March 18, 1969 C. F. NOVOTNY ETAL 3,433,367

BOOM BACK-STOP APPARATUS

Filed May 15, 1967 Sheet 1 of 3

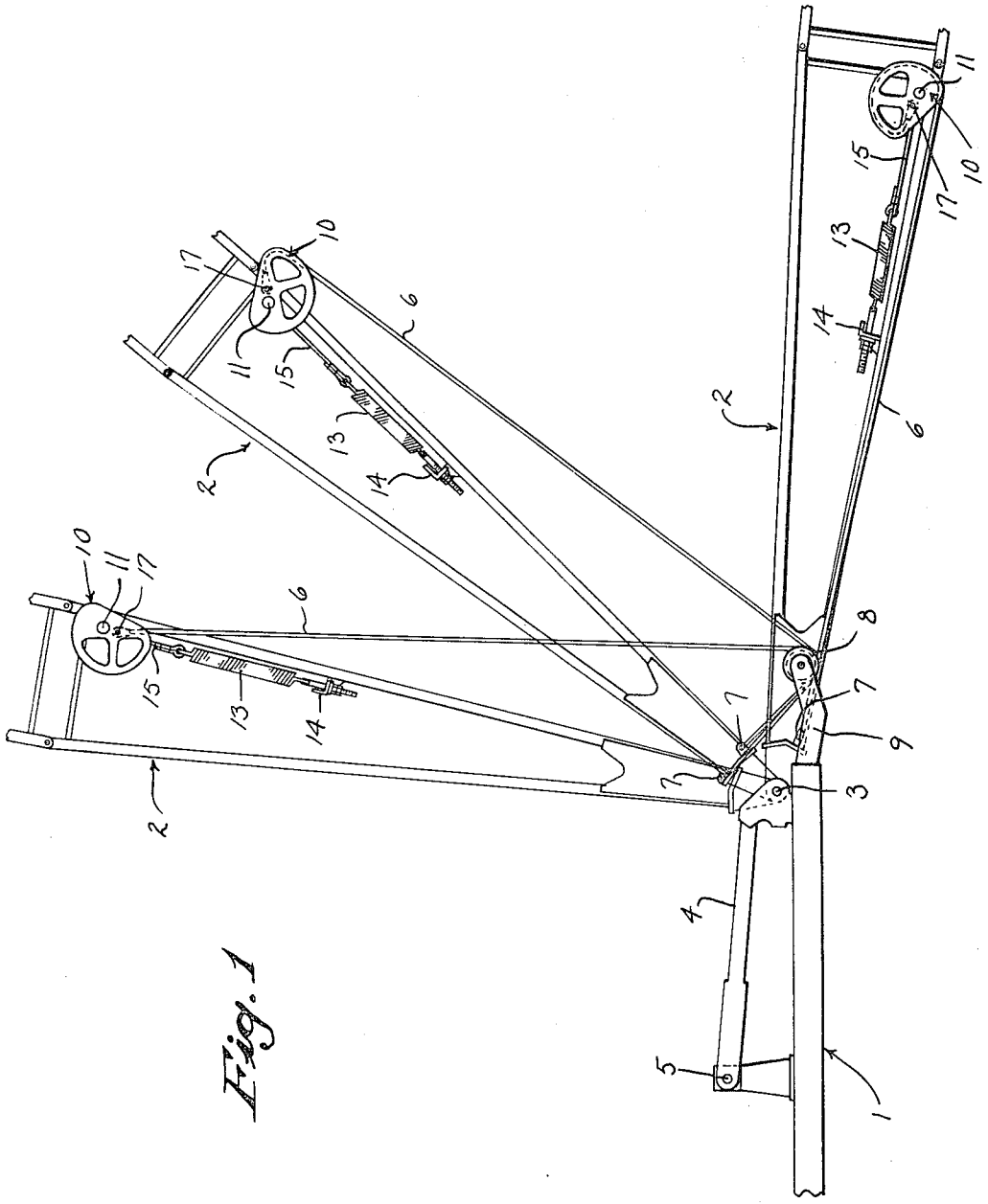

Fig. 1

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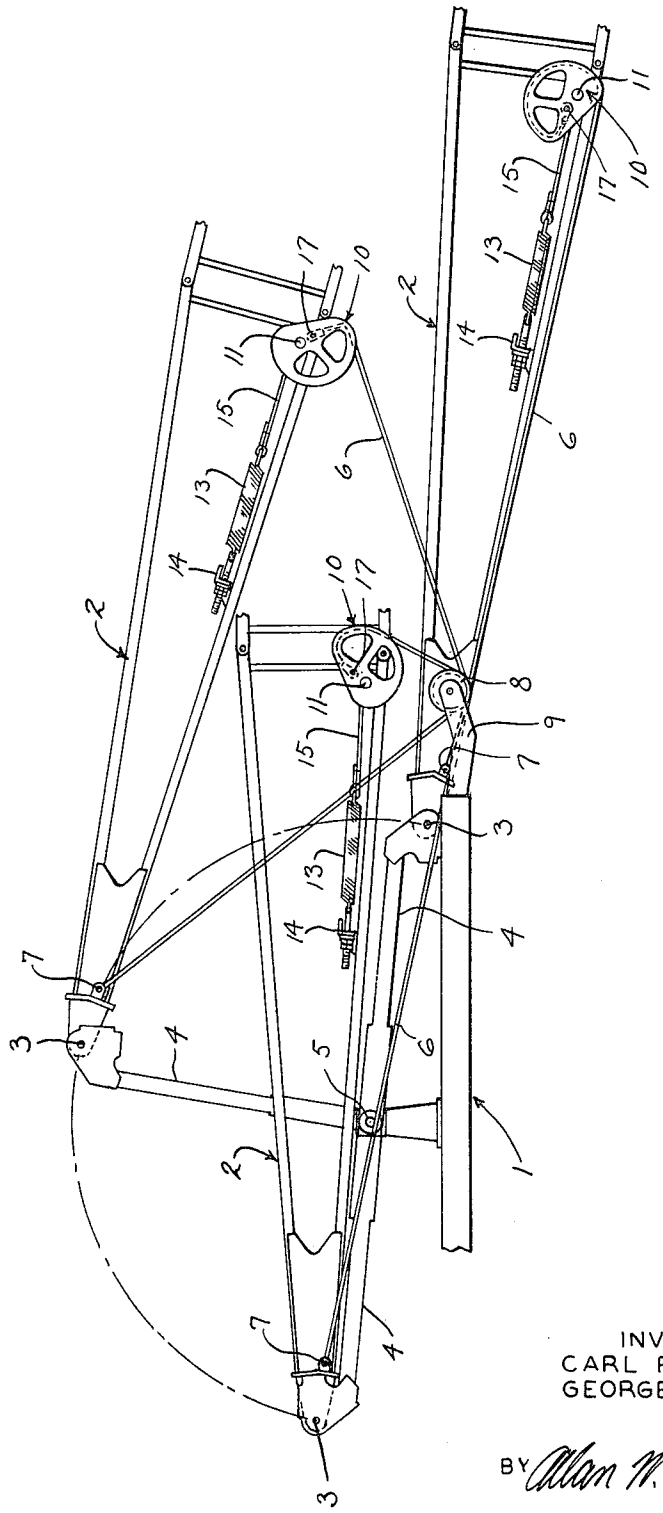

Fig. 2

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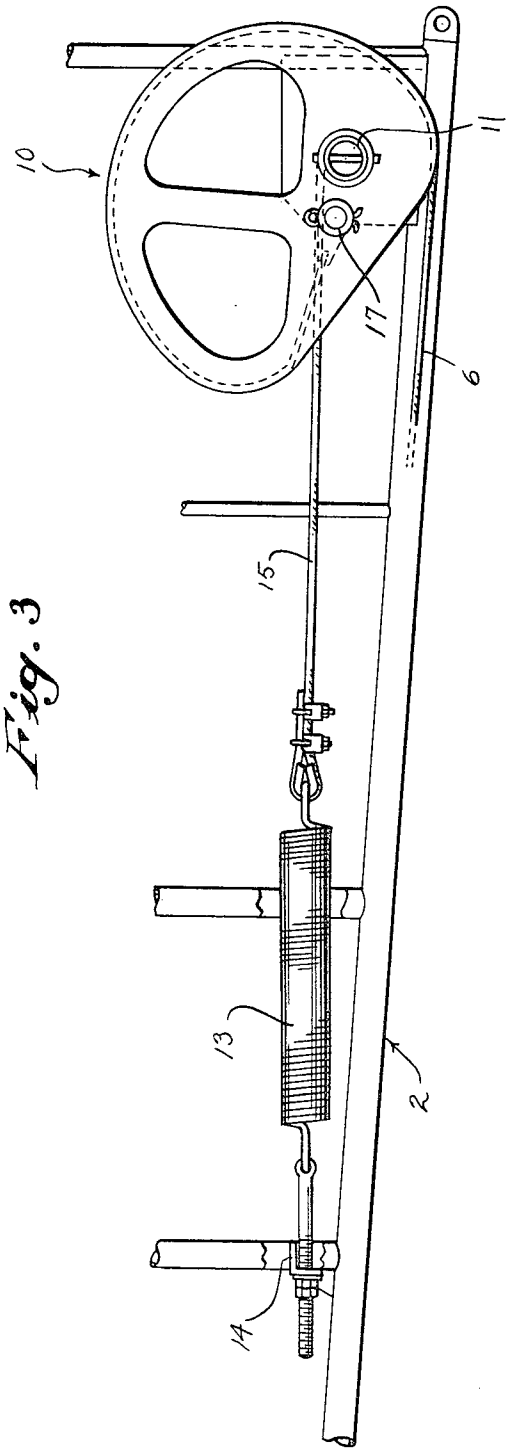

Fig. 3

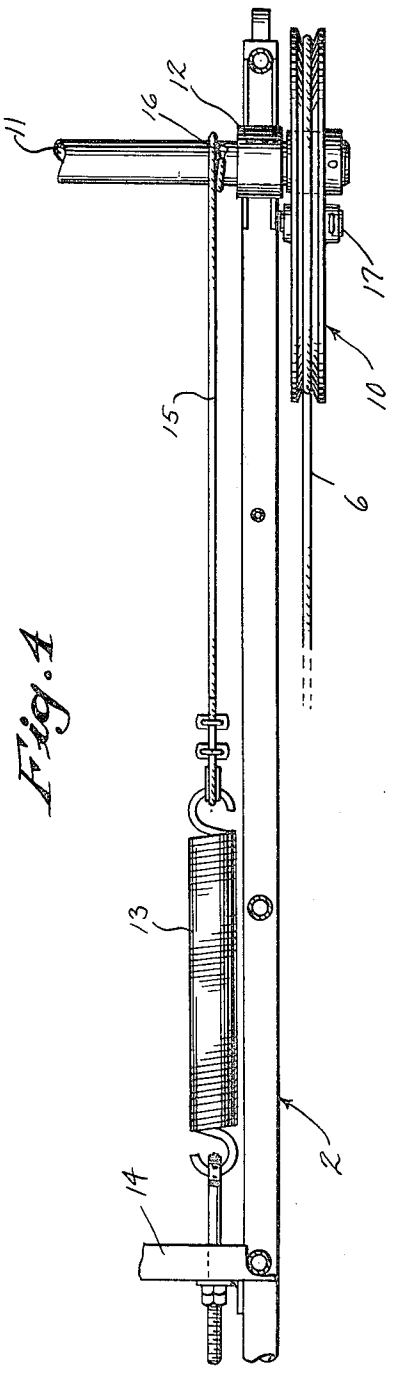

Fig. 4

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3,433,367

BOOM BACK-STOP APPARATUS

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Filed May 15, 1967, Ser. No. 638,527
U.S. Cl. 212—39 2 Claims
Int. Cl. B66c 13/48, 23/06

ABSTRACT OF THE DISCLOSURE

A back-stop apparatus for a retractable boom footed on the revolving frame of a truck mounted crane includes a take-up sheave mounted on a rotatable shaft on the boom above the foot and a stop sheave on the frame forward of the boom foot. A stop cable is connected at its lower end to the boom near the foot, passes about the stop sheave and is connected at its upper end to a point on the circumference of the take-up sheave. A tension spring is connected at one end to the boom, and a tension cable leads from the other end of the spring and is wrapped around and connected to the take-up sheave shaft to rotationally spring bias the sheave so that it rotates to take up slack in the stop cable as the boom luffs and as it retracts. The take-up sheave has a semicircular shape to provide sufficient circumference to take up the required amount of cable in a single rotation, while being adapted to clear the ground and provide a short moment arm when the boom is in a horizontal position.

Background of the invention

This invention relates to a boom back-stop apparatus that is particularly suitable for a retractable boom, for example on a truck mounted crane.

It is conventional to provide a back-stop apparatus to prevent a boom from moving backwardly past vertical and toppling over. Such an apparatus usually comprises a cable attached at its upper end to some point on the boom and at its lower end to the revolving frame or other supporting structure of a machine. The frame end of the cable is often attached to a spring loaded drum which serves to take up any slack in the cable resulting from luffing of the boom.

While the usual form of back-stop apparatus is suitable enough for an ordinary boom, it is not easily adaptable for use with a retractable boom such as is shown in the copending application of George W. Mork, Ser. No. 600,541, filed Dec. 9, 1966. The retractable boom of that application has its foot at a forward edge of a revolving frame during working, but the boom foot is lifted and moved rearwardly to retract the boom and thus shorten the machine for travel purposes. A conventional back-stop apparatus for a machine of this type would have to have a take-up drum capable of taking up a great amount of slack since the length of the stop cable would be reduced to practically nothing as its point of connection to the boom passed over the drum during retraction.

Summary of the invention

It is the general object of this invention to provide an improved boom back-stop apparatus that is generally useful, but particularly suitable for use with a retractable boom. One important feature of the invention is having both ends of the shot cable attached to the boom with the cable passing over a stop sheave on the frame, as a result of which the length of the cable does not change drastically during retraction. Another primary feature of the invention is the provision of a uniquely effective take-up means at one end of the cable which serves to take up such slack as does occur either during luffing or during retraction.

Brief description of the drawings

FIG. 1 is a schematic fragmentary view of a retractable boom monted on a revolving frame, the boom being provided with a back-stop apparatus formed according to this invention, alternative positions of the boom being shown,

FIG. 2 is a view similar to FIG. 1, but showing positions assumed by the boom during retraction,

FIG. 3 is an enlarged fragmentary side view more specifically illustrating the boom back-stop apparatus of FIGS. 1 and 2, and

FIG. 4 is an enlarged fragmentary top view further illustrating the boom back-stop apparatus of FIGS. 1 and 2.

Description of the preferred embodiment

In FIGS. 1 and 2, the numeral **1** designates the revolving frame of, for example, a truck mounted crane such as that shown in the aforementioned application Ser. No. 600,541. A boom **2** is pivotally attached at its foot **3** to the outer ends of a pair of retracting arms **4**, only one of which can be seen. The inner ends of the arms **4** are pivotally attached to the frame **1** as at **5**.

In FIG. 1, the boom **2** is in a working position with the foot **3** at the forward end of the frame **1** and suitably locked in place. In this position, the boom **2** can be pivoted between a nearly vertical position and a position at or slightly beyond horizontal in which the tip of the boom (not shown) is on the ground.

When it is desired to retract the boom **2** for traveling, it is lowered to its horizontal position and suitable means (not shown) are used to pivot the arms **4** counterclockwise about the point **5** to pick up the boom foot **3** and move it rearwardly, the boom **2** moving during this process through the positions shown in FIG. 2.

For the sake of simplicity and since the invention herein is useful in a variety of environments, obvious elements of the truck mounted crane such as the carrier vehicle, hoist mechanism, etc. and details of the retracting mechanism, boom and frame have not been shown and will not be described herein. They are of course known to those skilled in the art, and a specific showing can be found in the aforesaid application Ser. No. 600,541.

The back-stop apparatus comprises a stop cable **6** which fixed at its lower end to the boom **2** at a point **7** near the foot **3**. The cable **6** extends upwardly and passes about the outer or forward side of a rotatable stop sheave **8** which is mounted on an arm **9** extending from the frame **1**, the sheave **8** being forward of the boom foot **3**. The upper end of the cable **6** is attached to a take-up sheave **10** mounted at the forward surface of the boom **2** above the foot **3** and the sheave **8**.

The sheave **10** has a grooved circumference and a generally semicircular configuration, and is keyed to the outer end of and rotatable with a transverse tubular shaft **11** which is rotatably mounted between suitable bearings **12**, only one of which can be seen, provided on the boom **2**.

A tension spring **13** is attached at its lower end, by any suitable means, to a crosspiece or any other suitable support **14** provided on the boom **2** below the shaft **11**. A tension cable **15** is connected to and leads from the other end of the spring **13**, the free end of the cable **15** being at least partially wrapped about the shaft **11** and connected thereto at a key-hole slot **16**. The spring **13** and cable **15** constitute a tension means to rotationally bias the sheave **10** by urging the shaft **11**, and therefore the sheave **10**, to rotate counterclockwise as seen in FIGS. 1–3. The upper end of the stop cable **6** is attached to the sheave **10** on its flat side by any suitable means **17**.

The operation of the back-stop apparatus during normal working can be understood with reference to FIG. 1. The vertical position of the boom **2** shown therein represents the maximum desired working elevation. In this position, the cable **6** is extended completely so that it is not wound at all on the sheave **10**, the spring **13** then being stretched to the maximum extent desired with the free end of the cable **15** wound about the shaft **11** to the maximum extent desired. The cable **6** obviously prevents the boom **2** from being elevated further to the point where it might topple over backwards.

As the boom is lowered to the intermediate position shown in FIG. 1, which is close to the lowest normal working position, slack develops in the cable **6**. This allows the spring **13** to retract and, through the medium of the cable **15**, it rotates the shaft **11** and sheave **10** to wind the excess cable on the grooved circumference of the sheave **10**. Elevating of the boom **2** will of course re-stretch the cable **6**, causing unwinding of the sheave **10** and re-extension of the spring **13**. The cable **6** is thus held taut at all times as the boom is luffed during working, the sheave **10**, spring **13** and associated elements serving as a take-up means to compensate for any slack.

When the boom **2** is to be retracted, it is lowered to the horizontal position shown in both FIGS. 1 and 2, this also being the position of the elements in FIGS. 3 and 4. In this position, the cable **6** is at its shortest and the sheave **10** has gone through almost a complete revolution. The arms **4** are then pivoted counterclockwise about their inner ends **5** to move the boom foot **3** through the intermediate position shown in FIG. 2 to the retracted position to the left. During this movement, the cable **6** is stretched somewhat because it remains trained about the stop sheave **8** while the boom **2** lifts, but the sheave **10** unwinds to compensate therefore, as illustrated in FIG. 2. Again, the cable **6** is held taut through the entire operation.

Although the apparatus shown is otherwise particularly effective, it is during retraction that having the cable **6** attached at both ends to the boom **2** is most important, since with this arrangement the overall length of the cable **6** remains about the same instead of being reduced to almost nothing as the boom **2** moves rearwardly, and it is only necessary to compensate for slack to a relatively minor degree.

The semicircular shape of the sheave **10** is important in providing an especially effective apparatus. It is desirable for the sheave **10** to have a circumference great enough to take up the maximum possible slack in a single revolution to avoid any possibility of fouling. It is also desirable, however, to mount the sheave **10** as close as possible to the forward surface of the boom **2**, but without having it so far forward as to hit the ground when the boom **2** is lowered to horizontal. All of these objectives are fulfilled by the semicircular sheave **10** which provides a large circumference but is arranged to have its flat side generally down when the boom **2** is horizontal so that it can be mounted well forward on the boom **2** and still clear the ground.

Further, the semicircular shape with the cable **6** extending, in essence, tangentially from the flat side when the boom **2** is in its fully lowered horizontal position, the position shown in both FIGS. 1 and 2, provides a short moment arm that is helpful in keeping the cable **6** taut. That is, the spring **13** exerts its maximum force when the boom **2** is fully elevated, and its minimum force when the boom **2** is horizontal. It is in horizontal position, however, that the weight of the cable **6** exerts its greatest force and tends to develop a catenary which could result in fouling. The short moment arm referred to tends to compensate for the reduced effectiveness of the spring **13** to help in insuring that the cable **6** remains taut.

Terms like "semicircular," "down," "tangentially" and "flat" which are used herein with reference to the sheave **10** and its operation are not intended to be absolute but relative. That is, for example, the sheave **10** need not be strictly semicircular, and its flat side need not be exactly horizontal or parallel to the forward surface of the boom **2** when the latter is down. The indicated terms and others like them are intended rather to fairly describe the structure and operation in general terms and should be interpreted with the stated objectives in mind.

As has been seen, the apparatus of the invention shown herein keeps the cable **6** taut during both luffing and retraction, the sheave **10** serving to provide a particularly effective take-up for any slack. Although a preferred embodiment of the invention has been shown and described herein, however, it will be apparent that various modifications might be made without substantial departure from the concept of the invention. Other tension means may be provided to bias the sheave **10**, for examle, or as previously indicated the precise configuration or orientation of the sheave or other elements might be changed. Further, the invention is not necessarily limited in application to truck mounted cranes, and might well find use in various other environments. In view of the possible variations in structure and use, the invention is not intended to be limited by the showing herein, or in any other manner, except insofar as limitations appear specifically in the following claims.

We claim:

1. In a truck mounted crane or the like having a frame, a boom footed on the frame at a forward portion thereof, the foot of the boom being movable rearwardly with respect to the frame to retract the boom, and a back stop apparatus for the boom,

the improvement wherein

the back stop apparatus comprises: a stop sheave mounted on the frame forwardly of the boom foot; a stop cable which has one of its ends connected to the boom near its foot and which leads around the forward side of the stop sheave and has its other end connected to the boom above the foot; and slack take-up means at one end of the stop cable.

2. The combination of claim **1** wherein the slack take-up means comprises a take-up sheave to which said other end of the stop cable is connected and means to rotationally bias the take-up sheave so that it is adapted to wind up the stop cable; and wherein the take-up sheave has a semicircular configuration, and has a circumference sufficient to take up in a single revolution any slack developed in the stop cable as the boom is luffed between a vertical and a horizontal position, and is oriented so that the stop cable leads substantially tangentially from the flat side of the take-up sheave when the boom is horizontal.

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