United States Patent [19]

Bond

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[54] **TRAVELING BRIDGE WITH POWER-CABLE REEL ROTATED IN RESPONSE TO BRIDGE MOVEMENT, SLIPLESSLY AND WITH UNIFORM TENSION**

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[52] **U.S. Cl.** .... **191/12.2 R,** 191/12 R, 212/21, 210/527

[51] **Int. Cl.** **H02g 11/00**

[58] **Field of Search** .... 191/12 R, 12.2 R; 212/21; 210/527; 242/47.5, 107.10, 107.13

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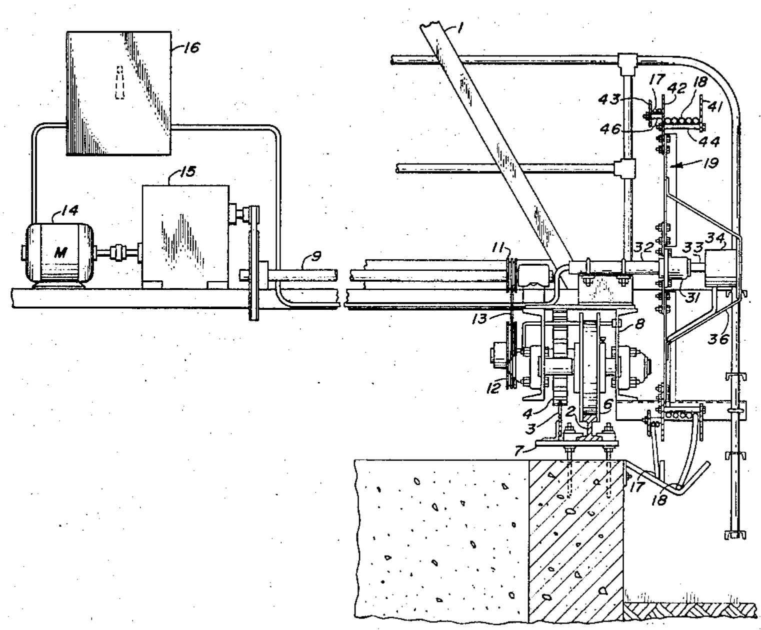
[57] **ABSTRACT**

Uniform tension is kept on a power cable leading to a bridge-type sludge collector. The traveling bridge carries a cable reel which winds the cable thereon with a substantially constant but non-slip tension by rotating the reel in response to bridge movement. The apparatus preferred for most installations uses a second cable on a companion section of the reel but extending from the reel in the opposite direction and oppositely wound so that the bridge movement away from the end at which this actuating cable is anchored turns the reel, by the pull of the unwinding actuating cable, to reel in the power cable. To compensate for minute discrepancies and maintain a uniform tension the anchoring of the actuating cable includes a weight and pulley arrangement.

9 Claims, 3 Drawing Figures



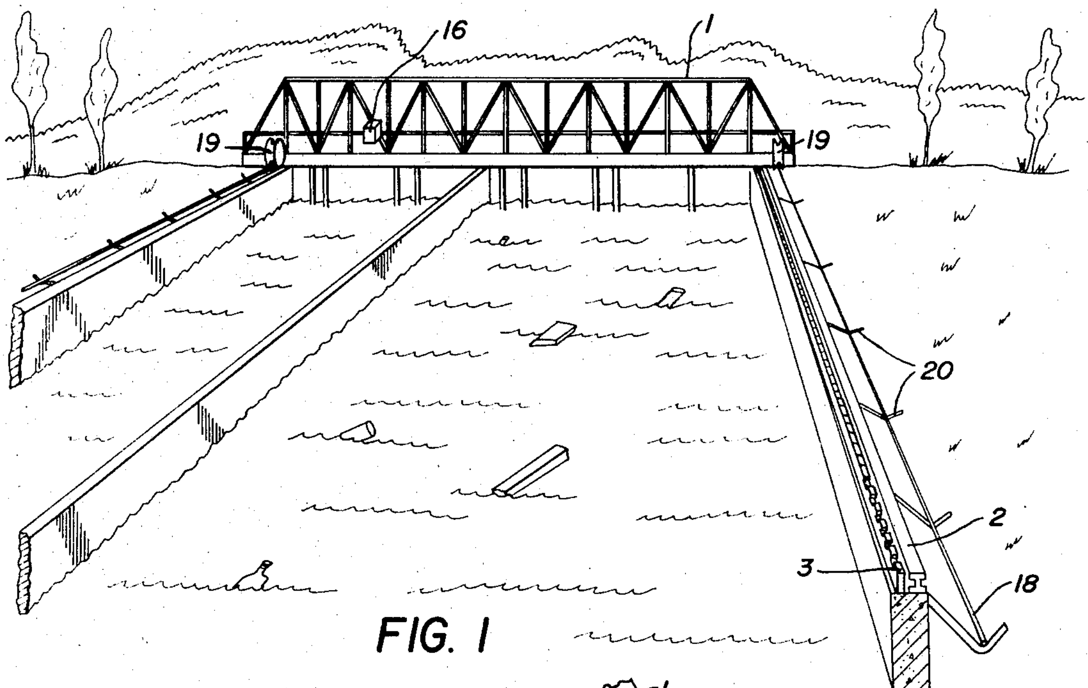


FIG. 1

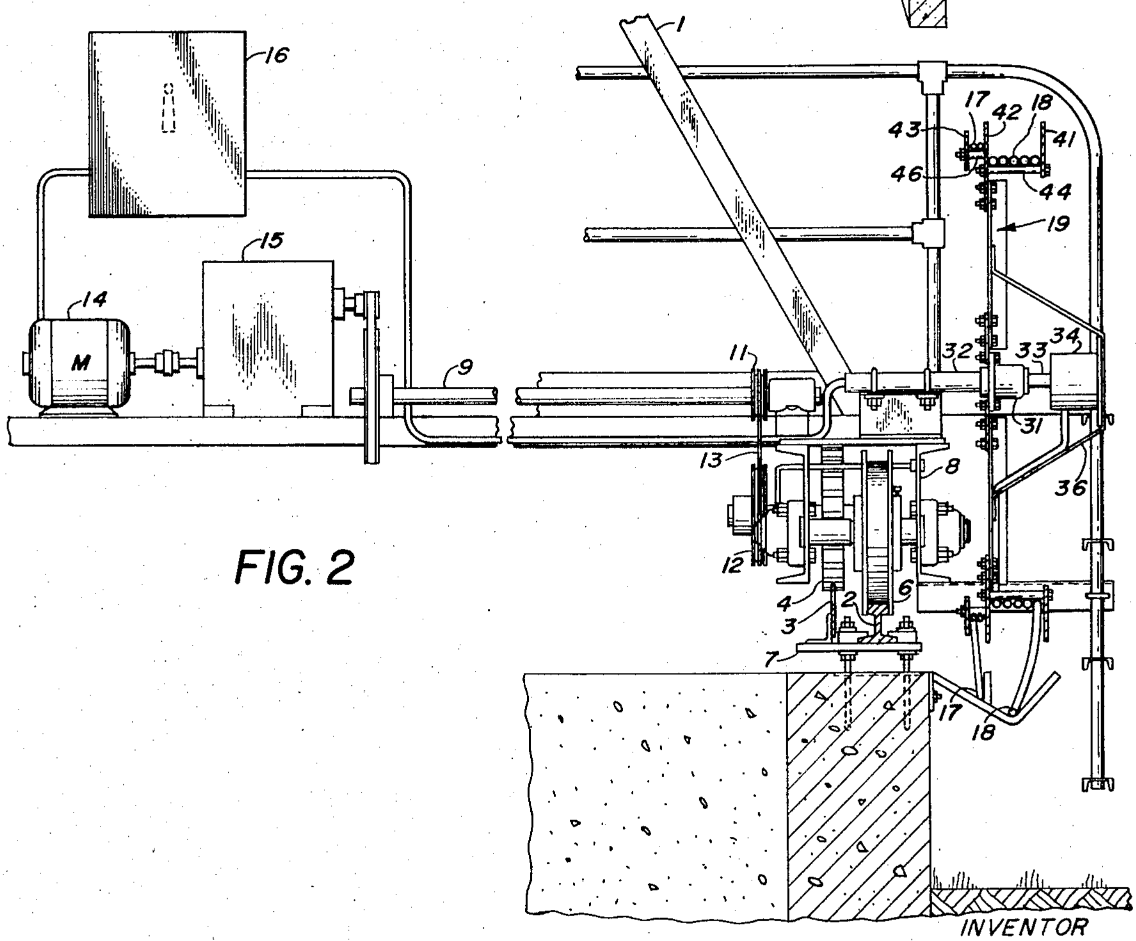


FIG. 2

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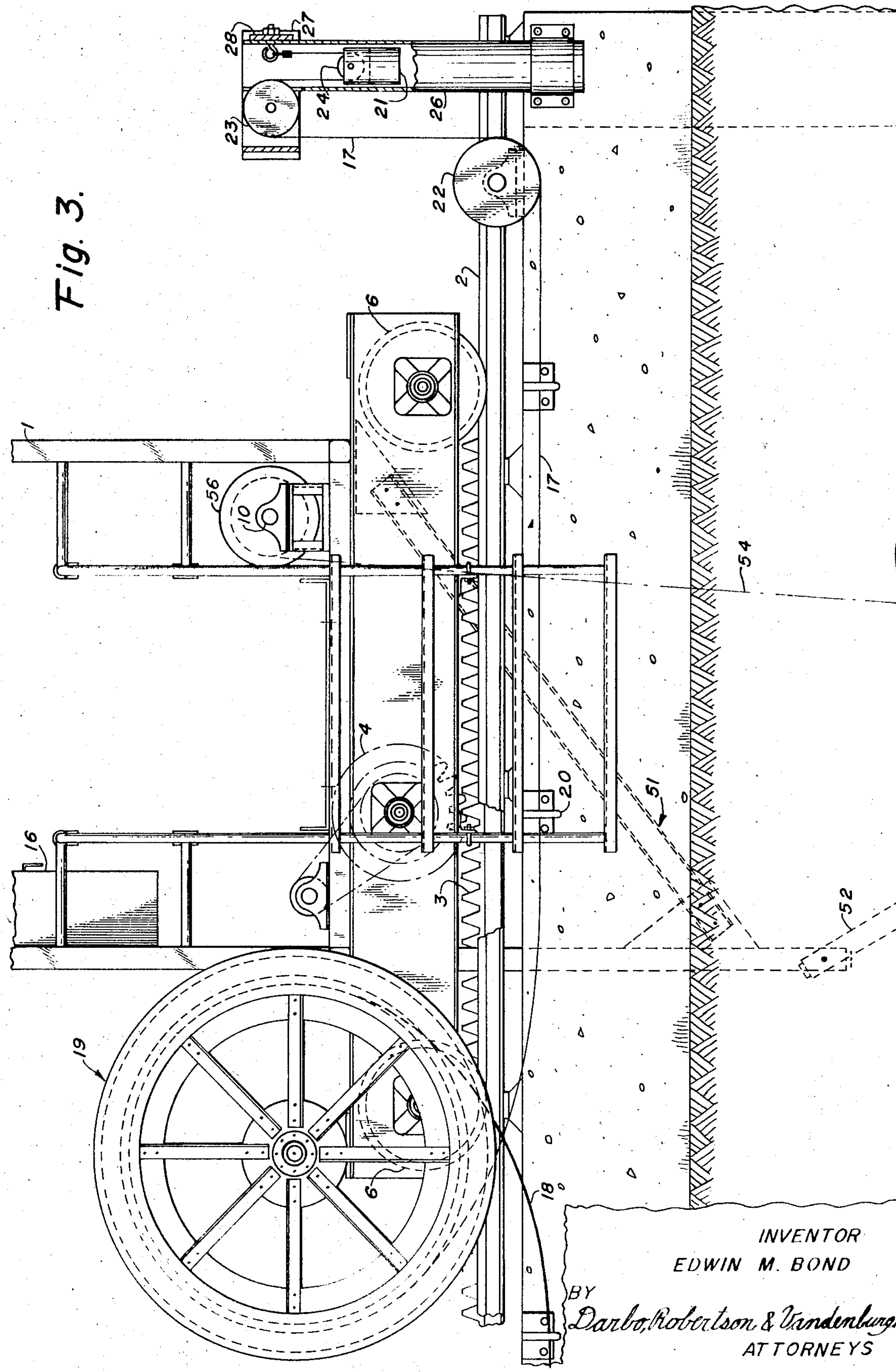

Fig. 3.

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TRAVELING BRIDGE WITH POWER-CABLE REEL ROTATED IN RESPONSE TO BRIDGE MOVEMENT, SLIPLESSLY AND WITH UNIFORM TENSION

INTRODUCTION

The invention of which this disclosure is offered for public dissemination in the event that adequate patent protection is available relates to a system for reeling power-cable by which a traveling bridge is powered for moving along the length of a tank a sludge-collecting scraper.

There have long been two different methods of tensioning power cable reels for traveling bridge sludge collectors. By one method, the reel is spring-wound. This is objectionable because turning of the reel changes the tension of the spring and there will be either undesirably high tension on the power cable when its maximum length has been payed out or inadequate tension on the power cable when it is fully reeled in.

The other method of winding the reels has been by a motor drive with some slippage device in the drive connection between the motor and the reel. Inasmuch as a slippage must transmit a torque sufficient to provide the desired tension on the cable, the slippage represents loss of power. Furthermore, the slippage devices tend to be either quite expensive or quite troublesome, or perhaps both.

According to the present invention these faults are completely avoided, a uniform tension for the cable being provided without slippage, and at low cost. This is accomplished in part by providing special means for turning the cable reel in response to bridge movement. It is then merely necessary to make the reel rotational speed such that the cable will be payed out or drawn in at a relative linear speed which is nominally (either constantly or on the average) equal to the speed of the bridge, and to provide some small compensation for irregularities. Both the responsive reeling and the compensation for irregularities can be provided by providing an acuating cable which, as compared to the power cable, extends from the reel in the opposite direction lengthwise of the tank and is wound oppositely. Thus the actuating cable is drawn out from the reel by one direction of movement of the bridge, thus turning the reel to wind the power cable. In the other direction of movement of the bridge, the power cable will turn the reel to pay itself out, thus reeling in the actuating cable. At the end of the tank the actuating cable is maintained evenly tensioned by a pulley and weight system. A moderate range for possible movement of the weight will provide the small amount of take-up required for the inevitable variations. It is also theoretically possible to use a spring-wound reel for accommodating these variations, while maintaining a substantially uniform tension. This is because the amount of cable wind-up to accommodate the variations can be quite small compared to the potential winding of the spring, so that there is very little change of spring tension. This would lose an important advantage of the cable and weight, however; the advantage of avoiding the cost of the spring-wound reel. There could be some special circumstances justifying giving up this advantage while retaining other advantages of this invention. For example, co-workers have recognized that (at least in theory) the spring-wound reel could be used for a variation of the invention for which the actuating cable system would not be used. Thus, for an exceptionally long travel of the bridge where it may be desired to have the anchored end of the power cable at the middle of the run, the turning of the reel in response to the movement of the bridge can be accomplished by something in the nature of chain driving of the reel, the proper speed relative to the movement of the bridge resulting from coupling the chain drive either to the drive of the bridge or to a traction-responsive drive system, with the correction ratio of drive. Difficulties are encountered, however, unless the chain drive is reversed as the reel passes over the center position, and such reversal presents problems.

Additional advantages and objects of the invention will be apparent from the following description and from the drawings.

DESIGNATION OF FIGURES

FIG. **1** is a pictorial view showing a sludge collector bridge spanning a double settling tank.

FIG. **2** is a view looking in the same direction as FIG. **1** but showing on a much larger scale the end portion of the bridge, together with a diagrammatic representation of the power unit for driving the bridge.

FIG. **3** is a view of the structure of FIGS. **1** and **2** as seen from the right of those figures.

BACKGROUND DESCRIPTION

Except for the inventive aspects to be described, the bridge may be conventional. As seen in FIG. **1**, it rides at each end thereof on a rail **2**. Uniform movement of the bridge, both as to speed and as to maintaining its parallelism with the ends of the tank is provided by driving each end of the bridge with a creep-free system of drive such as rack **3** and cogwheel **4**. To keep the bridge in proper position laterally of the tank, the rail **2** along one side of the tank is preferably engaged by double-flanged wheels **6**. The rail at the other side of the tank may be engaged by unflanged wheel, and if excessive variations are feared it may have an axial dimension substantially greater than that of the rail.

The rails **2** and also the racks **3** are preferably jointly supported by base plates **7** which are preferably adjustable at installation so as to make the rails extremely level. The wheels **2** and cogwheel **4** are rotatively mounted in frames or trucks **8**, one at each end of the bridge span **1**.

To ensure uniform movement of the two ends of the bridge, the drive for the two ends is through a shaft **9** extending the entire length of the bridge span **1**, and preferably driven at a midpoint so that even the torsional flexing of the shaft will be uniform for the two ends. Likewise there is a similar long shaft **10**, driven at the center of the bridge, which is used for driving the hoist line for the scraper mechanism.

At each end of the bridge span **1** the shaft **9** carries a sprocket **11** which drives chain **13** which in turn drives sprocket **12**.

Shaft **9** is driven by motor **14** through a speed reducer **15**. The motor is controled through an electrical control box **16**. Control box **16** may include timer mechanism for driving the bridge only on a predetermined schedule perhaps as rarely as once a day. It also includes reversing controls for motor **14** automatically stopping the motor and then reversing it at the end of each run. The present invention is concerned with making available for the motor **10** on the moving bridge 1 the electrical power for driving this motor. Commonly this power has been made available through an electrical cable which would be wound on or unwound from a reel carried by the bridge as the bridge moved in one direction or the other. The present invention is mainly concerned with the drive of such a reel.

GENERAL EXPLANATION OF PREFERRED REEL DRIVE

According to the illustrated and generally preferred form of the present invention, the reel **19** has wound thereon both the electric supply cable **18** and an actuating cable **19** which may be a 1/8 inch steel cable. As seen in FIG. **2**, the reel **19** is made in the form of a double reel. As seen in FIG. **3**, both of cables **17** and **18** leave reel **19** near the bottom thereof and extend in opposite directions along the tank. Thus they are wound on the reel in opposite directions. Each cable is supported along the length of the tank at suitable moderate intervals by cable supports **20**.

Preferably these are positioned, as seen in FIG. **2**, to hold the cables safely above the ground and also at a spacing from rails **2** such as to be safe even in a gale. Cable **18** is anchored and connected to a source of power at the end of the tank, and cable **17** is provided with a tensioning take-up means represented by weight **21** (FIG. 3) at the other end of the tank.

From FIG. **3** it is apparent that as the bridge **1** is driven to the right (by its cogwheels **4**) the cable **18**, being fixed at the left end of the tank, will draw itself out from reel **19**, turning the reel. This in turn will wind cable **17** on the reel **19**. When the drive of cogwheels **4** is reversed to drive the bridge **1** to the left, the tension maintained on cable **17** will cause the reel **19** to turn in the opposite direction winding the cable **18** onto the reel and paying out the cable **17**.

Theoretically it might be possible to make the payout of one cable so nearly equal to the take-in of the other cable that slight discrepancies could be accommodated by varying sag of the cables between the supports **20**. However, because of the wind problem and for other reasons it is preferred to maintain a certain optimum tension on the cable **18** at all times. For that reason it is preferred that the inevitable variations be accommodated by some take-up means for cable **17** at the end of the tank. For maximum certainty in maintaining the optimum tension, this take-up means is preferably a weight and pulley system as illustrated in FIG. **3**. Thus the cable **17** may extend around a first guide pulley **22** and a second guide pulley **23** from which it supports weight **21**. Weight **21** has been illustrated as including a third pulley **24** so that the weight will have only half of the movement of the take-up in cable **17** which it accomplishes. Of course the weight **21** would thus have twice the weight which would be required if it hung by a single line. Unless the entire assembly of pulleys **22**, **23** and **24** and weight **21** are housed, the weight **21** should be protected from the wind as by pipe **26**, which may also be used as a support for a pair of plates **27** between which are supported pulley **23** and anchor bar **28**. If the cable position is sufficiently far above ground, a single pulley **22** may be used with the cable **17** passing over it and down from it. Some engineers may prefer to have the weight **21** hang down into the tank, always above the liquid level thereof.

DETAILS OF DOUBLE REEL

As seen best in FIG. **2**, the reel **19** is carried by a bearing **31**, the inner member of which is mounted on a fixed sleeve or pipe **32**. Conduit **33** extends through and is fixed in sleeve **32**. To the right as seen in FIG. **2** it extends into slip ring assembly **34**. To the left as seen in FIG. **2** it leads along the structural portions of the bridge to control box **16**, and houses the conductors for supplying electricity to motor **14**.

The slip ring or collector ring assembly **34** is a unit available on the market and includes a plurality of collector rings each engaged by a brush, with rotary movement between the brushes and rings. Each conductor of cable **18** is connected to one conductor passing through conduit **33** by one brush and ring.

The outer member of slip ring assembly **34** is turned by the reel, as by brackets **36**. It may be part of the rotary support for the reel, being mounted on a bearing in assembly **34**.

As seen in FIG. **2**, the reel **19** has a series of flat rings **41**, **42** and **43** forming, with spacer-type support means **44** and **46**, two annular pockets. The pocket of larger volume is for power cable **18** which is of considerably larger diameter than actuating cable **17** which occupies the pocket of smaller volume. The base of the pocket for actuating cable **17**, represented by support means **46**, is located on a larger radius from the axis of reel **19** than is the base of the larger pocket represented by support means **44**. This is the construction to be used when the power cable **18** will be wound through a plurality of layers, the length of cable in each turn increasing with successive layers. The average length of cable **17** per turn should equal the average length of cable **18** per turn. This will keep movement of tensioning wieght **21** at a minimum.

Except for the slight movements of weight **26**, it is apparent that the cable **17** comprises a means for rotating the reel **19** responsively to the movement of the bridge **1** and at a speed such that the linear reeling speed accomplished by the rotation of reel **19** equals the speed of the bridge. More specifically, when the power cable **18** is being reeled in, the cable **17** is a means which, independently of tension on cable **18**, would turn reel **19** at approximately the correct reeling speed. The movement of the weight **21** produces only minor departures from the reeling speed which reel **19** would have if cable **17** were fixed at its end without any take-up means. Thus, whenever the means for driving the reel in the direction for winding the power cable is such that it tends, independently of the power cable, to wind the reel at the correct reeling speed, there will be very little need for accommodation of variations. This makes practical the use of the weight and pulley system, with only a small range of movement, for this accommodation. It would also make possible the use of other small-range systems, although they are not likely to be as perfectly uniform in their tension or as economical in cost. They could nevertheless be used in special constructions. For example, associates have suggested that the reel **19** could be driven by a sprocket on shaft **9**. This would be another way for driving the reel **19** normally at the correct average reeling speed without constant slippage in the drive thereof. Although it is not to be expected that with this manner of drive of the reel the optimum tension could be maintained safely on cable **18** without some take-up means at the end thereof, such take-up means would not be out of the question. Such a variation of the invention is not deemed as desirable as the illustrated form of the invention, however, for general use.

Another variation of the invention would drive the reel by shaft **9** through a differential. The shaft would drive the input element, the output element would drive the reel for the power cable, and the third element of the differential would be the tensioning element, preferably carrying a reel on which the tensioning cable would be wound and extend to a weight and pulley system. The drive ratios should make the average speed of reeling equal to travel speed, and the weight would only take up variations.

SCRAPER MECHANISM

Although this scraping mechanism may be entirely conventional, it may be briefly described for convenience. Downwardly extending rigid structure **51** has scraper mechanism **52** pivotally mounted on it. During scraping the flight or blade at the end of this scraper mechanism may rest on the bottom of the tank. At the end of the scraping movement of the bridge, the scraper mechanism would be raised by cable **54** wound on reel **56** driven by shaft **10.**

ACHIEVEMENT

The invention substantially in the form illustrated has proven very advantageous. As compared to spring-wound reels, it considerably prolongs the life of the power cable by maintaining optimum tension of the power cable, and by being completely free from danger of snapping the cable which sometimes occurs with spring-wound cables when the reel has temporarily stuck. In such a situation, the spring can build up considerable rotating speed of the reel such that its momentum snaps the power cable when the slack in the power cable has been taken up. As compared to the slip-drive systems of reel biasing, the present system is less costly and less troublesome and is free from power consumption due to the torque-slippage.

I claim:

1. An electrically powered traveling-bridge for moving a scraper along a tank of great length including an electric motor and drive means moving with the bridge for driving it along the length of the tank, a reel carried by the bridge for rotation about a generally horizontal axis, a power cable connected to a source of power at one point of the run, and windable on the reel and connected through the reel to the motor, and resting on support means as payed out by the reel, and means for turning the reel to wind the cable; said means by its own correlation to the movement of the bridge tending to provide a speed for the reel which makes the linear speed between the cable and the bridge approximately equal to the speed of the bridge.

2. An electrically powered traveling-bridge for moving a scraper along a tank of great length including an electric motor and drive means moving with the bridge for driving it along the length of the tank, a reel carried by the bridge for rotation about a generally horizontal axis, a power cable connected to a source of power at one point of the run, and windable on the reel and connected through the reel to the motor, and resting on support means as payed out by the reel, and means for turning the reel to wind the cable; said means by its own correlation to the movement of the bridge tending, substantially without slippage and substantially independent of cable tension or resilient action, to provide a speed for the reel which makes the linear speed between the cable and the bridge approximately equal to the speed of the bridge.

3. Traveling-bridge apparatus for carrying a scraper lengthwise of a tank of great length including a bridge straddling the tank and running on opposite longitudinal walls thereof, a reel carried by the bridge for rotation about a generally horizontal axis, a power cable connected to a source of power at one end of the movement of the bridge, windable on the reel, and connected to the motor through the reel, and resting on support means as payed out by the reel, characterized by:

- a reel control cable wound on the reel to be wound thereon approximately at the same rate that the power cable is payed out, and extending from the bridge in the opposite direction from the power cable, said cables being substantially restrained at opposite ends of the run of the bridge whereby movement of the bridge in one direction will cause the reel to rotate in one direction in response to tension on the power cable as it is payed out by the reel, and whereby movement of the bridge in the other direction will cause the reel to rotate in the opposite direction in response to tension of the second cable then being payed out by the reel, thereby winding the power cable.

4. Traveling-bridge apparatus for carrying a scraper lengthwise of a tank of great length including a bridge straddling the tank and running on opposite longitudinal walls thereof, a reel carried by the bridge for rotation about a generally horizontal axis, a power cable connected to a source of power at one end of the movement of the bridge, windable on the reel, and connected to the motor through the reel, and resting on support means as payed out by the reel, characterized by:

- a reel control cable wound on the reel to be wound thereon approximately at the same rate that the power cable is payed out, and extending from the bridge in the opposite direction from the power cable, said cables being substantially restrained at opposite ends of the run of the bridge whereby movement of the bridge in one direction will cause the reel to rotate in one direction in response to tension on the power cable as it is payed out by the reel, and whereby movement of the bridge in the other direction will cause the reel to rotate in the opposite direction in response to tension of the second cable, then being payed out by the reel, thereby winding the power cable:
- means for tensioning said cables with a small amount of take-up for maintaining a desired substantially uniform tension on the power cable.

5. Traveling-bridge apparatus for carrying a scraper lengthwise of a tank of great length including a bridge straddling the tank and running on opposite longitudinal walls thereof, a reel carried by the bridge for rotation about a generally horizontal axis, a power cable connected to a source of power at one end of the movement of the bridge, windable on the reel, and connected to the motor through the reel, and resting on support means as payed out by the reel, characterized by:

a reel control cable wound on the reel to be wound thereon approximately at the same rate that the power cable is payed out, and extending from the bridge in the opposite direction from the power cable, said cables being substantially restrained at opposite ends of the run of the bridge whereby movement of the bridge in one direction will cause the reel to rotate in one direction in response to tension on the power cable as it is payed out by the reel, and whereby movement of the bridge in the other direction will cause the reel to rotate in the opposite direction in response to tension of the second cable, then being payed out by the reel, thereby winding the power cable;

a weight and pulley system means for tensioning said cables with a small amount of take-up for maintaining a desired substantially uniform tension on the power cable.

6. An electrically powered traveling-bridge for moving a scraper along a tank of great length including an electric motor and drive means moving with the bridge for driving it along the length of the tank, a reel carried by the bridge for rotation about a generally horizontal axis, a power cable connected to a source of power at one point of the run, and windable on the reel and connected through the reel to the motor, and resting on support means as payed out by the reel, and means for turning the reel to wind the cable; said means by its own correlation to the movement of the bridge tending to provide a speed for the reel which makes the linear speed between the cable and the bridge approximately equal to the speed of the bridge; and a weight-biased system for modifying the speed of the reel rotation to maintain a uniform tension on the power cable while accommodating variations.

7. An electrically powered traveling-bridge for moving a scraper along a tank of great length including an electric motor and drive means moving with the bridge for driving it along the length of the tank, a reel carried by the bridge for rotation about a generally horizontal axis, a power cable connected to a source of power at one point of the run, and windable on the reel and connected through the reel to the motor, and resting on support means as payed out by the reel, and means for turning the reel to wind the cable; said means by its own correlation to the movement of the bridge tending to provide a speed for the reel which makes the linear speed between the cable and the bridge approximately equal to the speed of the bridge; and a small take-up biasing system for modifying the speed of the reel rotation to maintain a uniform tension on the power cable while accommodating variations.

8. A reel and reel-driving system for a traveling electrical apparatus having great length of travel including means responsive to apparatus travel in one direction for turning the reel about a horizontal axis to wind on the reel a power cable secured at its remote end, and in the opposite direction to lay the cable on support means when the apparatus travels oppositely; said means by its own correlation to the travel of the apparatus tending to provide a speed for the reel which makes the linear speed between the cable and the bridge approximately equal to the speed of the bridge.

9. A reel and reel-driving system for a traveling electrical apparatus having great length of travel including means responsive to apparatus travel in one direction for turning the reel about a horizontal axis to wind on the reel a power cable secured at its remote end, and in the opposite direction to lay the cable on support means when the apparatus travels oppositely; said means by its own correlation to the travel of the apparatus tending to provide a speed for the reel which makes the linear speed between the cable and the bridge approximately equal to the speed of the bridge and a weight-biased system for modifying the speed of the reel rotation to maintain a uniform tension on the power cable while accommodating variations.

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