cable 15 but also another cable section 36 which may be a continuation of the cable 15. At the junction of the two cable sections a clamp is provided to prevent slippage of the cable upon the drum. It will be apparent that when the sections are extended the cable 15 is wound up upon the drum and the cable 36 is unwound therefrom and the reverse takes place when the sections are retracted.

The upper end of the cable 36 is attached to the horizontal arm of a bell crank lever 38 pivoted upon the lower end of the section 5. The vertical arm of the lever has pivoted thereon a bolt 39 which acts to interlock sections 5 and 6 by penetrating an opening 30 in the track 31 in the same manner as the bolts 23 interlock the other mast sections. The bell crank is rotated clockwise by a spring 40 upon the bell crank pivot 41 having one end anchored and its other end engaging the vertical arm of the bell crank. The spring 40 has the same functions as the spring 32 and in addition it must overcome the weight of the retracting cable 36 and must be sufficiently powerful to insure unassisted projection of the bolt 39 into its locked position.

The inward travel of the bolts 23 and 39 is limited by stop members 42 which may be in the form of loops welded to the cross member which supports and guides the bolts. The stop members act to prevent the bolts from coming out of their guiding apertures 28. At each of the apertures 30 in the track 31 an additional rigid cross bar 43 is welded to the corner post of the mast sections and the track. The aperture 30 is extended through these cross members to provide rigid elongated guidance and support for bolts 23 and 39.

It may be found desirable to provide a directional pulley 44 for the retracting cable section 36. This pulley is positioned to locate the cable where it will not interfere with other elements of the mast assembly.

The interlocking mechanism actuating bar 27 may be held in actuating position in any suitable manner. As shown in the drawings, it is secured by welding or other means to a tripod support 45 extending downward from the bottom of sections 5 and 6.

The operation of the device is as follows: The assembled mast with its sections retracted is transported to the

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point of erection and the base section is raised to its vertical position and desirably supported by guy wires fastened to the loops 21. At this time, the bolts 23 and 39 are withdrawn from engagement with the tracks 31 but the sections are interlocked by another means. It will be noted by reference to Fig. 2 that the bars 27 are at this time locked between the arms 25 and 26 on the levers 22. It is also apparent that movement of the levers 22 is prevented by engagement of the rolls with the track. The sections 5, 6 and 7 at this time therefore cannot be extended. When tension is applied to the lifting cable 15 by rotation of the winch the three sections 5, 6 and 7 are raised simultaneously. When section 7 carrying the others reaches its full extension its bolt 23 registers with and enters an aperture 30 in the track thus locking section 7 to the base section 8.

Rotation of the lever 22 on section 7 has however caused the arm 25 to move away from the bar 27 thus unlocking sections 6 and 7. Further rotation of the winch now elevates the remaining sections until section 6 is fully extended at which time its bolt enters an aperture 30 in the track to thus lock sections 6 and 7 and also to unlock section 5 from section 6; section 5 is then raised and locked by the bolt 39 and bell crank 38.

After each section is raised guy wires attached to loops 21 are secured to the ground. Thus the mast is adequately supported at all times during its erection and when completely erected is effectively stabilized.

To retract the mast the rotation of the winch is reversed. By such action the retracting cable 36 through the action of the bell crank 38 withdraws its bolt 39 from the track and section 5 moves downward. As this section nears its full retraction its bar 27 engages the lower arm 26 of the lever 22 pivoted on section 6. The arm 25 is at this time out of the path of the bar. Thus the lever 22 is rotated counterclockwise to withdraw its bolt and unlock sections 6 and 7. The same action takes place as the sections descend to unlock section 7 from the base section 8. Continued rotation of the winch completes retraction of the sections. The use of the cable 36 provides positive retraction of the mast. However, the weight of the sections may be relied upon to telescope the mast sections.

It should be pointed out that while the invention has been described in connection with a telescoping mast the interlocking mechanism may be applied equally well to many other devices such as extensible platforms, ladder sections and the like wherein a series of relatively movable elements may be sequentially interlocked and subsequently sequentially unlocked.

What is claimed is:

1. An extensible structure comprising a plurality of sections, interlock mechanisms for interconnecting said sections comprising an actuator bar rigid with one section and presenting oppositely disposed upper and lower locking edges, a bolt on the adjacent section having pivoted bolt actuating means, a pair of arms on said bolt actuator positioned to be engaged by said actuator bar to move said bolt into locked and unlocked position respectively by the final travel of the sections in retraction and by the final travel of the sections in extension, said arms moving into position embracing said bar when the sections are fully retracted, an interlocking recess in one section into which the bolt on the adjacent section is received, and means to impart relative movement between the sections.

2. An extensible structure according to claim 1 and a spring tending to move said bolt actuating means into locking position.

3. An extensible structure according to claim 1 and a track secured to the structure sections upon which the end of said bolt rides during the extension of the sections.

4. An extensible structure according to claim 3 and an anti-friction roll in the end of said bolt engaging said track.

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5. An extensible structure comprising a plurality of sections, interlock mechanisms for interconnecting said sections comprising a lever pivoted near an extremity of a section, a bolt connected to and movable by said lever into locking and unlocking position, an actuator bar rigidly secured to the end of the adjacent structure section, a pair of arms rigid with and projecting laterally from said lever, one of said arms extending into the path of said actuator at all times where during unlocking movement of the sections it is engaged by said actuator to swing said lever in the direction to withdraw said bolt into unlocked position, said other arm being positioned on the lever to be moved into the path of said actuator by such unlocking action whereupon extension of the sections it is engaged by said bar, a track secured lengthwise of the sections in position to engage and prevent movement of said bolt during the extension of the sections and a locking recess in said track into which said bolt is thrust when the sections are fully extended.

6. An extensible structure according to claim 5 and a spring tending to move said bolt into locked position.

7. An extensible structure comprising a plurality of sections, interlock mechanisms for interconnecting said sections comprising a lever pivoted near an extremity of a section, a bolt secured to said lever and actuated by movement of the lever into locking and unlocking position, a pair of spaced arms extending from said lever one above the other, an actuating bar secured to the adjacent structure section in a position below its lower end to engage the lowest of said arms when the sections are wholly retracted whereby the lever is rotated to withdraw said bolt from locked position, a stop to prevent movement of the lever beyond unlocked position, said upper arm being moved by such unlocking movement into position in the path of and above said actuator bar thus acting with said lower arm to embrace said actuator bar, a track secured lengthwise upon the adjacent section in position to engage the end of said bolt and prevent movement of the lever

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during extension of the sections thus the sections become locked in retracted position and an interlocking recess in said track positioned to register with said bolt when the sections are extended, thus to permit the bolt to lock the sections in extended position and manual means to unlock the top section from the next adjacent section.

8. A multisection telescoping structure including interlocking mechanisms for locking adjacent sections in extended position, the interlock mechanisms for the lower sections comprising an actuator bar rigidly secured to the sections and a bolt on said sections having a pivoted bolt actuator coacting with said actuator bars on adjacent sections to lock and unlock the sections thru the action of said bolts, locking recesses on said sections within which said bolts are received as the sections are extended in sequence and means on said bolt actuators engaged by said bars as the sections are retracted acting to withdraw said bolts from said recesses in sequence, latching means on said bolt actuators acting when the bolts are withdrawn to interlock the retracted sections by interlocking said actuator bars to said bolt actuators, an interlock mechanism to interlock the top section to the next lower section comprising a lever pivoted on said top section, a bolt connected to and actuated by said lever to move said bolt into and out of locking position, a locking recess in the said next lower section into which said bolt is received, a spring acting to move said bolt into locking position, a lanyard connected to said lever operable manually to unlock the top and next lower sections and to positively extend and retract said sections.

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