Feb. 21, 1967 A. NEVULIS 3,305,220

TAKE-UP DEVICE

Filed Oct. 11, 1965 2 Sheets-Sheet 1

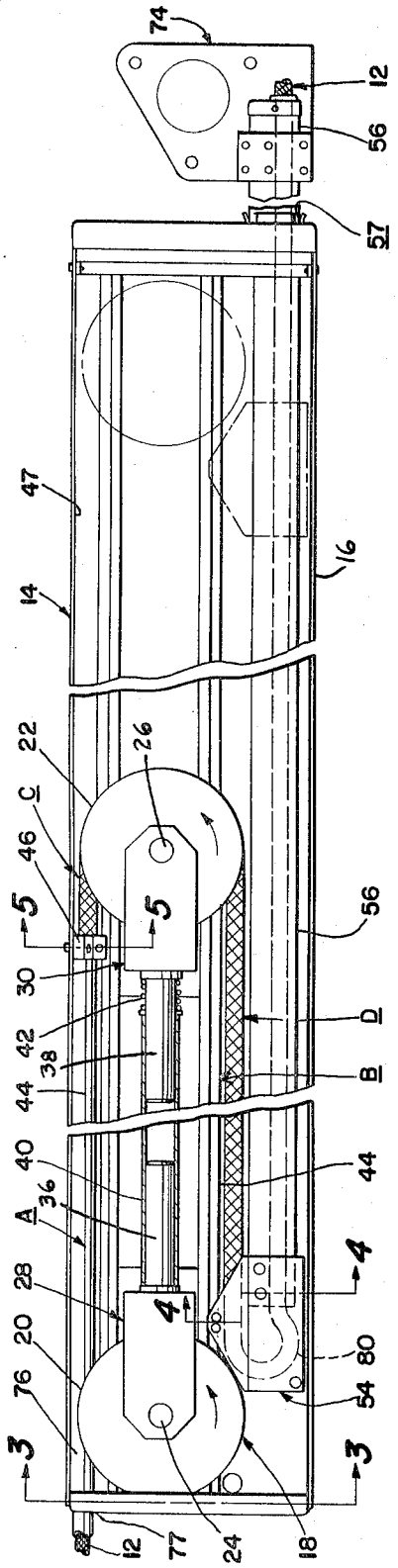

Fig. 1

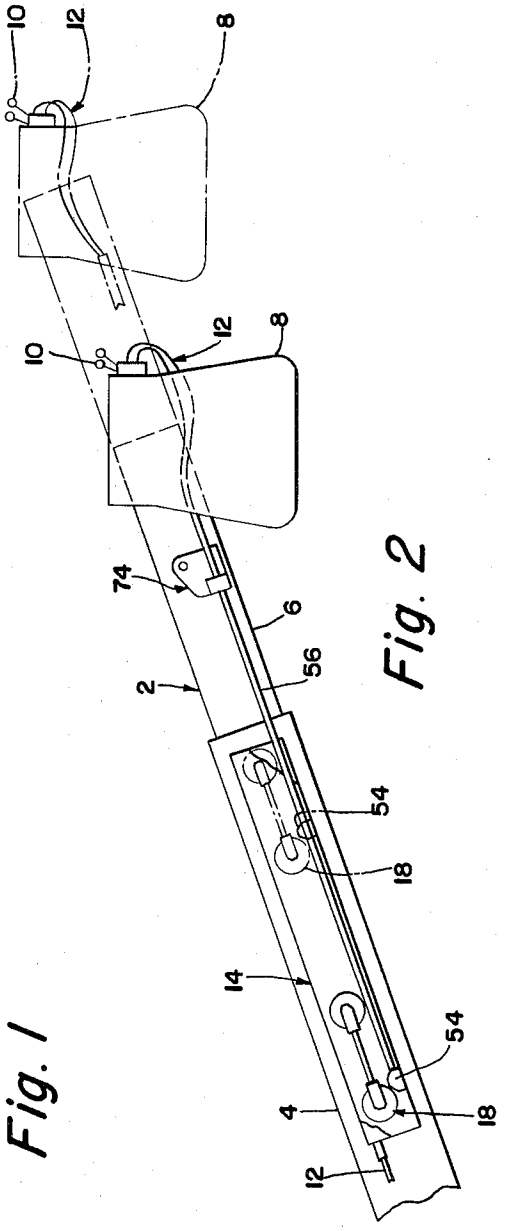

Fig. 2

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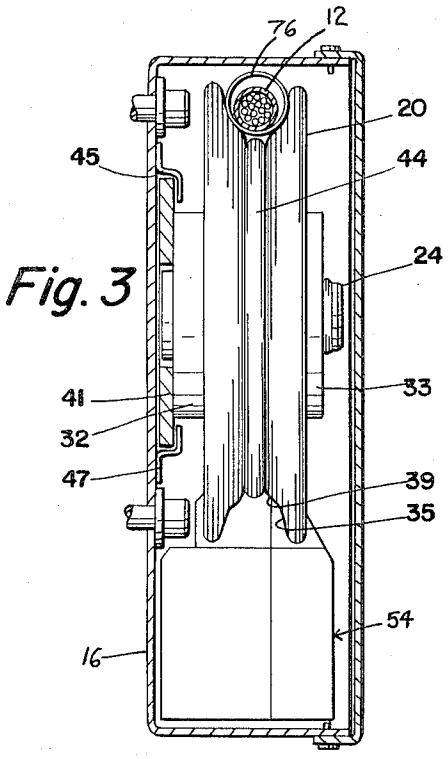

Fig. 3

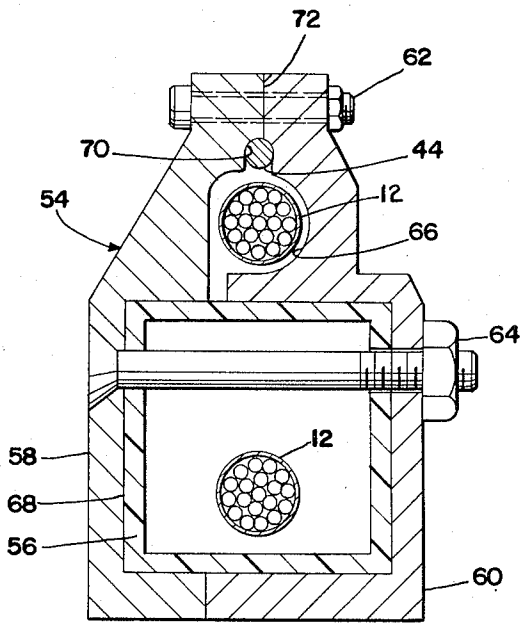

Fig. 4

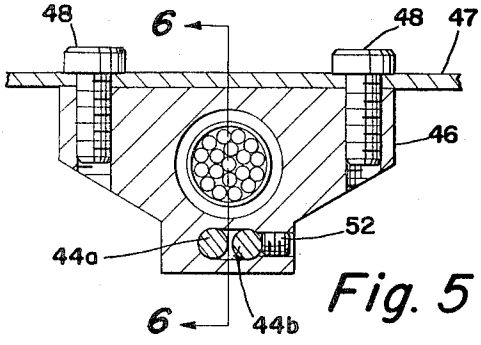

Fig. 5

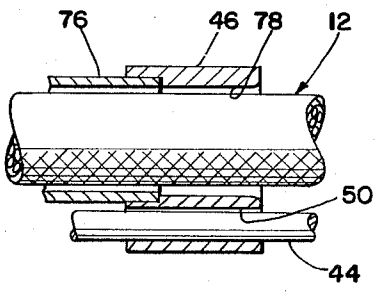

Fig. 6

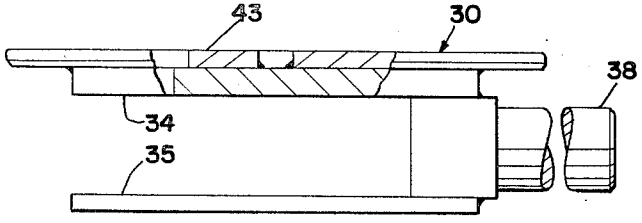

Fig. 7

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3,305,220

TAKE-UP DEVICE

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17 Claims. (Cl. 254—189)

This invention relates to take-up devices, and more particularly relates to an improved take-up mechanism for taking up the slack in flexible lines or the like extending between a fixed member and one or more movable members, such as with derricks, booms or the like.

Heretofore, it has been well known, particularly in the utility industry, to provide vehicle-mounted extensible derrick or boom structures for installing utility poles or the like. It has also been known to provide vehicle-mounted derrick or boom structures having a personnel bucket adjacent one end which may be elevated into an overhead position for the maintenance and/or repair of utility lines, poles, trees or the like, whereby a workman situated in the bucket can control operation thereof. However, an important problem involved the take-up and storage of the slack in the control lines extending from the bucket to a suitable power source either on the vehicle or on the ground. Heretofore, various types of reel and traveling pulley arrangements have been employed for these and other purposes. Such heretofore known devices, however, are generally expensive to produce, maintain and are frequently cumbersome in operation. More importantly, such devices have not been effective in preventing fouling or kinking of the lines, and particularly such devices have not prevented chafing or abrasive action on the lines, thereby greatly reducing the wear-life of the lines and the usability of the boom structure.

Accordingly, an object of the present invention is to provide an improverd take-up device to overcome the above and other related disadvantages in taking up the slack in flexible lines or the like extending between a stationary member and one or more movable members.

Another object of the present invention is to provide a take-up device of the character described which is of a compact, sturdy and inexpensive construction, and which can be quickly and easily incorporated with conventional equipment of the character described without substantial modifications of changes in the equipment.

A further object of the present invention is to provide a take-up device of the character described which is operable to take up the slack in flexible control lines extending from a personnel bucket mounted adjacent the end of a telescopic boom structure to a source of power, either on a vehicle mounting the boom structure, or on the ground without interference to the extension and retraction movements of the boom structure.

A still further object of the present invention is to provide a take-up device of the character described which is operable to maintain a constant, uniform tension on the control lines to prevent any fouling or kinking of the lines during extension and retraction of the boom structure.

A still further object of the present invention is to provide a take-up device of the character described which is operable to prevent any chafing or abrasive action on the control lines during operation of the boom structure so as to increase the wear-life of the lines and the usability of the boom structure.

Various other objects of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is an enlarged, broken longitudinal section view showing the take-up device of the present invention removed from a telescopic boom structure of FIG. 2;

FIG. 2 is a fragmentary side elevation view, on a reduced scale, showing the take-up device of the present invention mounted on the stationary member of a telescopic boom structure, with a personnel bucket mounted adjacent the end of the extensible boom section in retracted position (solid lines) and in the extended position (broken lines);

FIG. 3 is an enlarged vertical section view taken along the plane of line 3—3 of FIG. 1;

FIG. 4 is an enlarged vertical section view taken along the plane of line 4—4 of FIG. 1;

FIG. 5 is an enlarged vertical section view taken along the plane of line 5—5 of FIG. 1;

FIG. 6 is a vertical section view taken along the line 6—6 of FIG. 5; and

FIG. 7 is a partially sectioned top plan view showing one of the clevis members removed from the assembly.

Referring again to the drawings, and in particular to FIG. 2 thereof, there is shown a fragmentary portion of a powered derrick or boom, designated generally at 2, which may be pivotally mounted on a wheeled vehicle (not shown), such as a conventional type utility truck or the like. The boom 2 embodies a lower or inner relatively stationary section 4 and an upper or outer relatively extensible section 6 which may be disposed for telescopic movement within the inner boom section 4. A reciprocal fluid powered motor unit (not shown) may be disposed interiorly and/or exteriorly of the boom sections, and may be coupled at one end to the inner section 4 and at the other end to the outer section 6 for telescopic extension and retraction of the boom sections in a manner as known in the art.

In the embodiment shown, a personnel support or bucket 8 may be swingably disposed or mounted in cantilever relationship adjacent the terminal end of the outer boom section 6 for moving a workman into position adjacent an overhead object, such as power lines or the like. Control levers 10, such as for operation of electric or hydraulic power lines may be mounted on the bucket 8 and adapted to be actuated by the workman situated in the bucket for operation of the boom structure. A flexible control bundle 12, such as electrical or hydraulic power lines, may be operably coupled to the control levers 10 and to a source of power (not shown), such as a motor or pump, for extending and retracting the respective boom sections. Such control bundle 12 may be also utilized for moving the boom structure relative to its support, such as when the boom structure is mounted on a utility vehicle or the like, whereby complete control of the movement of the boom structure may be achieved by a workman standing in the bucket, as desired.

In accordance with the present invention, there is provided a novel take-up arrangement, designated generally at 14, for taking up the slack in the flexible control bundle 12 upon extension and retraction of the outer boom section 6 relative to the inner boom section 4. The take-up assembly 14 in the embodiment shown, includes a hollow container or housing 16 which may be detachably connected to the exterior of the inner boom section 4. Disposed interiorly of the housing 16 is a carriage assembly, designated generally at 18, which is adapted for reciprocal movement within the housing 16 upon extension and retraction of the outer boom section 6 relative to the inner boom section 4.

As best shown in FIGS. 2, 3 and 7, the carriage assembly 18 comprises a pair of oppositely disposed sheaves 20 and 22 which are mounted for free rotation on stub shafts 24 and 26. The stub shafts 24 and 26 are mounted adjacent the ends of a pair of oppositely disposed, generally U-shaped (FIG. 7) clevis members 28 and 30. The respective clevis members 28 and 30 are of similar construction and each include oppositely disposed side plates 32,

33 (FIG. 3) and 34, 35 (FIG. 7) between which the respective sheaves 20 and 22 are rotatably mounted. The side plates 32–35 of the respective clevis members 28 and 30 are open at one end and are connected together at the opposite end, such as by suitable weldments or the like, to cylindrical guide rods 36 and 38 which extend therefrom.

As best shown in FIG. 3, the sheaves 20 and 22 are preferably of similar construction, each of which includes a continuous annular outer groove 35 and a continuous annular inner groove 39 disposed concentrically relative to the outer groove 35. The inner concentric groove 39 is preferably of a substantially smaller radius than the outer groove 35 so as to accommodate in reeved relationship therein a flexible member for holding the respective clevis and sheave arrangements together in axial alignment, as will hereinafter be more fully described.

The respective clevis and sheave arrangements may be resiliently connected together for movement, as a unit, by means of a cylindrical sleeve 40 which is adapted to slidably receive within the opposed ends thereof, the guide rods 36 and 38 of the respective clevis members 28 and 30. The outside diameter of the rods 36 and 38 and the inside diameter of the sleeve 40 are preferably selected to provide a slidable, yet snug fit between the parts. To provide a relative resilient coaction between the clevis members 28 and 30 a resilient means 42, such as a coiled compression spring, may be disposed around one of the rods 38 so as to bear at one end against one of the clevis members 30 and at its other end against the sleeve 40. By this arrangement, the resilient characteristics of the spring 42 acts to exert a constant axial pressure for urging the respective clevis members 28 and 30 apart, thereby to maintain contact between the sheave 22 and the control bundle 12.

In opposition to the biasing force imparted by the spring 42, a flexible cable 44, such as a ¼ inch steel wire rope or the like, may be reeved around the respective sheaves 20 and 22 within the respective inner concentric grooves 39 (FIG. 3) provided therein. The free ends 44*a* and 44*b* of the cable 44 are preferably clamped together adjacent its upper stretch A (FIG. 5) by a generally T-shaped bracket 46 which may be fixedly attached to the top wall 47 of the housing 16, as best shown in FIG. 1. The bracket 46 may be attached to the housing by suitable fasteners 48, such as bolts or the like, and includes an elongated, in cross-section, such as oblate, passageway 50 (FIG. 6) which is adapted to receive therein the free ends 44*a* and 44*b* of the cable 44. Another fastener 52, such as a set screw or the like, may be threaded into the bracket 46 transversely of the passageway 50 for clamping the free ends 44*a* and 44*b* of the cable 44 in side-by-side, overlapping relationship. By this arrangement, the clevis members 28 and 30, which rotatably mount the respective sheaves 20 and 22, are resiliently held together in axial alignment against the biasing force imparted by the spring 42, whereby the carriage assembly 18 may be moved, as a unit, within the housing 16.

The lower stretch B of the cable 44 is preferably fixedly clamped adjacent the sheave 20 by a bracket 54 which is fixedly attached to a reciprocal tubing member 56. As best shown in FIG. 4, the bracket 54 is of a two-part construction which includes an outer cover section 58 and an inner base section 60 which are detachably joined together by suitable fasteners 62 and 64, such as by bolts and nuts or the like. The respective mating sections 58 and 60 are preferably formed to provide upper 66 and lower 68 cavities therebetween. The upper cavity 66 has a generally semi-circular groove 70 disposed substantially at the parting line 72 between the respective sections 58 and 60 adapted to receive and clamp therebetween the lower stretch B of the cable 44 upon tightening of the respective fastener 62. The lower cavity 68 is preferably polygonal, such as square-shaped, in cross section adapted to receive and clamp therebetween one end of the reciprocal tubing member 56 upon tightening of the respective fastener 64.

The reciprocal tubing member 56 which is fixedly clamped at one end to the cable 44 by bracket 54, extends through an aperture 57 adjacent one end of the housing 16 and is preferably fixedly attached at its other end to the outer extensible boom section 6 by a support bracket 74 attached to the exterior of the boom section 6. Preferably, the tubing member 56 is of an elongated, hollow construction which may be of any suitable cross-section shape, such as the polygonal square shape illustrated in FIG. 4. It is desirable that the tubing member 56 be comprised of an insulating material, such as bonded fiberglass or the like, so as to insulate the control bundle 12 carried therein from the other component parts of the boom structure.

To guide the carriage assembly during reciprocal movement within the housing 16, suitable guide plates 41 and 43 (FIGS. 3 and 7) may be attached to each of the respective clevis members 28 and 30, such as by suitable weldments or the like. The respective guide plates 41 and 43 are adapted to ride in a pair of oppositely disposed, generally S-shaped flanges 45 and 47 (FIG. 3) which are spaced apart and extend parallel relative to one another for substantially the full length of the housing 16. The respective flanges 45 and 47 serve to provide suitable track for reciprocal movement of the carriage assembly 18 within the housing 16.

It can be seen by this arrangement, that the upper stretch A of the cable 44 is fixedly clamped to the housing 16 adjacent the sheave 22 while the lower stretch B of the cable 44 adjacent the sheave 20 is fixedly clamped to the tubing member 56 which in turn is attached to the outer extensible boom section 6, whereby the carriage assembly 18 may be reciprocated axially within the housing 16 on the flange tracks 45 and 47 upon extension and retraction of the outer boom section 6.

The control bundle 12 for controlling operation of the boom structure either from the bucket 8, the ground, or from the vehicle itself, may be led from a suitable power source (not shown) and inserted through a rigid conduit 76 (FIG. 1) located interiorly of the housing 16. The conduit 76 may be disposed through an opening 77 provided in the end of the housing 16 so as to extend immediately above the sheave 20 in the general direction toward the other sheave 22. The conduit 76 containing the control bundle 12 may be fixedly clamped adjacent its other end within a passageway 78 provided in the aforementioned bracket 46, as best shown in FIG. 6. By this arrangement, there is substantially no relative sliding movement between the outer surface of the control bundle 12 and the confronting inner surface 12 of the conduit 76, thereby eliminating any chafing or abrasion between that portion of the control bundle located within the conduit 76 during operation of the device.

From the conduit 76, the upper stretch C of the control bundle 12 is reeved around the annular groove 39 of the sheave 22 which acts as a guide therefor. The lower stretch D of the control bundle 12 extends rearwardly from the sheave immediately above the reciprocable tubing member 56 in the direction toward the sheave 20. The control bundle 12 is looped, such as indicated in broken line 80 at FIG. 1, through the bracket 54 so as to extend again forwardly through the tubing member 56. The control bundle 12 projects outwardly from the outer end of the tubing member 56 so as to be coupled to the control levers 10 provided on the bucket 8 for operation of the boom structure by a workman situated in the bucket, as aforesaid. It will be seen that by this arrangement that there is substantially no relative sliding movement between the outer surface of the control bundle 12 and the confronting inner surface of the tubing member 56, thereby eliminating any chafing or abrasion on that portion of the control bundle 12 disposed within the tubing member 56.

In operation, the solid lines in FIGS. 1 and 2 illustrate the position of the elements comprising the novel take-up arrangement 14 of the present invention when the outer extensible boom section 6 is in its innermost or retracted position relative to the inner stationary boom section 4. In this position, the carriage assembly 18 may be at the extreme left end of its guide tracks 45 and 47, and the reciprocable tubing member 56 may be at the end of its full retracted movement adjacent the sheave 20 so that the upper stretch C of the control bundle 12 is substantially fore-shortened in the direction toward the sheave 22 while the lower stretch D thereof is substantially lengthened in a direction toward the sheave 20. A workman situated in the bucket 8 merely by operation of the control levers 10 may then actuate a reciprocal fluid powered motor (not shown) for extending the outer boom section 6 relative to the inner boom section 4 in a conventional manner, whereby the bucket 8 may be moved into any overhead position, as desired.

During the above operation, the reciprocable tubing member 56, being attached at one end to the lower stretch B of the cable 44 by the bracket 54 and at its other end to the outer boom section 6 by the bracket 74, is also moved to the right in the general direction of extension of the outer boom section 6, whereby the carriage assembly 18 for taking up the slack in the control bundle 12 is in effect "pulled" as a unit, to the right on its guide tracks 45 and 47, as shown by broken lines in FIGS. 1 and 2. The distance between the centers 24 and 26 of the axially aligned sheaves 20 and 22 remains substantially constant during movement of the carriage assembly 18, due to the axial retaining force imparted on the sheaves 20 and 22 by the cable 44. The cable 44 being reeved around the sheaves 20 and 22 and being fixedly attached adjacent its upper stretch A to the housing 16 by the bracket 46 causes the sheaves 20 and 22 to rotate in a counterclockwise direction during the extension operation, as shown by the arrows in FIG. 1. Rotational movement of the sheave 22 causes the upper stretch C of the control bundle 12 to progressively lengthen so as to be laid-out adjacent the top of the housing 16 and simultaneously causes the lower stretch D thereof to progressively foreshorten adjacent the tubing member 56, without any relative axial movement between the exposed stretches C and D of the control bundle 12 and the housing whereby any chafing or abrasive action on such exposed portions of the control bundle 12 is completely eliminated. It can further be seen that there is a substantial absence of any sliding movement between the control bundle 12 and the sheave 22 which acts as a guide therefore during the take-up of slack in the control bundle 12. It will also be seen however, that because the upper stretch C of the control bundle 12 is linearly lengthened at the same rate that the lower stretch D thereof is linearly foreshortened, a constant, uniform tension is maintained at all times on the control bundle 12, whereby any slack in the control bundle is taken-up and the possibility of any tangling and/or damage thereto is effectively obviated. Upon retraction of the outer boom section 6, the reverse action takes place, whereupon the tubing member 56 is reciprocated in the opposite direction so as to in effect "push" the carriage assembly 18 to the left, as shown in FIGS. 1 and 2. This reverse action progressively foreshortens the upper stretch C of the control bundle 12 and simultaneously progressively lengthens the lower stretch D thereof so as to maintain a constant, uniform tension on the control bundle 12 in a manner to prevent any chafing or abrasive action on the parts, as aforesaid.

It will be seen that the novel take-up arrangement 14 of the present invention can be provided to take-up the slack in control lines on boom structures of any given size. This may be accomplished simply by variation in the size and/or arrangement of the respective sheaves 20 and 22, such as by variation in the diameter and/or by variation in the axial distance between the sheaves, whereby tension may be maintained on control lines of any predetermined length, as desired. Furthermore, while the take-up arrangement has been illustrated for use on the exterior of the boom structure, it will be seen that the mechanism may be disposed entirely interiorly of the boom structure as desired. It is preferred, however, that the mechanism be detachably connected to the exterior of the boom structure for ready access and maintenance thereof.

It will also be observed that the mechanism of the invention may be utilized for taking up the slack in any type of flexible lines, such as electrical and fluid control lines or permanent lines or the like, and between two or more telescopic members of any construction, such as derricks, cranes, aerial towers or the like.

From the foregoing description and accompanying drawings, it will be seen that the present invention provides a novel mechanism for taking up the slack in flexible lines extending between a fixed member and one or more movable members. Such mechanism maintains a constant, uniform tension on the lines and eliminates any stress and/or strain thereon during movement of the members. Furthermore, such mechanism effectively prevents any frictional engagement between the lines and the fixed and/or movable members so as to eliminate any chafing or abrasive action thereon and hence, to increase the wear-life of the lines.

The terms and expressions which have been used are used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of any one of the features shown or described, or portions thereof and it is recognized that various modifications are possible within the scope of the invention claimed.

I claim:

1. A take-up device for taking up the slack in flexible line means extending between a relatively stationary inner boom section and an outer extensible boom comprising, a support member attached to said inner boom section, a carriage means disposed for movement on said support member, said carriage means including a pair of spaced rotatable elements and one of said elements acting as a guide for said line means, an endless flexible drive means engageably mounted on said rotatable elements, said drive means having one portion attached to said support member, a movable member attached at one end to another portion of said drive means and at its other end to said outer boom section, and said line means having an upper stretch fixedly mounted relative to said support member and a lower stretch fixedly mounted relative to said movable member, whereby the upper stretch of said line means is progressively lengthened and the lower stretch of said line means is progressively shortened without relative movement with respect to said support and movable members upon movement of said outer boom section in one direction and vice versa upon movement of the outer boom section in the opposite direction.

2. A take-up device in accordance with claim 1, wherein said rotatable elements each include annular sheaves, and wherein said drive means includes a flexible cable looped in reeved relationship around said sheaves.

3. A take-up device in accordance with claim 2, including a pair of spaced apart, operably disposed clevis means rotatably mounting said sheaves, and a resilient means operably coacting with one of said clevis means for resiliently urging an associated one of said sheaves into engagement with said line means.

4. A take-up device in accordance with claim 2, wherein each of said sheaves includes an inner annular recess adapted to engageably receive said cable and an outer annular recess disposed concentrically relative to said inner recess adapted to engageably receive said line means.

5. A take-up device for taking up the slack in flexible lines extending between an inner relatively stationary sec-

tion and an outer extensible section of a telescopic boom comprising, a support member attached to said inner boom section, a carriage means including a rotatatable guide element disposed for reciprocal movement on said support member, said line means disposed in looped engaged relationship around said rotatable guide elements, a movable member operably connected at one end to said carriage means and at its other end to said outer boom section for reciprocably moving said carriage means on said support member upon extension and retraction of said outer boom section, said line means having an upper stretch fixedly attached to said support member and a lower stretch attached to said movable member, whereby said upper stretch is adapted to be lengthened and said lower stretch is adapted to be shortened without the movemen relative to the respective support and movable members upon extension of said outer boom section and vice versa upon retraction of said outer boom section.

6. A take-up device in accordance with claim 1, wherein said movable member includes an elongated, hollow tube disposed for reciprocal movement with respect to said support member, and wherein said line means extend through said tube for movement with said tube and are adapted to be operatively coupled to a work element associated with said outer boom section.

7. A take-up device for use with extensible booms or the like, said device comprising, a relatively stationary support member and a relatively movable member, carriage means disposed for reciprocable movement on said support member, said carriage means including a pair of axially spaced, rotatable elements attached together for movement, as a unit, on said support member, an endless flexible drive means looped in driving relation around said rotatable elements, said drive means having an upper portion fixedly attached to said support member adjacent one of said rotatable elements and a lower portion fixedly attached to said movable member adjacent the other of said rotatable elements for reciprocal movement of said carriage means on said support member upon movement of said movable member, flexible control line means disposed in engaged relationship around one of said rotatable element, said control line means having an upper stretch fixedly attached to said support member and a lower stretch attached to said movable member, whereby said upper stretch is adapted to be lengthened and said lower stretch adapted to be shortened without movement relative to the respective support and movable members upon movement of the movable member in one direction and vice versa upon movement of the movable member in the opposite direction.

8. A take-up device in accordance with claim 7, wherein the boom includes an inner relatively stationary section and an outer section adapted for movement relative to said inner section, and wherein said movable member is attached to said outer boom section for movement with said outer boom section relative to said inner boom section.

9. A take-up device in accordance with claim 8, wherein said movable member includes an elongated, hollow tube, and wherein said control line means is disposed through said tube and is adapted for movement with said tube.

10. A take-up device in accordance with claim 7, wherein said rotatable elements each include annular sheaves mounted for free rotation on said carriage means, and said endless drive means includes a flexible cable looped in reeved relationship around said sheaves.

11. A take-up device in accordance with claim 7, including a resilient means operably connected to said carriage means between said rotatable elements for maintaining a constant tension to said control line means.

12. A take-up device in accordance with claim 7, wherein said carriage means includes a pair of oppositely disposed clevis members mounting said rotatable elements, each of said clevis members including a shaft extending axially from one end thereof in the general direction toward one another, and the free ends of said sheets being disposed within a sleeve extending between said clevis members.

13. A take-up device in accordance with claim 12, including a resilient means disposed around one of said shafts and operably coacting between an associated one of said clevis members and said sleeve for maintaining a constant tension on said control line means.

14. A take-up device in accordance with claim 12, wherein said rotatable elements each include an annular sheave mounted for free rotation on an associated one of said clevis members, and wherein said endless drive means includes a flexible cable looped in reeved relationship around said sheaves for holding the latter together in spaced relationship.

15. A take-up device in accordance with claim 7, wherein said control line means are electrical control lines, and wherein said movable member comprises a hollow tube having good insulating characteristics adapted to receive the electrical lines therein.

16. A take-up device in accordance with claim 15, wherein said tube is comprised of fiberglass.

17. A take-up device in accordance with claim 1, wherein said rotatable elements each include angular sheaves mounted for free rotation on said carriage means, said drive means including an endless flexible line looped in engaged relationship around said sheaves, and resilient means operably coacting between said sheaves for normally urging said sheaves axially apart against the repeating force imparted by said flexible line.

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