Jan. 30, 1968 L. C. CERNOSEK 3,366,407

PORTABLE MAST

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Fig. 1

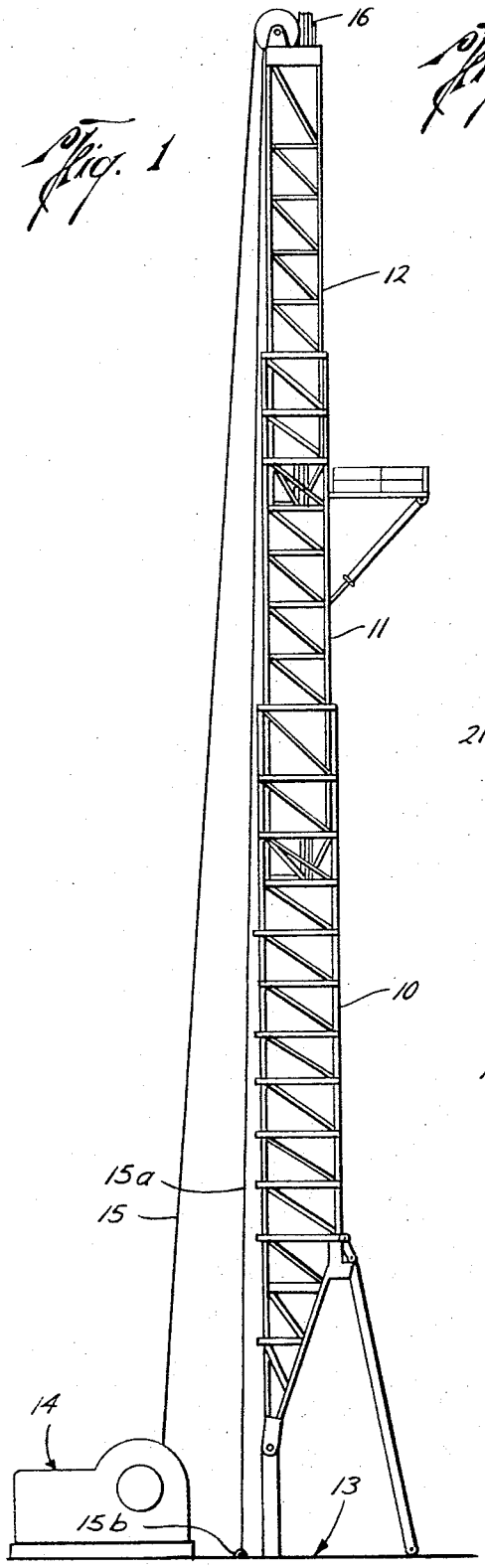
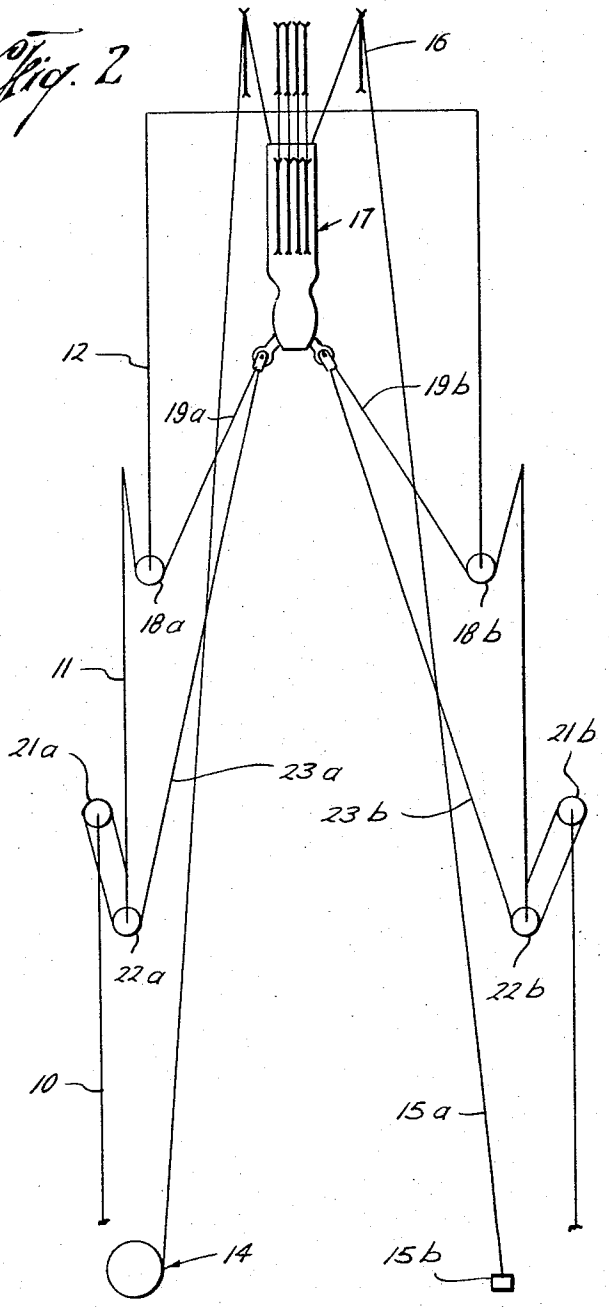


Fig. 2



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Fig. 3

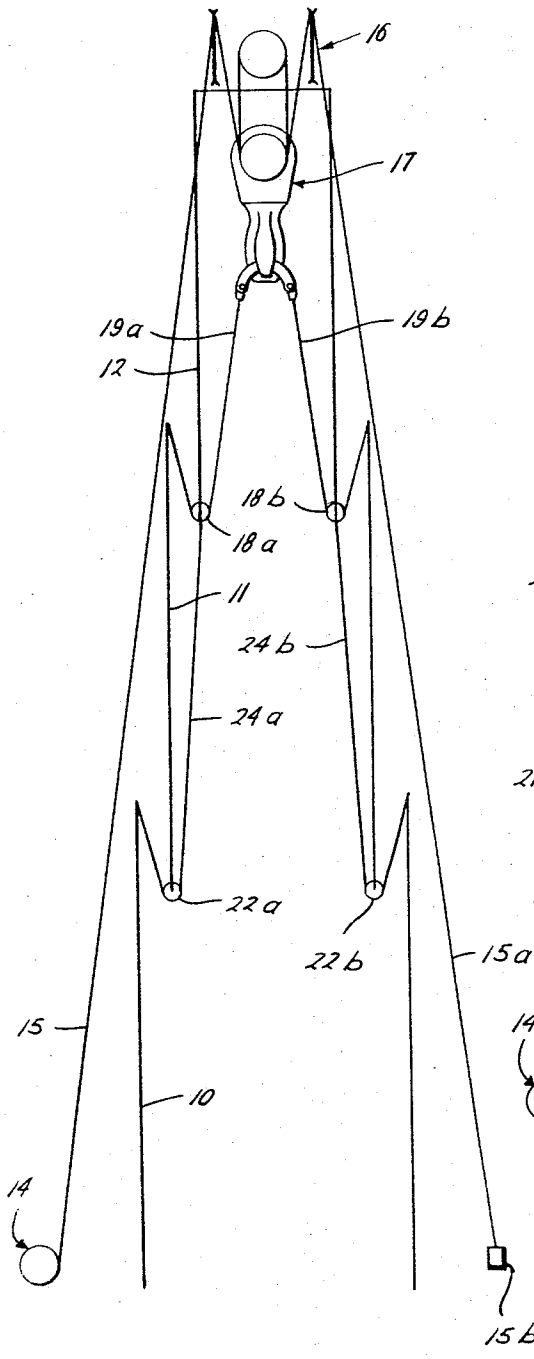
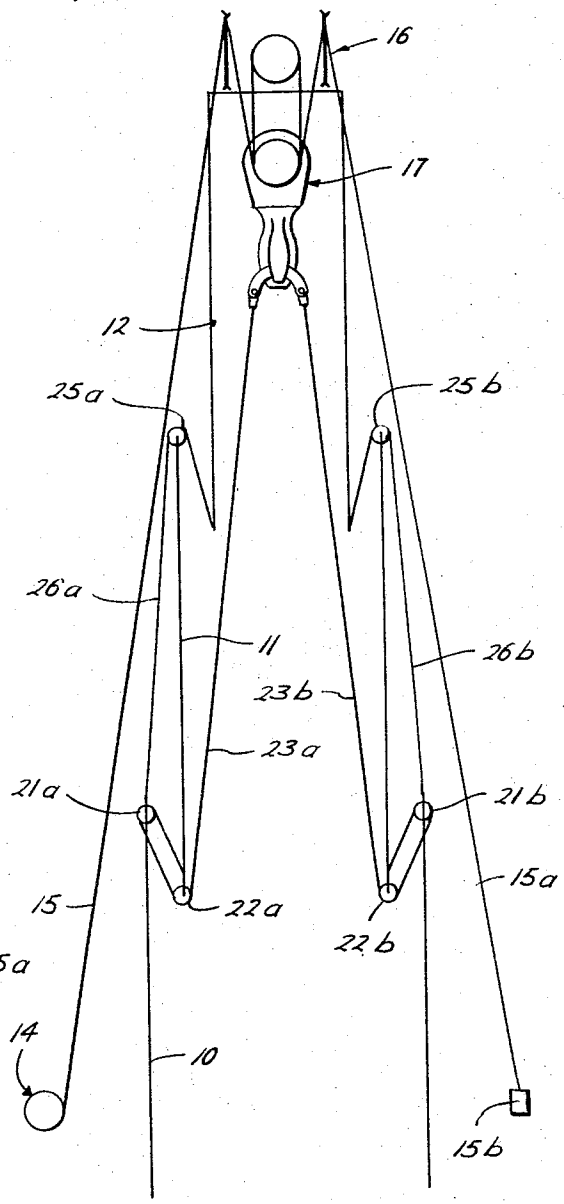


Fig. 4



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Fig. 5A

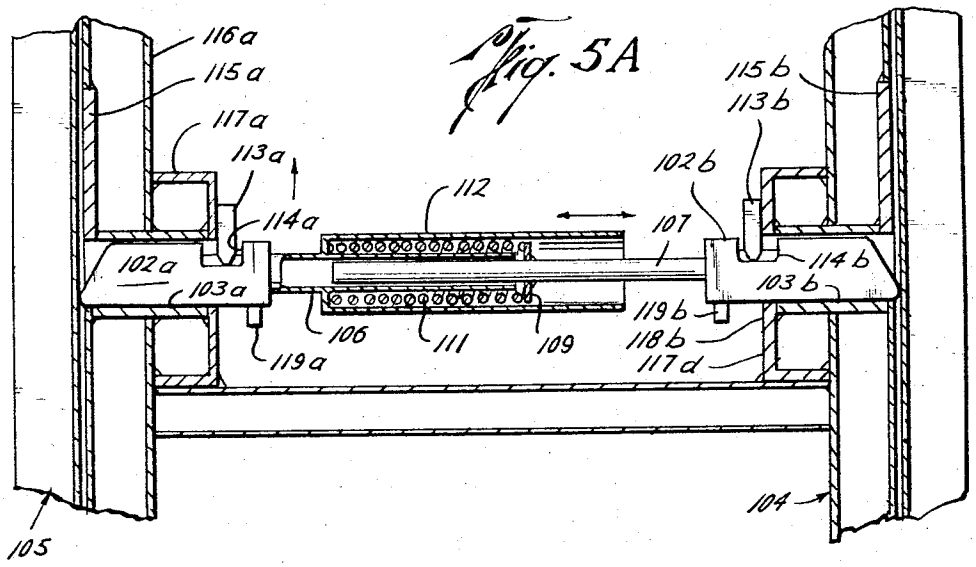
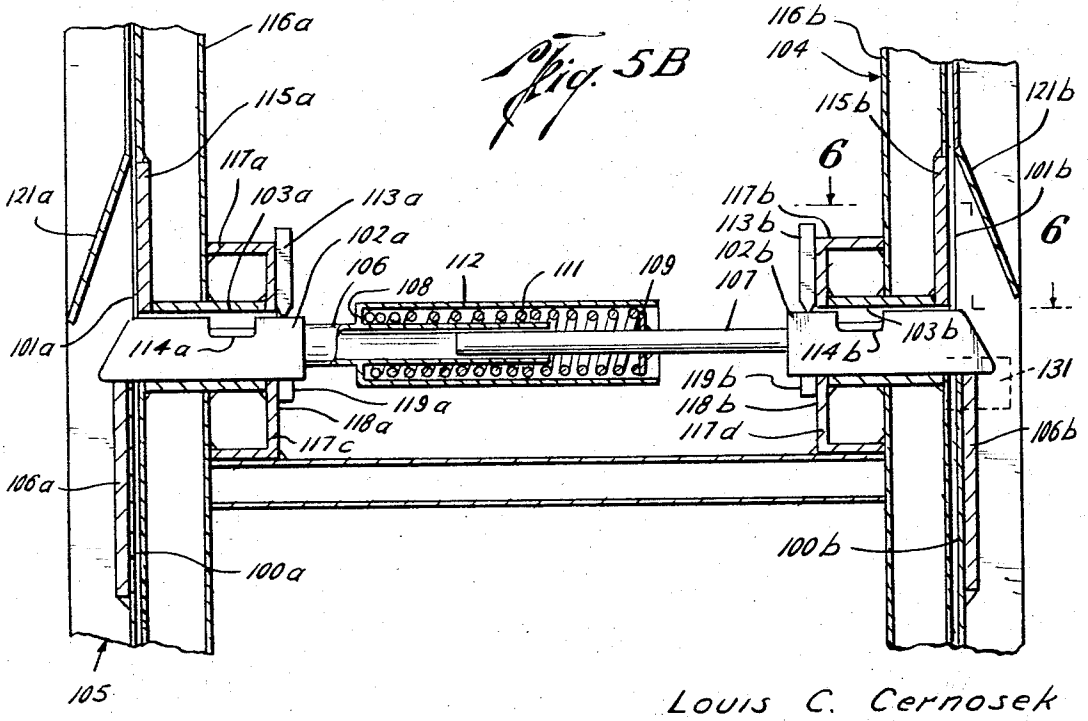


Fig. 5B



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Fig. 5C

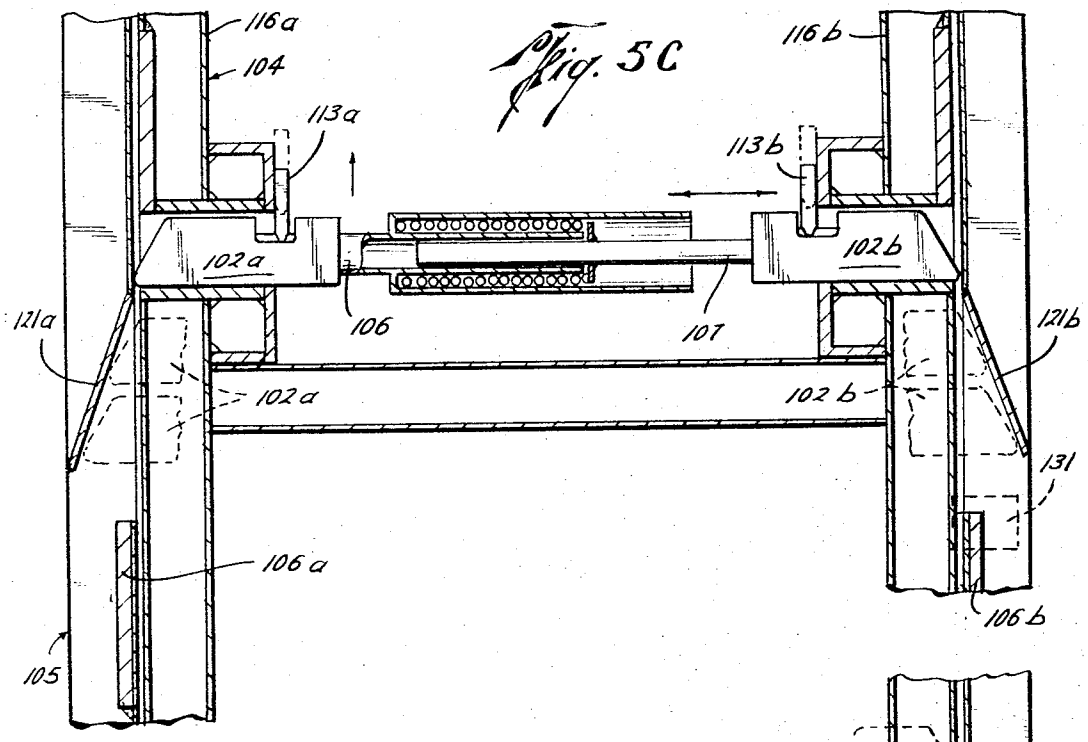
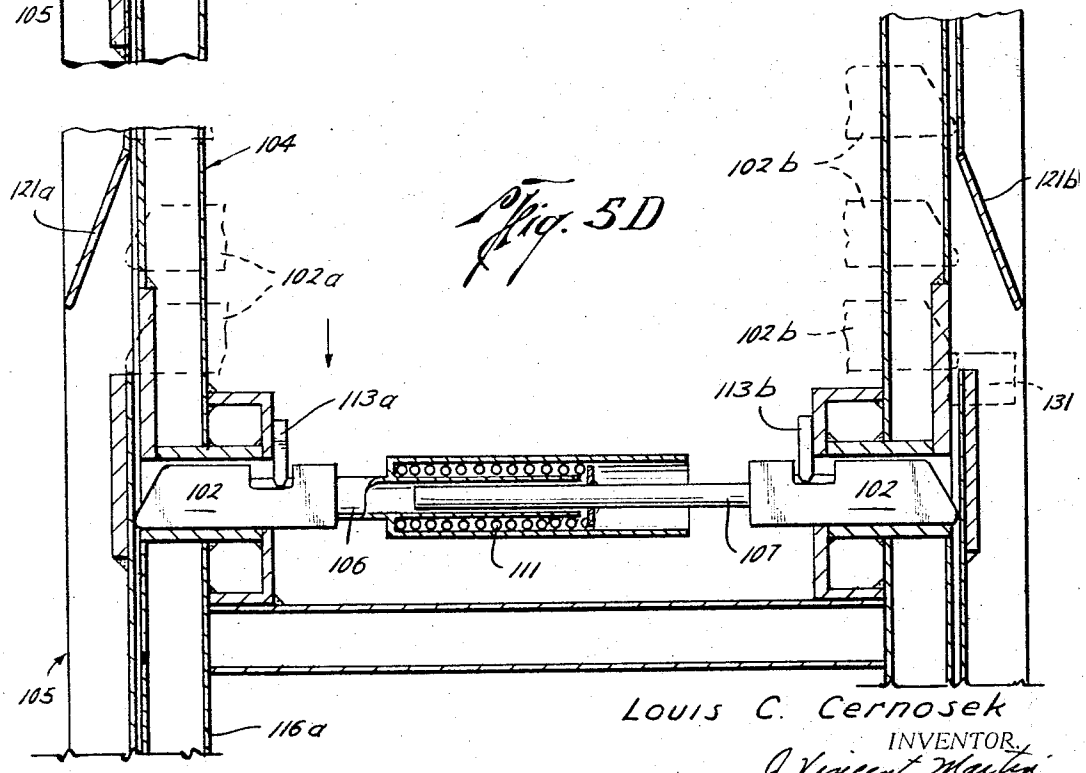


Fig. 5D



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Fig. 6

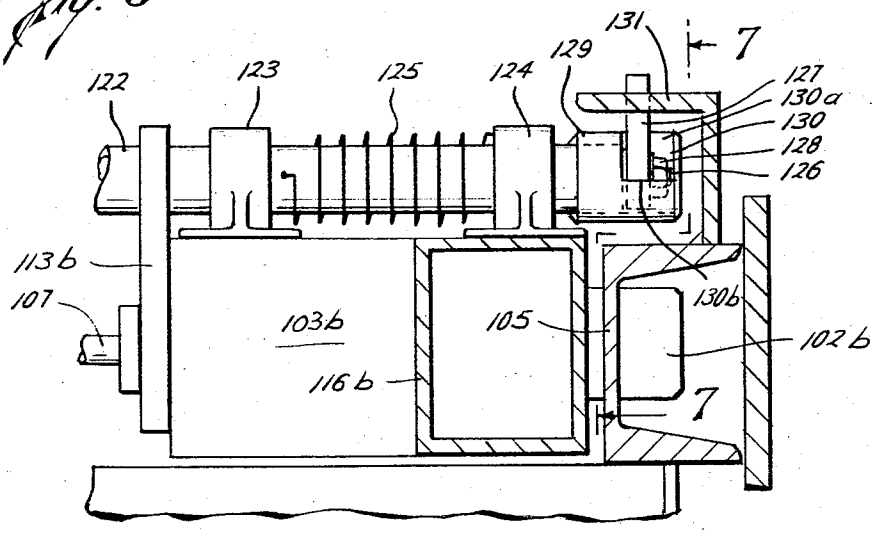


Fig. 7

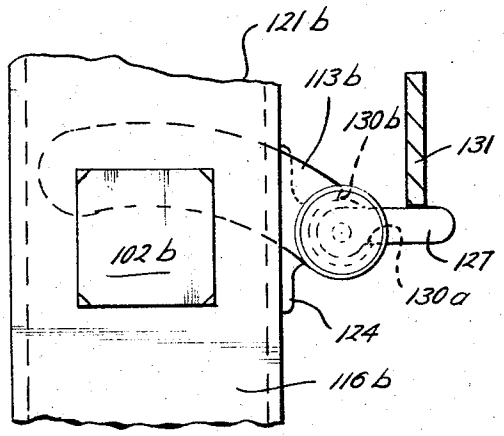
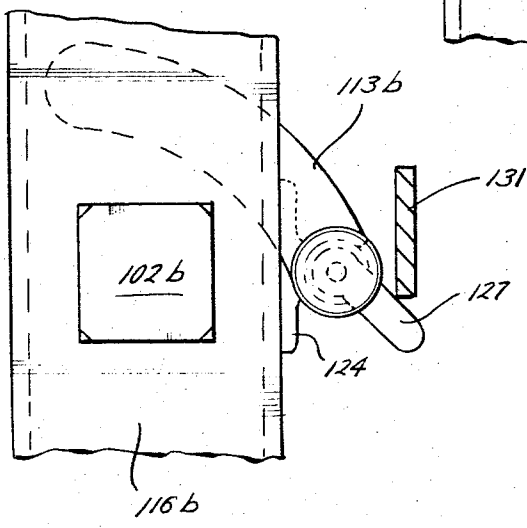


Fig. 8



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3,366,407

PORTABLE MAST

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7 Claims. (Cl. 287—58)

ABSTRACT OF THE DISCLOSURE

This patent discloses a telescoping mast of three sections in which the mast may be raised and lowered by raising and lowering the traveling block relative to the crown block. The intermediate and upper telescoping sections are raised simultaneously. Three different bridle arrangements are shown. In one instance, separate lines are provided for each mast section. In the other two forms of invention, the raising line is tied in one case to the upper section and in the other case to the intermediate section. There is also shown a latch system which automatically latches upon a moving section being moved up to latched position. Upon further upward movement the latch is moved into inoperative position and held in inoperative position during downward movement of the movable section.

This invention relates to drilling rigs. In one aspect, it relates to a system for raising and lowering a triple-section mast. In another aspect, it relates to a latch system for latching sections of a telescoping mast together.

Triple-section masts have been used in the past. However, there has not been available a simple, inexpensive system for raising simultaneously the intermediate and upper section of the mast with upward movement of the traveling block.

It is an object of this invention to provide a system for raising and lowering a triple-section mast with raising and lowering of the traveling block.

Another object is to provide a system for raising and lowering a triple-section mast with raising and lowering movement of the traveling block with the intermediate and upper sections raised simultaneously.

Another object is to provide a system of raising a triple-section mast with a single upward pass of the traveling block, and for lowering such triple-section mast with a single lowering pass of the traveling block.

Telescoping masts are latched together in extended position. Many different types of latch systems have been proposed in the past. These have conventionally required actuation of the latch system by a member of the crew up in the mast, or manipulation of remote control apparatus by workmen at the base of the mast. These prior art systems have required precautionary measures to prevent accidental unlatching, and danger is always present where a workman is required in the derrick structure while it is being raised or lowered and latched into place.

Another object of this invention is to provide an automatic latch means for a telescoping mast.

Another object is to provide a latch means for a telescoping mast in which the latch means automatically actuates on raising of the mast to latch position and automatically deactuates upon raising of the mast beyond the latch position to permit lowering of the mast.

Other objects, features and advantages of this invention will be apparent from the drawings, the specification and the claims.

In the drawings, wherein illustrative embodiments of this invention are shown, and wherein like reference numerals refer to like parts:

FIGURE 1 is a side elevational view of a triple-section mast;

FIGURE 2 is a diagrammatic view of a triple-section mast illustrating a raising system for the mast;

FIGURE 3 is a diagrammatic view illustrating another system for raising the triple-section mast;

FIGURE 4 is a diagrammatic illustration of still another form of mast-raising system;

FIGURES 5A, B, C and D are views partly in cross-section and partly in elevation of the securing system of this invention for securing mast sections together, and showing in FIGURE 5A one of the movable mast sections moving upwardly; in FIGURE 5B the mast sections being secured together against downward movement of the movable section; in FIGURE 5C the securing means being retracted by raising of the movable mast section; and in 5D the lowering of the movable mast section with the securing means in retracted position;

FIGURE 6 is a bird's-eye view partially in elevation and partially in cross-section of a portion of the securing means taken along the line **6—6** of FIGURE 5B;

FIGURE 7 is a fragmentary view taken along the line **7—7** of FIGURE 6; and,

FIGURE 8 is a view similar to FIGURE 7 and illustrating the manner in which the securing system is released by raising of the movable mast section.

The triple-section drilling mast illustrated in FIGURE 1 includes the lower section **10**, the intermediate mast section **11**, and the upper mast section **12**. The mast is mounted on a suitable base indicated generally at **13**. A drawworks indicated generally at **14** is provided for paying out and taking in the line **15** which extends up to the crown block **16**. In the conventional manner, the line **15** is trained over several sheaves of the crown block **16** and a traveling block such as traveling block **17** shown in FIGURE 2. The dead line or free end **15***a* of line **15** is secured to the structure **13** as at **15***b*.

By this invention there is provided a raising and lowering system for extending and collapsing the mast with a single pass of the traveling block, that is, a single raising or a single lowering of the traveling block. As there are two movable sections, the upper section must be moved a greater distance than the intermediate section, and provision is made for accomplishing this by raising the upper section at a greater rate.

One form of raising and lowering system is shown in FIGURE 2. In this system, a pair of sheaves **18***a* and **18***b* are mounted on the lower end of the upper mast section **12**. A pair of cables **19***a* and **19***b* extend from the traveling block **17** and are anchored to the upper end of the intermediate mast section **11**. These cables **19***a* and **19***b* are trained over sheaves **18***a* and **18***b*, respectively. Thus, upon upward movement of the traveling block relative to the intermediate mast section **11**, the upper mast section **12** will be moved upwardly relative to the intermediate mast section **11**.

Sheaves **21***a* and **21***b* are mounted on the upper end of lower mast section **10**, and sheaves **22***a* and **22***b* are mounted on the lower end of intermediate mast section **11**. Cables **23***a* and **23***b* are secured to the traveling block **17** and to the lower end of the intermediate mast section **11**. Cable **23***a* is trained over sheaves **21***a* and **22***a*. Cable **23***b* is trained over sheaves **21***b* and **22***b*. It will be appreciated that the use of the double sheaves between the lower and intermediate mast sections will result in slower movement of the intermediate mast section relative to movement of the upper mast section **12** upon upward movement of the traveling block **17**. Where the intermediate and upper mast sections are of substantially equal length such that the upper mast section will travel twice as far as the intermediate mast section, the ratio of movement of the upper mast section to the intermediate mast section is, of course, two to one. With this system, raising of the traveling block **17** to the top of the mast

will of course result in full extension of the entire mast. Of course, the several cables should be such that they begin raising the movable sections as the traveling block **17** is raised from its lowermost position.

Referring now to FIGURE 3, a modified form of raising system is illustrated. This raising system is substantially similar to that shown in FIGURE 2 except that the sheaves **21***a* and **21***b* are omitted and cables **24***a* and **24***b* are substituted for the cables **23***a* and **23***b* of FIGURE 2. These cables **24***a* and **24***b* are connected to the upper end of the lower mast section **10** and the lower end of the upper mast section **12** and trained over the sheaves **22***a* and **22***b*, respectively. Thus, as the upper section is raised by upward movement of the traveling block **17**, the intermediate mast section **11** is raised. Due to the fact that the intermediate section is raised by movement of the upper section, the rate of movement of the upper mast section **12** is, of course, greater than the rate of movement of the intermediate mast section **11**.

In FIGURE 4 still another mast-raising system is shown. In this system, the raising of the intermediate mast section is identical to the system for raising the intermediate mast section shown in FIGURE 2. The method of raising the upper mast section **12** differs. At the upper end of the intermediate mast section **11**, sheaves **25***a* and **25***b* are provided. Cables **26***a* and **26***b* are attached to the lower end of the upper section **12** and to the upper end of the lower section **10** and trained over the sheaves **25***a* and **25***b*, respectively. Thus, as the intermediate section **11** is raised by upward movement of the traveling block **17**, the upper mast section **12** is raised. Again the rate of movement of the upper mast section **12** is, of course, greater than the rate of movement of the intermediate mast section **11**.

In all three systems for raising and lowering the mast, balance is obtained by a symmetrical arrangement in which the several raising cables are effective on opposite sides of the movable sections of the mast. Of course, this system need not be necessarily employed, and other sheave and cable arrangements which follow the concept of this invention could be utilized. However, the use of the symmetrical systems with the sheaves located on opposite sides of the mast is preferred to avoid imparting to the mast any components of force other than in the vertical direction.

Reference is now made to FIGURES 5 through 8 wherein the means for securing sections of the telescoping mast together is illustrated. While it will be apparent that the relationship of elements could be reversed, the illustrated embodiment shows the movable parts of the securing system in the upper mast section and the fixed parts of the system in the lower mast section. The system would be used to secure the lower to the intermediate mast section of FIGURE 1, and also the intermediate to the upper mast section of FIGURE 1. Of course, it could be used to secure together a mast having only a single movable section. In the explanation to follow, the mast sections will be referred to as upper and lower, but they could of course be the lower and intermediate, or intermediate and upper sections of the mast shown in FIGURE 1.

Means are provided in the system for locking the upper mast section against downward movement relative to the lower mast section. Preferably, the lower mast section has a pair of confronting faces **100***a* and **100***b*. These confronting faces have slots **101***a* and **101***b* therein. A pair of latch blocks **102***a* and **102***b* are carried in suitable guideways **103***a* and **103***b* in the upper mast section **104**. These latch blocks extend out into the slots **101***a* and **101***b*. The lower mast section **105** includes the reinforced plates **106***a* and **106***b* which have their upper extremities at the lower ends of slots **101***a* and **101***b*, respectively, and provide a supporting surface for the latch blocks **102***a* and **102***b*. Thus, when the latch blocks are extended, the weight of the upper mast section is supported on the lower mast section through the latch blocks.

The latch blocks **102***a* and **102***b* are constantly urged away from each other and into said slots **101***a* and **101***b*. Thus, when freed from the mechanism to be hereinafter explained, they automatically will extend into the slots **101***a* and **101***b* when in register therewith.

Any suitable means may be employed for urging the latch blocks away from each other. In the illustrated embodiment, the latch block **102***a* is provided with a tubular shank **106**. The latch block **102***b* is provided with a cylindrical shank member **107** which is smaller in diameter than the inner diameter of the tubular shank **106** and telescopes therein. The shank **106** has an abutment surface **108**. The shank **107** has a confronting abutment surface **109**. A spring **111** is positioned about the two shanks and in compression between the two abutment surfaces to thus urge the two latch blocks away from each other. If desired, a suitable cover for the spring may be provided by a cylindrical cover member **112**. This cover member is preferably carried by the shank **106** and is secured to the abutment plate **108**.

With the exception of the time when the latch blocks are in the mast-supporting position shown in FIGURE 5B, lock members **113***a* and **113***b* are positioned in slots **114***a* and **114***b*, respectively, in the latch blocks **102***a* and **102***b*. As will be explained hereinbelow, suitable mechanism is provided which will automatically lift the lock members from the locking slots and permit automatic extension of the latch members when the latch members are opposite the slots in the lower mast section.

The structure of the upper mast section in the vicinity of the latch blocks is reinforced to support the upper mast section on the lower mast section through the latch blocks. Preferably, a pair of thick plates **115***a* and **115***b* are provided in the box sections **116***a* and **116***b*, respectively, which form a pair of the vertical components of the upper mast section. These plates are substantially thicker than the wall section of the box member. The guides **103***a* and **103***b* for the latch blocks are provided by box sections of structural steel welded in the members **116***a* and **116***b*. Additional support is provided for the guideways by welding the several angle irons **117***a* and **117***b* to the guideways and the supporting mast members above the guideways. Similarly, angle iron sections **117***c* and **117***d* are welded to the guideways and the supporting structure at positions below the guideways. These lower angle irons and the lower portions of the guideways **103***a* and **103***b* provide surfaces **118***a* and **118***b* against which stops **119***a* and **119***b* carried by the latch blocks **114***a* and **114***b*, respectively, may strike to limit outward movement of the latch blocks.

From the above explanation, it will be apparent that when the upper section is being raised as illustrated in FIGURE 5A, the lock members are in their slots and the latch blocks are held against outward movement. It is also preferred that the confronting surfaces **101***a* and **101***b* be imperforate surfaces so that the latch blocks may slide against these surfaces as shown in FIGURE 5A, but this is not necessary. As the upper section reaches a position where the latch blocks are in register with the slots in the lower section, the lock members **113***a* and **113***b* are raised to release the latch blocks, and these blocks project into the slots **101***a* and **101***b* to support the upper mast section.

Means are provided for retracting the latch blocks upon upward movement of the upper mast section. This means is preferably provided by retractor plates **121***a* and **121***b* carried by the lower mast section **105**. These retractor plates are positioned in register with the slots **101***a* and **101***b* and diverge outwardly and downwardly from the surfaces **100***a* and **100***b*, respectively. As shown in FIGURE 5C, upward movement of the upper mast section will result in contact of the latch blocks with the retractor plates. As the plates converge in an upward

direction, they provide inclined surfaces which force the latch blocks to their retracted position as shown in FIGURE 5C. When the latch blocks reach their retracted position, the lock members **113***a* and **113***b* drop into the slots **114***a* and **114***b*, respectively, to retain the latch blocks in retracted position and permit lowering of the upper mast section past the slots **101***a* and **101***b* as shown in FIGURE 5D.

Reference is now made to FIGURES 6 through 8 wherein the control system for the lock members is illustrated. This system includes a trip system for raising the lock members when the latch blocks are in register with the slots which is effective upon upward movement of the upper mast section and is ineffective upon downward movement of the upper mast section.

The latch members **113***a* and **113***b* are nonrotatably mounted on an actuator arm **122**. This arm is mounted on the guideway **103***b* by suitable journal members **123** and **124**. An identical journal member is journalled about the other end of the arm and is mounted on the guideway **103***a*. This journal is not shown. Means are provided for urging the actuator arm in a direction to place the lock members in their slots in the latch blocks. This means may be provided by spring **125** on the actuator arm **122**. The actuator arm has in its end a threaded stud **126**. Rotatably mounted on this stud is a trip arm **127**. The trip arm is held on the stud by nut **128**. Surrounding the stud **126** and suitably secured to the trip arm as by welding is a sleeve **129**. This sleeve has a slot **130** therein which when viewed along the rotational axis of the actuator arm **122** extends for approximately 90°. The slot terminates in a surface **130***a* which extends laterally of the mast. This surface preferably extends horizontally. The other terminus **130***b* of the slot extends longitudinally of the mast and preferably in a vertical plane. Thus, the trip arm is free to move between the two surfaces **130***a* and **130***b*. It will be noted from FIGURE 7 that the dimension of the trip arm is such that limited rotation is permitted within the confines of these two surfaces **130***a* and **130***b*. This system provides a one-way lost motion connection between the actuator arm and the trip arm.

Means for actuating the trip arm on upward movement of the upper section is provided by a trip member **131**. This trip member is mounted on the lower mast **105** and lies in the path of the trip arm when the arm is extended horizontally as illustrated in FIGURE 7. Upon continued upward movement of the upper section, the trip arm is actuated by the trip member and rotates the actuator to raise the lock members **113***a* and **113***b* and release the latch blocks to permit the latch blocks to extend and engage the lower mast section. This is illustrated in FIGURE 8. During the time that the retractor plates are urging the latch blocks to retracted position upon raising of the upper mast section from the securing position, the trip arm moves upwardly past the trip member. Once it disengages the trip member, the spring **125** rotates the actuator arm counter-clockwise as viewed in FIGURE 7 to return the lock member to the position shown in FIGURE 7. It will be noted that the trip arm extends horizontally in this position. However, the trip arm will be above the trip member instead of below as shown in FIGURE 7. Then, upon downward movement of the upper mast section the trip arm is free to rotate counterclockwise within the slot **130** and past the trip member **131**.

The operation of the securing system is illustrated sequentially in FIGURES 5A through 5D. In FIGURE 5A the upper mast section is shown moving upwardly with the latch blocks **102***a* and **102***b* in retracted position. The lock members **113***a* and **113***b* are in engaged position and the latch blocks are running against the confronting surfaces **100***a* and **100***b* of the lower mast section. As the latch blocks approach the slots **101***a* and **101***b*, the trip arm **127** engages the trip member **131**. The trip arm is in engagement with surface **130***a* and therefore continued upward movement results in rotation of the actuator arm **122** to raise the lock members **113***a* and **113***b* to the positions shown in FIGURE 5B. When these lock members are raised and the latch blocks reach a position of register with the slots **101***a* and **101***b* in the lower mast section, they are extended by spring **111** to the position shown in FIGURE 5B. This is the normal operational position of the mast. It will be noted that the sole action necessary to engage the securing means is merely the raising of the upper mast section to the securing position.

When it is desired to lower the mast, the upper mast section **104** is raised from the securing position. As is moves upwardly, the retractor plates **121***a* and **121***b* are engaged by the latch blocks and effect retraction of the latch blocks as illustrated in FIGURE 5C. While the latch blocks are retracting, the trip arm **127** moves above the trip member **131**, and lock member **113***a* and **113***b* are returned to their locking position as shown in FIGURE 5C by spring **125**. This action prevents extension of the latch blocks into their slots upon subsequent lowering of the upper mast section. During the locking action, the lost motion connection between the trip arm and the actuator arm permits the trip arm to rotate relative to the actuator arm and pass the trip members.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A drilling mast comprising:
a lower mast section,
an intermediate mast section telescoped with the lower mast section,
an upper mast section telescoped with said intermediate mast section,
said mast sections in nonrotating telescoping relationship with each other,
and securing means responsive to raising said intermediate and upper sections to selected positions for automatically latching said three sections together and preventing downward movement of the upper and intermediate sections and responsive to further raising movement of the intermediate and upper sections to render said securing means inoperative and permitting lowering of said intermediate and upper sections.

2. A drilling mast comprising:
a lower mast section,
an upper mast section telescoped with said lower mast section,
one of said sections having support means,
latch block means carried by said other section and mounted for movement laterally of the mast from a retracted position to an extended position for engaging said support means,
means urging said latch block means toward extended position,
retractor plate means on said one section moving said latch block means from extended to retracted position with upward movement of one of said latch block means and said retractor plate means past the other,
and lock means carried by said upper and lower mast sections selectively locking said latch block means in retracted position during downward movement of one of said latch block means and said support means past the other and unlocking said latch block means and permitting extension thereof during upward movement of one of said latch block means and said support means past the other.

3. A drilling mast comprising:
a lower mast section,
an upper mast section telescoped with said lower mast section,
support means on said lower section,
latch black means carried by said upper section and mounted for movement laterally of the mast from a retracted position to an extended position overlying said support means,
means urging said latch block means toward extended position,
retractor plate means on said lower section extending downwardly and away from said latch block means and moving said latch block means from extended to retracted position with upward movement of said latch block means past said retractor plate means,
and lock means carried by said upper and lower mast sections selectively locking said latch block means in retracted position during downward movement of said latch block means past said support means and unlocking said latch block means and permitting extension thereof during upward movement of said latch block means past said support means.

4. A drilling mast comprising:
a lower mast section,
an upper mast section telescoped with said lower mast section,
said lower section having spaced supports,
retractor plate means on said lower section above said supports extending downwardly and outwardly of said lower section,
latch blocks carried by said upper section and mounted for movement laterally of the mast from a retracted position inboard of said supports to an extended position overlying said supports,
means urging said blocks toward said extended position,
and lock means selectively controlling movement of said latch blocks,
said lock means including a trip member on said lower mast section and a one-way lost motion connection effective to release said latch blocks upon upward movement of said upper section and to permit said lock means to hold said latch blocks in retracted position as they move downwardly past said supports.

5. A drilling mast comprising:
a lower mast section,
an upper mast section telescoped with said lower section,
said lower section having spaced parallel confronting surfaces,
said surfaces having vertically extending slots therein,
latch blocks carried by said upper section mounted for movement laterally and in opposite directions toward said surfaces,
means urging said blocks away from each other and into said slots,
retractor plate means carried by said lower section and diverging outwardly and downwardly from said surfaces and in register with said slots for moving said latch blocks to retracted position,
lock members selectively engaging said latch blocks when they are in related position and holding them in retracted position,

means urging said lock members toward engaged position,
an actuator for moving said lock members to disengaged position,
a trip member on said lower section,
and a trip arm having a one-way lost motion connection with said actuator and engageable with said trip member on movement of the upper mast section,
said one-way lost motion connection operative on upward movement of the upper mast section to effect release of said lock member and on downward movement of the upper mast section permitting movement of the trip arm relative to the actuator to permit the trip arm to be actuated by the trip member without moving the actuator to permit the lock members to remain engaged.

6. In a telescoping mast,
an automatic latch for latching the upper and lower mast sections together in extended position comprising,
latch blocks for latching the two mast sections together,
retractor means on one mast section for retracting the latch blocks on raising of the upper mast section until the blocks pass the retractors,
lock membars for holding the latch blocks in retracted position,
and actuator means operative in response to upward movement of the upper mast section to a selected position to disengage the lock members from the latch blocks to permit the latch blocks to latch the two mast sections together,
said actuator means being inoperative during downward movement of the upper mast section.

7. A drilling mast comprising:
a lower mast section,
an upper mast section,
said mast sections in nonrotating telescoping relationship with each other,
and securing means responsive to raising said upper section to selected position for automatically latching said two sections together and preventing downward movement of the upper section and responsive to further raising movement of the upper section to render said securing means inoperative and permitting lowering of said upper section.

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