Aug. 22, 1967 A. J. NELSON 3,336,895

YAW CONTROL OF TOWED BARGES

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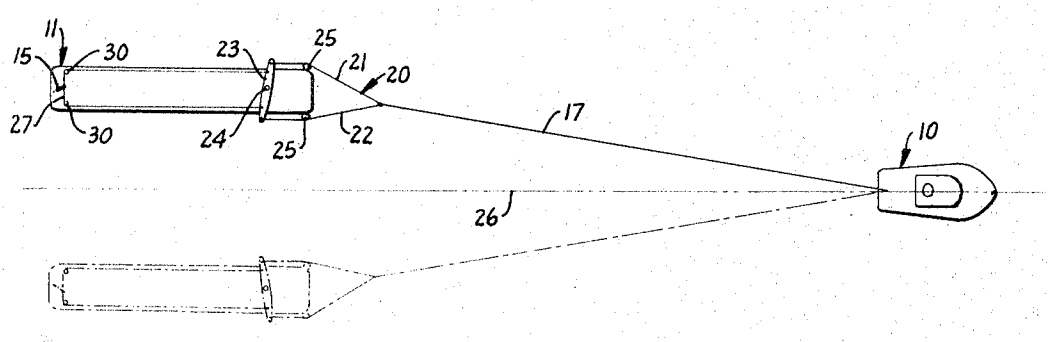


FIG. 1.

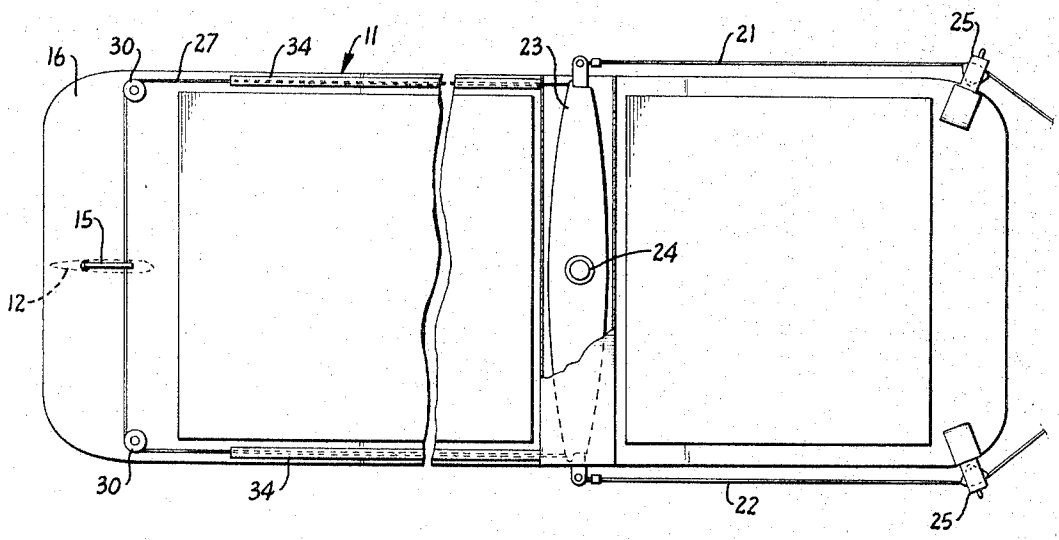


FIG. 2.

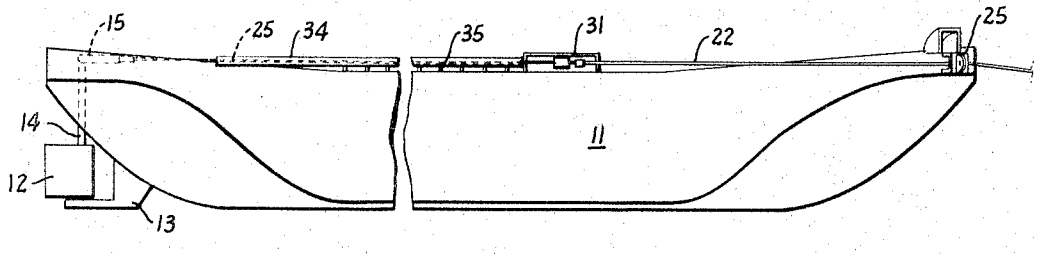


FIG. 3.

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YAW CONTROL OF TOWED BARGES

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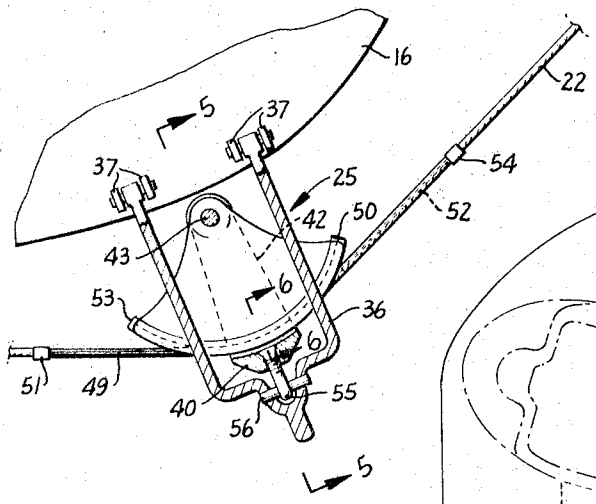


FIG. 4.

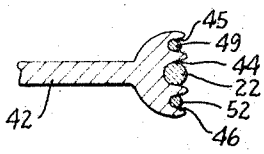


FIG. 6.

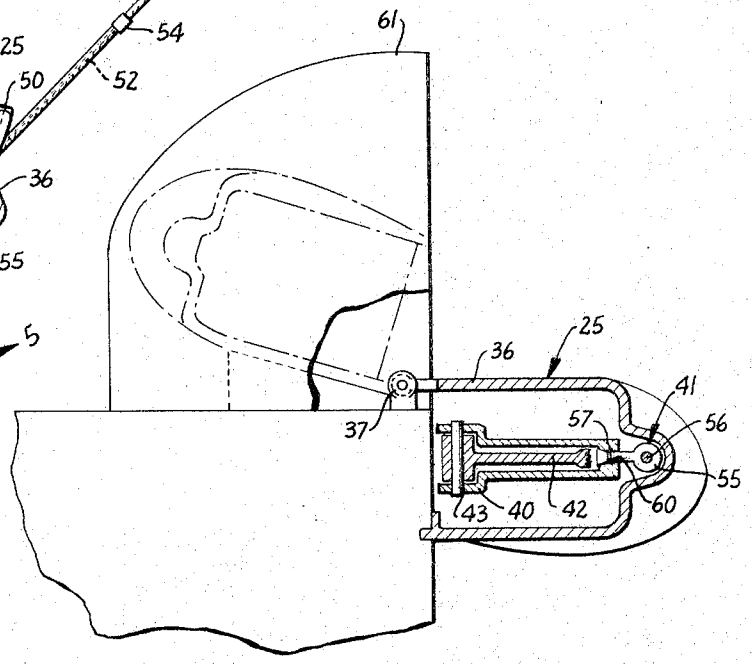


FIG. 5.

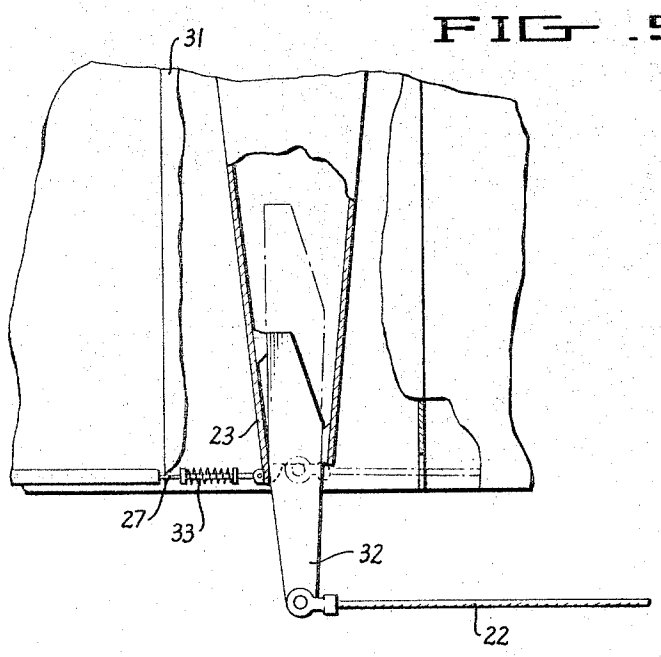


FIG. 7.

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YAW CONTROL OF TOWED BARGES

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13 Claims. (Cl. 114—236)

ABSTRACT OF THE DISCLOSURE

An apparatus for imparting draft forces and condition responsive steering to a towed barge comprising, as a primary component, a beam pivotally secured to the barge in generally transverse relationship relative thereto for rotation about a vertical axis extending through the longitudinal centerline of the barge. Draft forces are imparted to the towed barge from a leading propulsion barge by a bridle having ends connected to opposite ends of the beam and a center portion secured to the propulsion barge. The beam is connected to a rudder on the towed barge to impart yaw corrective steering movement to the rudder responsive to rotation of the beam upon deviation of the towed and propulsion barges from longitudinal alignment.

The present invention relates to a device to effect the yaw control of towed barges and more particularly is directed to an improved steering imparting draft connection for use between propulsion and towed barges. In its more specific aspects, the invention is concerned with a construction facilitating both the transmission of draft forces to a towed barge and the condition responsive control of rudder structure on the towed barge.

In a nautical sense, yaw is defined as the temporary deviation of a vessel from its direct course. This deviation typically takes place about the vertical turning axis of the vessel. Yawing of a towed barge, simply stated, is the wandering thereof off the track established by its towing, or propulsion, tug. It can be appreciated that this wandering is an inefficient and, at times, hazardous phenomena.

Prior art efforts to control the yaw of towed barges have taken various forms. Some of these rely on providing the barge with special hull form configurations and/or skegs which tend to maintain the barge on a straight course. The latter forms have the disadvantage that they are not capable of effecting varying control to accommodate differing adverse conditions. Other forms provide the towed barge with manual or condition responsive rudder structure to maintain its desired direction. Although the forms employing rudder structure are capable of varying control, they have met with little or no success. This has resulted because those requiring manual control are attendant with the disadvantages inherent with human operators and those provided with condition responsive control have been incapable of adequately coordinating steering and draft of towed barges.

It is, accordingly, a principal object of the present invention to provide a yaw control system for towed barges which avoids prior art shortcomings of the type noted above.

Another and more specific object of the invention is to provide a condition responsive yaw control system capable of coordinating the steering and draft of a towed barge.

A further object of the invention is to provide a yaw control and draft connection between a towed and propulsion barge wherein draft forces are imparted to the towed barge at a point along its longitudinal center line, thus avoiding the yaw tendency created by typical draft connections which tend to impart towing forces laterally of the towed barge under adverse conditions.

A further object of the invention is to provide a combined draft and condition responsive yaw control construction having elements which are subjected to a minimum of stress during all operation.

With respect to the latter object, it is another object of the invention to provide a draft connection wherein shock load effects are minimized.

Still another object of the invention is to provide a versatile draft cable guide construction.

The improved steering imparting draft connection of the present invention is designed for use in combination with a propulsion barge of conventional nature and a towed barge having a steering drag device thereon. In its more basic aspects, the invention comprises: a bridle secured to the propulsion barge and extending rearwardly therefrom, which bridle has end portions disposed on opposite sides of the towed barge; a beam extending transversely of the towed barge and pivotally secured thereto for rotation about a vertical axis passing through the longitudinal center line of the barge; and, connection means between the end portions of the bridle and the opposed ends of the beam. In a preferred embodiment, the steering drag device takes the form of a moveable rudder and connection means is provided between the beam and rudder. This latter connection means is designed to impart steering movement to the rudder responsive to pivotal movement of the beam. Through this overall arrangement, the beam functions to impart both draft force and condition responsive steering to the towed barge.

From a subsequent discussion it will be seen that, in the preferred form, the bridle comprises an elongated flexible member folded upon itself. To facilitate the use of such a bridle, the invention further comprises guide structure for the flexible member.

The foregoing and other objects and the details of the invention will become more apparent when viewed in light of the following detailed description and accompanying drawings, wherein:

FIGURE 1 is a plan view schematically illustrating the connection of the present invention employed between a propulsion and towed barge, with solid and phantom line representations illustrating the condition which occurs when the towed barge strays to either side of the desired direction of travel;

FIGURE 2 is a plan view, partially in section, illustrating the towed barge and the inventive connection thereto;

FIGURE 3 is a side elevational view of the towed barge illustrated in FIG. 2;

FIGURE 4 is a plan view, partially in section, illustrating the preferred form of the inventive guide structure employed with the connection bridle;

FIGURES 5 and 6 are sectional views taken on planes 5—5 and 6—6, respectively, of FIG. 4; and

FIGURE 7 is a plan view, partially in section, illustrating the connection structure between the bridle and beam.

Referring now to the drawings, the numerals **10** and **11** therein designate the propulsion and towed barges, respectively, in their entirety. The propulsion barge **10** is of conventional tug structure, the details of which form no part of the present invention. The towed barge **11** is of relatively conventional hull structure and includes a rudder **12** mounted at the stern thereof for pivotal movement about a vertical axis. Mounting of the rudder **12** is effected by support arm **13** fixed to the towed barge hull and a support shaft **14** fixed to the rudder **12**. The shaft **14** is mounted vertically between the hull of the barge **11** and the arm **13** for pivotal movement about its vertical axis. A tiller arm **15** is fixed to and extends laterally from the upper end of the shaft **14**.

In the form illustrated, the towed barge **11** is provided with a deck **16** over which the tiller arm **15** extends. This deck, together with the conventional hull form structure of the barge **11**, is not a necessary part of the present invention, but has been chosen merely for illustrative purposes. Specifically, this hull and deck construction has been chosen primarily to illustrate that the improvement of the present invention is easily adaptable to conventional hull structures presently in use. From the subsequent discussion, it will become apparent that the inventive improvement is well adapted for use with any towed barge employing steering drag means.

The overall arrangement of the steering imparting draft connection between the propulsion barge **10** and towed barge **11** can best be seen from FIGURE 1. The main force transmitting element shown in this figure comprises an elongated flexible towing hawser **17** secured to the barge **10** and extending rearwardly therefrom towards the barge **11**. The hawser **17** preferably takes the form of a wire cable and has secured to the rearward end thereof an elongated flexible bridle **20** folded upon itself to form segments defining end portions **21** and **22** extending around opposite sides of the barge **11**. Similarly to the hawser **17**, the bridle **20** is also preferably formed of wire cable. The end portions **21** and **22** are connected, respectively, to the opposed ends of a beam **23** extending transversely of the barge **11**. The beam **23** is secured to the barge **11** for pivotal movement about a vertical axis passing through the longitudinal center line of the barge by a trunnion support **24** mounted on the barge deck. Guide sheave structures **25** mounted on either side of the barge **11** guidingly engage the end portions **21** and **22** for direction to the beam **23**.

Through aforedescribed elements **20** to **25**, towing forces transmitted by the hawser **17** are imparted to the barge **11** along its longitudinal center line. The interrelationship of the elements **20** to **25** also provides for pivotal movement of the beam **23** about the trunnion **24** as the barge **11** strays to either side of the line of direction, designated by the numeral **26** in FIG. 1, of the propulsion barge **10**.

Upon straying of the barge **11** to either side of the line of direction **26**, as illustrated in FIG. 1, a steering connection between the beam **23** and the rudder **12** immediately functions to effect return of the towed barge to alignment with the line of direction. This connection comprises an elongated flexible cable **27** having the respective end portions thereof secured to the opposed ends of the beam **23** and an intermediate portion secured to the tiller **15**. To assure that movement of the cable **27** is accurately transmitted to the tiller, the cable is maintained under tension by guiding engagement with sheaves **30** mounted on the deck **16**.

The details of the mounting for the beam **23** and the connection of the portions **21** and **22** thereto can be more clearly seen from FIGS. 2, 3 and 7. From these figures, it can be seen that a housing **31** is disposed on the deck **16** to shield the beam **23** and assure free movement of the ends thereof through a predetermined arc. The extent of this arc is selected to provide effective operation of the beam under all circumstances.

The detailed connection of the portion **22** to the beam **23** is best shown in FIG. 7. From this figure, it can be seen that an extensible arm **32** is telescopically received in the beam **23** for movement between the solid and phantom line positions illustrated. The purpose of this arrangement is to provide for retraction of the portion **22** and its connection to the beam **23** to positions disposed inwardly of the towed barge hull sides. This retractable characteristic is of advantage when it is desired to locate the barge at dock or any other non-towed condition where lateral protuberances are to be avoided. Suitable detent means (not illustrated) provide for selective movement of the arm **32** between the solid and phantom line positions illustrated in FIG. 7. Although not illustrated in detail, it is to be understood that the portion **21** is secured to the beam **23** through a retractable construction corresponding to that used for the portion **22**.

From FIG. 7 it can also be seen that the cable **27** is secured to the beam **23** under tension by a spring connection **33**. Although not illustrated in detail, it is to be understood that this connection may take the form of any one of the various spring tensioning means well known in the art. The end of the cable **27** opposite that illustrated in FIG. 7 is also preferably secured to the beam through a tension spring connection.

In order to minimize the possibility that the cable **27** might be fouled, it is extended through shielding tubes **34** disposed on either side of the barge **11** opposite the load carrying deck portions thereof. The tubes **34** are fixed to the deck **16** and spaced therefrom by rigid supports **35**. Through the latter provision, the tubes are well facilitated for the attachment thereto of cargo tie-down devices, such as ropes.

Referring now to FIGS. 4, 5 and 6, therein is illustrated, in detail, the guide sheave structure **25** about which the cable portion **22** is directed. This structure comprises a rigid support **36** pivotally secured to the deck **16** by ears **37** for movement between an operative condition extending laterally from the barge **11** and an inoperative condition disposed inwardly of the barge sides (see the solid and phantom line illustrations, respectively, in FIG. 5); a sheave mount **40** secured to and extending inwardly from the support **36** for universal movement with respect thereto by a toggle connection **41**; a sheave segment **42** pivotally secured to an inner portion of the mount **40** by a pin **43**, which segment has extending around the periphery thereof a primary groove **44** receiving the cable portion **22** and a pair of auxiliary cable receiving grooves **45** and **46**; a first auxiliary cable **49** received in the groove **45** and having one end thereof fixed to a peripheral end of the segment by a connection **50** and the other end thereof fixed to the cable portion **22** by a connection **51**; and, a second auxiliary cable **52** received in the groove **46** and having one end thereof fixed to a peripheral end of the segment **42** opposite the connection **50** by a connection **53** and the opposite end thereof fixed to the cable portion **22** by a connection **54**. The toggle connection **41** comprises an eye **55** pivotally received on a pin **56** extending through the support **36** and a leg **57** fixed to the eye and extending into pivotally supporting engagement with an opening **60** in the mount **40**. A shield **61** is disposed on the deck **16** so as to cover the entire guide sheave structure **25** when in the retracted phantom line position illustrated in FIG. 5.

When in the solid line position illustrated in FIG. 5, the guide sheave structure **25** functions to direct the cable portion **22** to the arm **32** (see FIG. 7). In performing this function, the structure **25** supports the cable portion **22** in spaced relationship with respect to the bow of the towed barge for relatively free universal movement. The segmented sheave arrangement employed in the structure **25** has the advantage that a relatively large sheave diameter may be employed without spacing the cable from the barge by a distance nearly as great as would be necessary with a 360° sheave of the same diameter. This structure also has the advantage that the spacing of the center of gravity of the sheave segment from the hinge pin **56** increases as the segment is turned to either side of the intermediate position illustrated in FIG. 4. As a result, upon turning of the sheave segment, the weight thereof carried by the cable portion **22** is increased, thus introducing an added sag into the cable. This characteristic is desirable, since sag in the cable functions to minimize the effect of shock loads applied thereto.

At this point, it is noted that the auxiliary cables **49** and **52** function to maintain the principal cable portion **22** in non-slip engagement with the sheave segment at all times. The auxiliary cables do not, however, interfere with the normal guiding relationship between the sheave and

primary cable portion. It is also noted that, although the guide sheave construction cooperating with the cable portion **21** is not illustrated in detail, this construction corresponds identically in function and operation to that described with respect to the cable portion **22**.

From the foregoing description, it is believed apparent that the present invention enables the accomplishment of the objects initially set forth herein. In this regard, attention is directed to the fact that the use of the pivoted beam **23** provides for sharing of the towing force between the end portions **21** and **22** of the bridle at all times, thus avoiding a high concentration of stress in one portion during yawing. Furthermore, since the preferred embodiment of the invention eliminates the use of skegs, the high towing resistance offered by skegs is alleviated and the tow line stress resulting from this resistance is avoided. It is to be understood, however, that the invention is not intended to be limited to the specific details of the exemplary embodiment illustrated and described herein. For example, the exact positioning of the beam trunnion along the center line of the towed barge and the turning ratio maintained between the beam and the rudder may be varied, within the definition of the claims hereinafter set forth, without department from the spirit of the invention.

What is claimed is:

1. In a combination comprising:

(a) a propulsion barge; and,

(b) a towed barge having a rudder;

an improved steering imparting draft connection between said barges, comprising:

(1) a draft bridle secured to said propulsion barge and extending rearwardly thereform, said bridle having respective end portions disposed on opposite sides of said towed barge;

(2) a beam extending transversely of said towed barge, said beam being pivotally secured to said towed barge for rotation about a substantially vertical axis passing through the longitudinal centerline of said towed barge;

(3) draft connection means between the end portions of said bridle and the opposite ends of said beam whereby when said propulsion and towed barges deviate from longitudinal alignment said beam is pivoted about said vertical axis; and,

(4) steering connection means between said beam and rudder to impart yaw correction steering movement to said rudder responsive to pivotal movement of said beam.

2. An improved steering imparting draft connection according to claim **1**, wherein:

(a) the bridle comprises an elongated flexible member having free end segments folded towards each other to define said end portions;

(b) the bridle is secured to the propulsion barge through a connection fixed to said member intermediate the end segments thereof; and,

(c) said connection is disposed forwardly of the towed barge and said respective segments extend rearwardly therefrom to opposite sides of the towed barge.

3. An improved steering imparting draft connection according to claim **2**, including guide means disposed on each of said opposite sides of the towed barge to direct said respective segments to the draft connection means.

4. An improved steering imparting draft connection according to claim **3**, wherein:

(a) said flexible member comprises a primary cable; and,

(b) each of said guide means comprises:

(1) a substantially horizontal support secured to the towed barge and extending laterally from a side thereof;

(2) a sheave mount secured to and extending inwardly from said support toward the towed barge for pivotal movement about a substantially horizontal axis disposed substantially parallel to the side of the towed barge from which said support extends;

(3) a sheave segment pivotally secured to and extending outwardly from an inner portion of said mount for movement about a substantially vertical axis, said sheave segment having extending around the periphery thereof a primary cable receiving groove and at least two auxiliary cable receiving grooves, said primary groove guidingly receiving said primary cable;

(4) a first auxiliary cable guidingly received in one of said auxiliary grooves and having the respective ends thereof secured in substantially fixed relationship to said primary cable and one end of the periphery of said sheave segment; and

(5) a second auxiliary cable guidingly received in the other of said auxiliary grooves and having the respective ends thereof secured in substantially fixed relationship to said primary cable and the other end of the periphery of said sheave segment.

5. An improved steering imparting draft connection according to claim **4**, including retraction means securing said support to be towed barge for selective movement between an operative condition extending laterally from a side of the towed barge and an inoperative condition disposed substantially inwardly of said side.

6. An improved steering imparting draft connection according to claim **4**, including means securing said sheave mount to said support for pivotal movement about a second substantially horizontal axis disposed normal to said first mentioned horizontal axis.

7. An improved steering imparting draft connection according to claim **1**, wherein said steering connection means comprises:

(a) an elongated flexible member having the respective ends thereof secured to the opposed ends of said beam and an intermediate portion operatively secured to said rudder for movement therewith; and,

(b) directing means operatively engaging said elongated flexible member to effect the guiding of substantially the entire length thereof under tension.

8. An improved steering imparting draft connection according to claim **7**, wherein said directing means comprises:

(a) a pair of tubular elements fixed, respectively, to said towed barge adjacent the opposite sides thereof and having extending slidably therethrough said elongated flexible member; and

(b) a pair of sheaves mounted on said towed barge, respectively, between each of said tubular elements and said rudder in guiding relationship to said flexible member.

9. An improved steering imparting draft connection according to claim **8**, including:

(a) means spacing said tubular elements from the towed barge to facilitate the attachment of cargo tie-down devices thereto; and,

(b) housing means disposed around said beam to prevent inadvertent interference with the rotation thereof.

10. An improved guide for use in directing a primary flexible cable past an upstanding member, comprising:

(a) a support secured to and extending laterally from said member;

(b) a sheave mount secured to and extending inwardly from said support for universal pivotal movement with respect thereto;

(c) a sheave segment pivotally secured to and extending outwardly from an inner portion of said mount, said sheave segment having extending around the periphery thereof a primary cable receiving groove and at least two auxiliary cable receiving grooves,

said primary groove guidingly receiving said primary cable;

(d) a first auxiliary cable received in one of said auxiliary grooves and having the respective ends thereof secured in substantially fixed relationship to said primary cable and one end of the periphery of said sheave; and,

(e) a second auxiliary cable guidingly received in the other of said auxiliary grooves and having the respective ends thereof secured in substantially fixed relationship to said primary cable and the other end of the periphery of said sheave.

11. In a combination comprising:

(A) a propulsion barge; and,

(B) a towed barge having steering drag means thereon; an improved steering imparting draft connection between said barges, comprising:

(1) a bridle comprising an elongated flexible member extending rearwardly of said propulsion barge, said member having free end segments folded towards each other to define end portions disposed on opposite sides of said towed barge;

(2) means securing said bridle to said propulsion barge in rearwardly extending relationship relative thereto, said means comprising:

(a) a connection fixed to said elongated member intermediate the end segments thereof and forwardly of said towed barge so that said segments extend rearwardly from said connection to opposite sides of the towed barge; and

(b) an element secured between said connection and propulsion barge;

(3) a beam extending transversely of said towed barge, said beam being pivotally secured to said towed barge for rotation about a substantially vertical axis passing through the longitudinal centerline of said towed barge;

(4) draft connection means between the end portions of said bridle and the opposite ends of said beam comprising a pair of arms, each of which has one end secured to one of the opposite ends of the beam

and another end secured to one end portion of the bridle for selective movement between an operative condition extending laterally from a side of the towed barge and an inoperative condition disposed inwardly of said side; and,

(5) guide means disposed on each of said opposite sides of the towed barge to space said segments laterally from said sides and direct said segments to the draft connection means.

12. An improved steering imparting draft connection according to claim **1**, further including a housing disposed around said beam to prevent inadvertent interference with the rotation thereof, said housing being positioned in close proximity to the deckline of said towed barge between the operating components of said barge located on the deck thereof.

13. An improved steering imparting draft connection according to claim **3**, wherein:

(a) said draft connection means are disposed, respectively, laterally of the opposite sides of said towed barge; and,

(b) said guide means are disposed, respectively, laterally of the opposite sides of said towed barge and forwardly of said respective draft connection means to maintain the respective end segments laterally of the opposite sides of said towed barge and permit weight responsive sag in said segments.

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