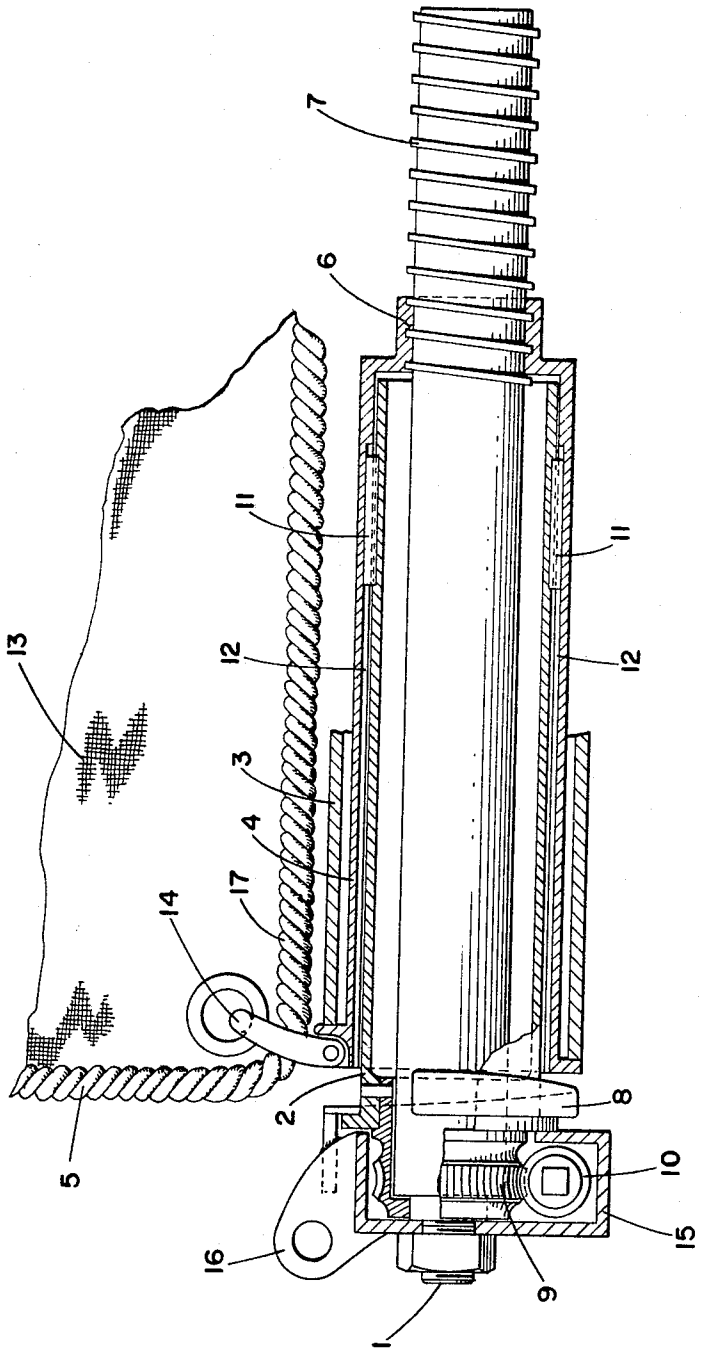
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DEVICE FOR EFFECTING A ROLLING REEF

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DEVICE FOR EFFECTING A ROLLING REEF

Sven O. Aulin, Djupadalsvagen 17, Lidingo, Sweden

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The present invention relates to reefing gear for making a rolling reef, and is of the type essentially consisting of a first part arranged to be attached to a ship's mast or standing rigging, and a second part arranged to be attached to a boom where the second part is capable of being coaxially rotated and locked against rotation in relation to the first part. The reefing device of the present invention is mainly characterized in that the second part is arranged to be attached to the boom and comprises at least two concentric and telescopically displaceable sleeves which by means of a key and key-way, splines or similar arrangements are locked against rotation in relation to each other while permitting relative axial movement therebetween. The outer sleeve is arranged to be rigidly and coaxially attached to the boom, preferably inside of the same, and the inner sleeve is arranged to project coaxially beyond the outer one on reefing, and thus serve as a take-roller for the boltrope of the sail.

Reefing devices have long been known which consist of one part which is principally an axle attached to the mast of the vessel in such a manner as to allow the axle to be swung horizontally and vertically, and another part journalled on the axle and rigidly attached to a boom. This latter part is thus capable of being rotated in relation to the former part, and is generally provided with means for locking it against rotation. On reefing, the boom is rotated, generally by means of a crank via a worm and worm wheel, at which the sail is wound on the boom. When a suitable part of the sail has thus been wound, the boom is locked against rotation. Generally, the locking is automatically accomplished by means of a worm and worm wheel which is self-locking.

These well known reefing devices make it possible to decrease or increase the sail area of the vessel at increasing and decreasing wind forces respectively. However, ever since its appearance, it has been well known to yachtsmen that the sail will belly too much after reefing, i.e., the bunt of the sail becomes too deep. The reason for this is partly because the natural bunt of the sail is displaced towards the top of the sail on reefing, and partly because the boltrope which is many times thicker than the sail will "steal" or take-in faster than the sail as it winds on the boom, whereby the natural bunt eventually will become very much enlarged or deepened. This is a serious drawback, for, apart from the fact that the sail acquires a less desirable or faulty contour, the vessel will, due to the increased bunt, become comparatively tender or "cranky" just when it should be comparatively stiff. Consequently, the vessel cannot be as effectively operated. Further contributing towards the increased bellying of the sail is the condition that the boltrope on winding will wind on the boom in rounds after each other in a direction away from the mast so that the lower part of the still-standing boltrope will be drawn away more and more from the mast. A further consequence of this is that it is difficult to prevent the sail from gathering into vertical wrinkles whereby its efficiency is still more decreased. Eventually, one is forced to wind the boltrope on top of the already wound rounds at which the bunt of the sail will be still further deepened. Another consequence of the "stealing" of the boltrope on reefing that is not insignificant is that the aft end of the boom after reefing a number of turns will hang down towards the deck and be cumbersome. The said inconveniences inherent in the hitherto-known rolling reef are entirely eliminated by the arrangement according to the present invention.

An object of the invention is to improve the operation and handling of sailing vessels under all sailing conditions by maintaining optimum sail contour regardless of how much the sail is reefed.

Another object of the invention is to maintain an optimum sail bunt regardless of how much the sail is reefed by eliminating boltrope "stealing."

Yet another object of the invention is to maintain optimum sail bunt by decreasing the sail bunt with increased sail reefing.

Still another object of the invention is to prevent vertical wrinkles in the sail regardless of how much the sail is reefed.

A further object of the invention is to prevent lowering of the aft end of the boom regardless of how much the sail is reefed.

An embodiment of the invention will be described here with reference to the drawing which shows a sectional view of the same seen from one side.

In the drawing, numeral **1** indicates an axle rigidly secured to gear housing **15**, which housing is arranged to be hinged in a vertical plane by means of lug **16**. Lug **16** is attached to a fitting that will allow the boom to swing in the horizontal plane, which fitting is in turn fastened to the mast of the vessel. The said fitting is not shown in the drawing as it is well known to those versed in the art, as is the mast which is also not shown in the drawing. A worm wheel **9** is rotatably journaled on the axle **1**. It may be rotated by means of worm **10**, to the axle of which a crank is to be attached. This crank is not shown in the drawing. The worm is by means of its axle journaled in housing **15** surrounding worm wheel **9**. A sleeve **2** is rigidly attached to the worm wheel coaxially with the same. Another sleeve **4** is telescopically displaceable on sleeve **2**. Sleeve **4** is rigidly attached inside boom **3** and coaxially with the same. In the described embodiment, the boom is a thin-walled tube of Fiberglas reinforced plastic. Sleeves **2** and **4** are locked against rotation in relation to each other by means of keys **11** on sleeve **2** which engage key-ways **12** on sleeve **4**. The tack of sail **13** is by means of a shackle **14** attached to sleeve **4** and boom **3**.

Sleeve **4** has at its free end an internal thread **6** engaging an external thread **7** on axle **1**. The pitch of these threads is equal to the thickness of the boltrope of the sail. A cam ring **8** is attached to gear housing **15**. Its function and shape will be explained below.

On reefing, boom **3** is assumed to be rotated in such a direction by means of worm **10** and worm wheel **9** that the horizontal part **17** of the boltrope will be pulled downwards on the back side of the figure and upwards again on the front side of the figure. The sail is then wound on the boom, and the vertical part **5** of the boltrope is wound on the part of sleeve **2** which projects beyond sleeve **4** and the boom. Simultaneously with the rotation of the boom one turn, the boom will be displaced together with sleeve **4** axially in relation to sleeve **2**, a distance equal to the thickness of the boltrope, as the threads **6–7** have that pitch. For each turn the boom is rotated, a further equal length of sleeve **2** will be uncovered, so that new space is provided for a further round of the boltrope.

The boom, together with the wound part of the sail, thus is continuously displaced during the operation of reefing in a substantially horizontal direction away from the mast. The wound coil of the boltrope must necessarily follow in this movement and be displaced in the same direction on sleeve **2**. This is accomplished by means of a cam ring **8**. This member has the shape of a part of a thread around sleeve **2**, but is rigidly fixed to gear housing **15**, and, consequently, it does not rotate together with sleeve **2** when the latter is

rotated. The cam ring **8** has at least the same pitch as threads **6–7**, i.e., equal to the thickness of the boltrope, and, consequently, the coil of the wound boltrope will be continuously displaced in such a way that new space for winding of further rounds of the still-standing part of the boltrope will be provided on reefing.

The dimension of sleeve **2** should be chosen such that its radius plus the thickness of the boltrope will be about equal to the outer radius of the boom. By this means the boltrope cannot "steal" on winding. On the contrary, the described arrangement will cause the sail to steal more and more in relation to the boltrope because the radius of the boom together with the wound part of the sail increases on winding, whereas the takeup roller for the boltrope (sleeve **2**) will keep its radius unchanged. This will in turn cause the bunt of the sail to become less and less deep which is ideal when the wind force increases, for the comparative stiffness of the vessel will thus be able to carry more canvas than would otherwise have been the case. As the sail will constantly keep its correct contour, the vessel can be operated at the greatest possible efficiency.

As is evident from what has been said above, the boltrope is constantly wound in rounds one in front of the other in the direction towards the mast. Independent of the number of turns that are reefed, the still-standing part of the boltrope will thus remain parallel to the mast. This fact, in combination with the continuous movement of the boom away from the mast, has a marked tendency to prevent the development of the above-mentioned vertical wrinkles of the sail. Finally, the aft end of the boom will not hang down towards the deck.

The arrangement according to the invention is particularly well suited for modern sails with boltropes of synthetic fibers. Such boltropes do not shrink when they are wetted by rain and washing down seas, and they have therefore no tendency to tighten and grip around sleeve **2** on which they are wound. Owing to the fact that synthetic materials in addition have a low coefficient of friction, the displacement of the wound coil of the boltrope by the cam ring **8** provides no difficulties, not even in cases when further turns should be wound after previously performed reefing.

In connection with small vessels, the rolling reef according to the invention may be considerably simplified. Thus, it is possible to dispose with the thread system **6–7** that is governing the actual displacement of the boom and arrange a spring instead, such that it will push or pull sleeve **4** and the boom in the direction towards the mast. The displacement of the boom may then be accomplished only by means of the cam ring **8**. In very small boats and dinghies one may even dispose with the cam ring **8** and simply displace the boom with one's hand. Obviously, the boom itself could in some cases constitute the outer sleeve **4**. Similarly, the dimensions hinted at in the drawing may be largely modified so that the bunt or the bellying of the sail will be adjusted to exact requirements. On the other hand, the device may be further developed so that it will be suitable for light wind sails with a very deep bunt. Instead of sleeves **2** and **4**, one may utilize a series of sleeves arranged to be telescopically displaced so that the radius of the take-up drum for the boltrope will be continuously decreased.

It is to be understood that the instant invention is not limited to the specific embodiments described therein, such further applications and modifications of the invention being contemplated as would normally occur to those skilled in the art to which the invention applies.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In a sailing vessel having a mast, a boom, a sail and associated boltrope, and reefing gear of the type for making a rolling reef where a first part of the reefing gear is attached to the mast and a second part is attached

to the boom and rotatable relative to the first, a reefing device comprising:

a gear housing,

means securing said gear housing to said mast for permitting said gear housing to pivot in a vertical and horizontal direction,

an axle having a first end portion disposed within said gear housing and rigidly secured thereto and the opposite end portion of said axle extending away from said gear housing,

a worm wheel journaled within said gear housing on said axle and secured thereon against relative axial translation,

a worm journaled within said gear housing in operative relationship to said worm wheel for imparting rotation to said worm wheel when rotated and for securing the same against rotation when stationary,

a boltrope take-up reel disposed coaxially of said axle and having one end thereof rigidly attached to said worm wheel, and the other end thereof extending in the direction of said opposite end portion of said axle for taking up successive rounds of boltrope upon rotation of said take-up reel,

said take-up reel having a radius of one boltrope diameter less than the outside radius of said boom,

a cam ring disposed coaxially with said take-up reel and rigidly attached to said gear housing for guiding said bolt rope onto the portion of said take-up reel adjacent said gear housing and displacing the same therealong in side-by-side rounds in a direction away from said gear housing upon rotation of said take-up reel,

said cam ring having a camming displacement in an axial direction equal to the diameter of said boltrope for one revolution relative thereof,

a boom displacement sleeve disposed coaxially without said take-up reel in close sliding relationship therewith and suitably diamensioned for rigid and coaxial disposition within said boom for supporting and rotating the same upon reefing,

said boom displacement sleeve having one end thereof disposed adjacent said cam ring and the opposite end thereof extending to the region of said opposite end portion of said axle,

means between said take-up reel and said boom displacement sleeve for securing said boom displacement sleeve to said take-up reel for rotation therewith while allowing relative axial translation therebetween,

external threads disposed on said opposite end portion of said axle,

said external threads having a thread pitch equal to the diameter of said boltrope, and

internal threads within said opposite end of said boom displacement sleeve disposed in operable engagement with said external threads for displacing said boom displacement sleeve axially relative to said take-up reel in a direction away from said gear housing a distance equal to one boltrope diameter for each revolution of said boom displacement sleeve by which said boom is correspondingly lengthened and additional space is provided on said take-up reel for a further round of boltrope, whereby upon progressive rotation of said worm, said worm wheel will rotate said take-up reel, said boom displacement sleeve and attached boom thus reefing said sail and associated boltrope as simultaneously said cam ring guides and displaces said boltrope onto and along said take-up reel and said boom displacement sleeve correspondingly lengthens the boom and provides additional space on said take-up reel for further rounds of boltrope, thus maintaining optimum sail contour regardless of the extent of reefing.

2. In a sailing vessel having a mast, a boom, a sail and associated boltrope, and reefing gear of the type for mak-

ing a rolling reef where a first part of the reefing gear is attached to the mast and a second part is attached to the boom and rotatable relative to the first, a reefing device comprising

an axle,

means for pivoted attachment of one end portion of said axle to a mast while allowing the opposite end portion of said axle to extend away from said mast,

a boltrope take-up reel disposed coaxially of said axle and having one end thereof rotatably attached to said axle and the other end thereof extending in the direction of said opposite end portion of said axle for taking up successive rounds of boltrope upon rotation of said take-up reel,

said take-up reel having a radius of one boltrope diameter less than the outside radius of said boom,

means for imparting rotation for said take-up reel and for securing the same against rotation,

a cam ring disposed coaxially with said take-up reel and rigidly secured to said axle for guiding said boltrope onto the portion of said take-up reel adjacent said mast and displaying the same therealong in side-by-side rounds in a direction away from said mast upon rotation of said take-up reel,

said cam ring having a camming displacement in an axial direction equal to the diameter of said boltrope for one revolution relative thereof,

a boom displacement sleeve disposed coaxially without said take-up reel in close sliding relationship therewith and suitably dimensioned for rigid and coaxial disposition within said boom for supporting and rotating the same upon reefing,

said boom displacement sleeve having one end thereof disposed adjacent said cam ring and the opposite end thereof extending to the region of said opposite end portion of said axle,

means between said take-up reel and said boom displacement sleeve for securing said boom displacement sleeve to said take-up reel for rotation therewith while allowing relative axial translation therebetween,

external threads disposed on said opposite end portion of said axle,

said external threads having a thread pitch equal to the diameter of said boltrope, and

internal threads within said opposite end of said boom displacement sleeve disposed in operable engagement with said external threads for displacing said boom sleeve axially relative to said take-up reel in a direction away from said gear housing a distance equal to one boltrope diameter for each revolution of said boom displacement sleeve by which said boom is correspondingly lengthened and additional space provided on said take-up reel for a further round of boltrope, whereby upon rotation of said boltrope take-up reel, said boom displacement sleeve and attached boom will be rotated, thus reefing said sail and associated boltrope as simultaneously said cam ring guides and displaces said boltrope onto and along said take-up reel and said boom displacement sleeve correspondingly lengthens the boom and provides additional space on said take-up reel for further rounds of boltrope, thus maintaining optimum sail contour regardless of the extent of reefing.

3. In a sailing vessel having a mast, a boom, a sail and associated boltrope, and reefing gear of the type for making a rolling reef where a first part of the reefing gear is attached to the mast and a second part is attached to the boom and rotatable relative to the first, a reefing device comprising

an axle,

means rotatably securing a first end portion of said axle to said mast while allowing the opposite end portion of said axle to extend away from said mast,

a boltrope take-up reel disposed coaxially of said axle and having one end thereof attached to said axle and the other end thereof extending in the direction of said opposite end portion of said axle for taking up successive rounds of boltrope upon rotation of said take-up reel,

a cam ring disposed coaxially with said take-up reel and rigidly attached to said axle for guiding said boltrope onto the portion of said take-up reel adjacent said mast and displacing the same therealong in side-by-side rounds in a direction away from said mast upon rotation of said take-up reel,

a boom displacement sleeve disposed coaxially with said take-up reel in close sliding relationship therewith and suitably dimensioned for rigid and coaxial disposition within said boom for supporting and rotating the same upon reefing,

said boom displacement sleeve having one end thereof disposed adjacent said cam ring and the opposite end thereof extending to the region of said opposite end portion of said axle,

means between said take-up reel and said boom displace ment sleeve for securing said boom sleeve to said take-up reel for rotation therewith while allowing relative axial translation therebetween,

external threads disposed on said opposite end portion of said axle,

internal threads within said opposite end of said boom displacement sleeve disposed in operable engagement with said external threads for displacing said boom sleeve axially relative to said take-up reel in a direction away for said mast upon revolution of said boom displacement sleeve by which said boom is correspondingly lengthened and space provided on said take-up reel for additional boltrope, whereby upon rotation of said boltrope take-up reel, said boom displacement sleeve and attached boom will be rotated, thus reefing said sail and associated boltrope as simultaneously said cam ring guides and displaces said boltrope onto and along said take-up reel and said boom displacement sleeve correspondingly lengthens the boom and provides additional space on said take-up reel for further rounds of boltrope, thus maintaining optimum sail contour regardless of the extent of reefing.

4. In a sailing vessel having a mast, a boom, a sail and associated boltrope, and reefing gear of the type for making a rolling reef where a first part of the reefing gear is attached to the mast and a second part is attached to the boom and rotatable relative to the first, a reefing device comprising:

an axle,

means for pivoted attachment of a first end portion of said axle to said mast while allowing the opposite end portion of said axle to extend away from said mast,

a boltrope take-up reel disposed coaxially of said axle and having one end thereof rotatably attached to said axle for taking up successive rounds of boltrope upon rotation of said take-up reel,

camming means supported adjacent said take-up reel for guiding said boltrope onto said take-up reel and displacing the same therealong and side-by-side rounds in a direction away from said mast,

a boom displacement sleeve disposed coaxially of said take-up reel and suitably dimensioned for rigid and coaxial disposition within said boom for supporting and rotating the same upon reefing,

means between said take-up reel and said boom displacement sleeve for securing said boom sleeve to said take-up reel for rotation therewith while allowing relative axial translation therebetween,

means for displacing said boom displacement sleeve axially relative to said take-up reel in a direction away from said mast for each revolution of said

boom sleeve by which said boom is correspondingly lengthened and space provided on said take-up reel for additional boltrope, whereby upon progressive rotation of said take-up reel, said boom sleeve and attached boom will be rotated, thus reefing said sail and associated boltrope as simultaneously said camming means guides and displaces said boltrope onto and along said take-up reel and said boom displacement sleeve correspondingly lengthens the boom and provides additional space on said take-up reel for further rounds of boltrope, thus maintaining optimum sail contour regardless of the extent of reefing.

5. In a sailing vessel having a mast, a boom, a sail and associated boltrope, and reefing gear of the type for making a rolling reef where a first part of the reefing gear is attached to the mast and a second part is attached to the boom and rotatable relative to the first, a reefing device comprising:

an axle,

means securing a first end portion of said axle to said mast while allowing the opposite end portion of said axle to extend away from said mast,

a boltrope take-up reel disposed coaxially of said axle and having one end thereof rotatably attached to said axle and the other end thereof extending in the direction of said opposite end portion of said axle, for taking up successive rounds of boltrope upon rotation of said take-up reel,

a cam ring disposed coaxially with said take-up reel and rigidly supported by said axle for guiding said boltrope onto the portion of said take-up reel adjacent said mast and displacing the same therealong in side-by-side rounds in a direction away from said mast upon rotation of said take-up reel,

a boom displacement sleeve disposed coaxially without said take-up reel in close sliding relationship therewith and suitably dimensioned for rigid and coaxial disposition within said boom for supporting and rotating the same upon reefing,

said boom displacement sleeve having one end thereof disposed adjacent said cam ring and the opposite end thereof extending to the region of said opposite end portion of said axle, and

means between said take-up reel and said boom displacement sleeve for securing said boom displacement sleeve to said take-up reel for rotation therewith while allowing relative axial translation therebetween.

6. In a sailing vessel having a mast, a boom, a sail and associated boltrope, and reefing gear of the type for making a rolling reef where a first part of the reefing gear is attached to the mast and a second part is attached to the boom and rotatable relative to the first, a reefing device comprising:

an axle,

means securing the first end portion of said axle to said mast while allowing the opposite end portion of said axle to extend away from said mast,

a boltrope take-up reel disposed coaxially of said axle and having one end thereof rotatably attached to said axle and the other end thereof extending in the direction of said opposite end portion of said axle for taking up successive rounds of boltrope upon rotation of said take-up reel,

said take-up reel having a radius less than the outside radius of said boom,

a boom displacement sleeve disposed coaxially without said take-up reel in close sliding relationship therewith and suitably dimensioned for rigid and coaxial disposition within said boom for supporting and rotating the same upon reefing,

means between said take-up reel and said boom displacement sleeve for securing said boom sleeve to said take-up reel for rotation therewith while allowing relative axial translation therebetween, and

means for imparting rotation to said take-up reel and for securing the same against rotation, whereby upon rotation of said take-up reel, said boom displacement sleeve and attached boom will be rotated, thus reefing said sail and associated boltrope while said boltrope is guided by hand onto said take-up reel in side-by-side rounds extending away from said mast and said boom is further displaced away from said mast by hand, thus maintaining optimum sail contour regardless of the extent of reefing.

7. A reefing device for sailing vessels comprising:

a boltrope take-up reel for taking up successive rounds of a sail boltrope upon rotation of said take-up reel,

means for rotatably attaching said take-up reel to a mast of a vessel,

means for imparting rotation to said take-up reel and for securing the same against rotation,

camming means for guiding said boltrope onto said take-up reel and displacing the same therealong in side-by-side rounds,

a boom displacement sleeve disposed coaxially with said take-up reel and suited for attachment to a boom for supporting and rotating the same on reefing,

means securing said boom displacement sleeve to said take-up reel for rotation therewith while allowing axial translation therebetween, and

means for axially displacing said boom displacement sleeve relative to said take-up reel through a distance for each revolution of said boom sleeve to correspondingly displace said boom and provide space on said take-up reel for additional boltrope, whereby upon rotation of said take-up reel, said boom sleeve and attached boom will be rotated, thus reefing said sail and associated boltrope as simultaneously said camming means guides and displaces said boltrope onto and along said take-up reel and said boom sleeve correspondingly displaces the boom and provides space on said take-up reel for additional boltrope, thus maintaining optimum sail contour.

8. In a sailing vessel provided with the usual mast and boom for the support of a sail and its included boltrope, the method of varying the sail area on reefing while maintaining the optimum sail configuration in terms of the extent of the bunt thereof which comprises:

rolling the foot of the sail about the boom, and

correspondingly lengthening the boom as the sail is rolled thereupon so as to displace the portion of the sail rolled on the boom in a direction away from the mast.

9. In a sailing vessel provided with the usual mast and boom for the support of a sail and its included boltrope, the method of reefing the sail while maintaining the optimum sail configuration in terms of the extent of the bunt which comprises:

rotating the boom to thereby roll the sail upon the boom,

winding said boltrope about a sleeve of lesser diameter than said boom, and

guiding the boltrope around said sleeve so that as each new turn is wound thereupon, the preceding turns are displaced axially along said sleeve out of the path of said boltrope.

10. The method of claim 9 further including the step of progressively lengthening the boom as it is rotated so as to displace the sail wound thereon in a direction away from said mast.

No references cited.

MILTON BUCHLER, *Primary Examiner.*

T. M. BLIX, *Assistant Examiner.*