Oct. 3, 1967 D. G. JELATIS ETAL 3,344,933

REMOTE CONTROL CRANE SYSTEM

Filed April 8, 1966 2 Sheets-Sheet 1

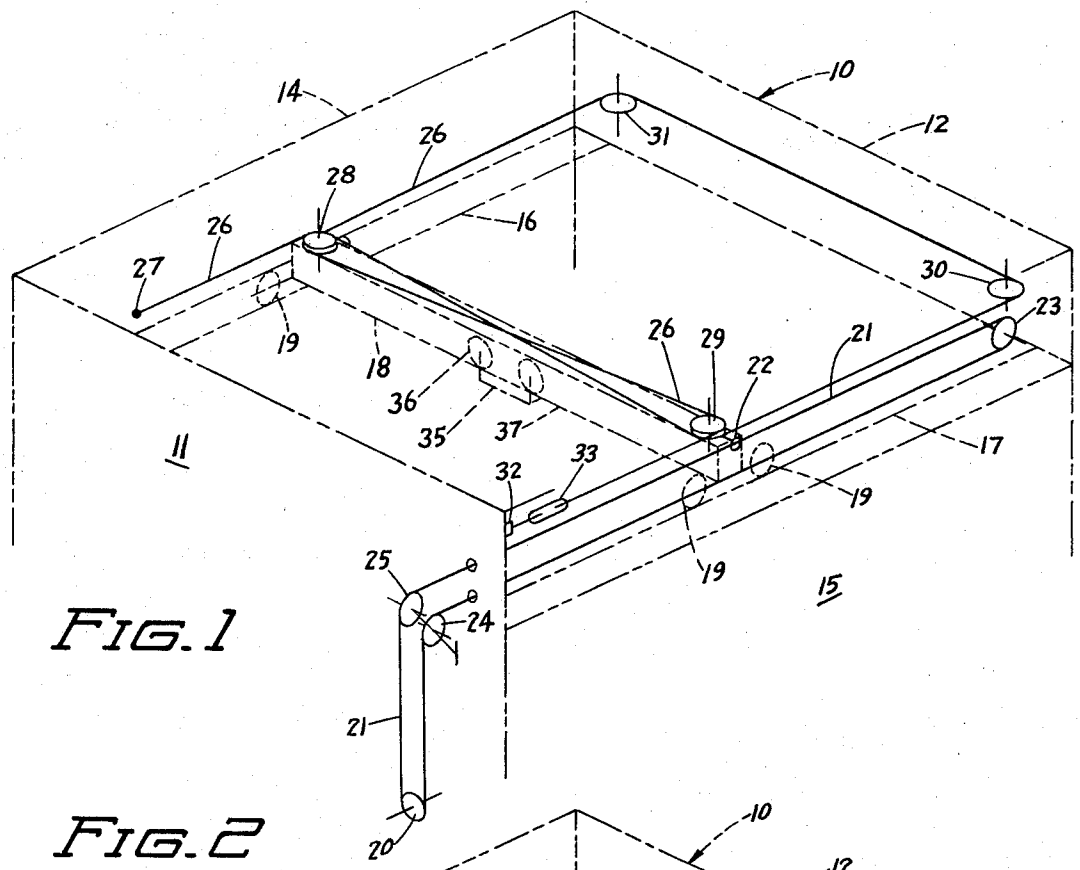
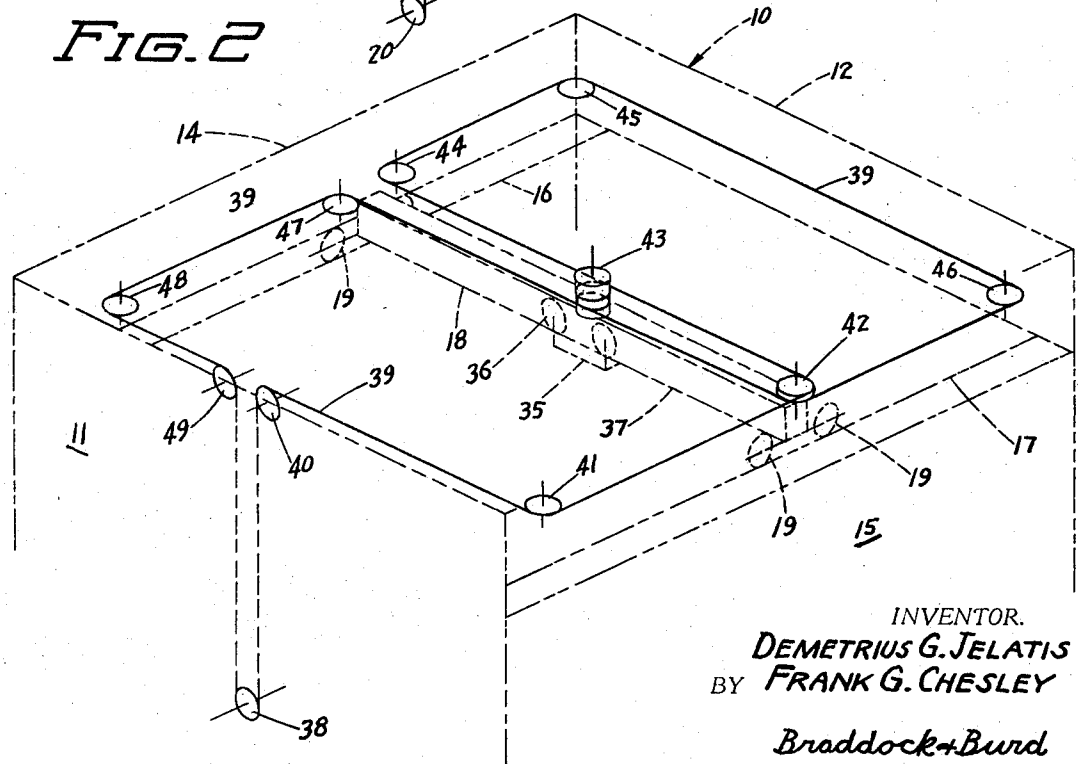


FIG. 1

FIG. 2



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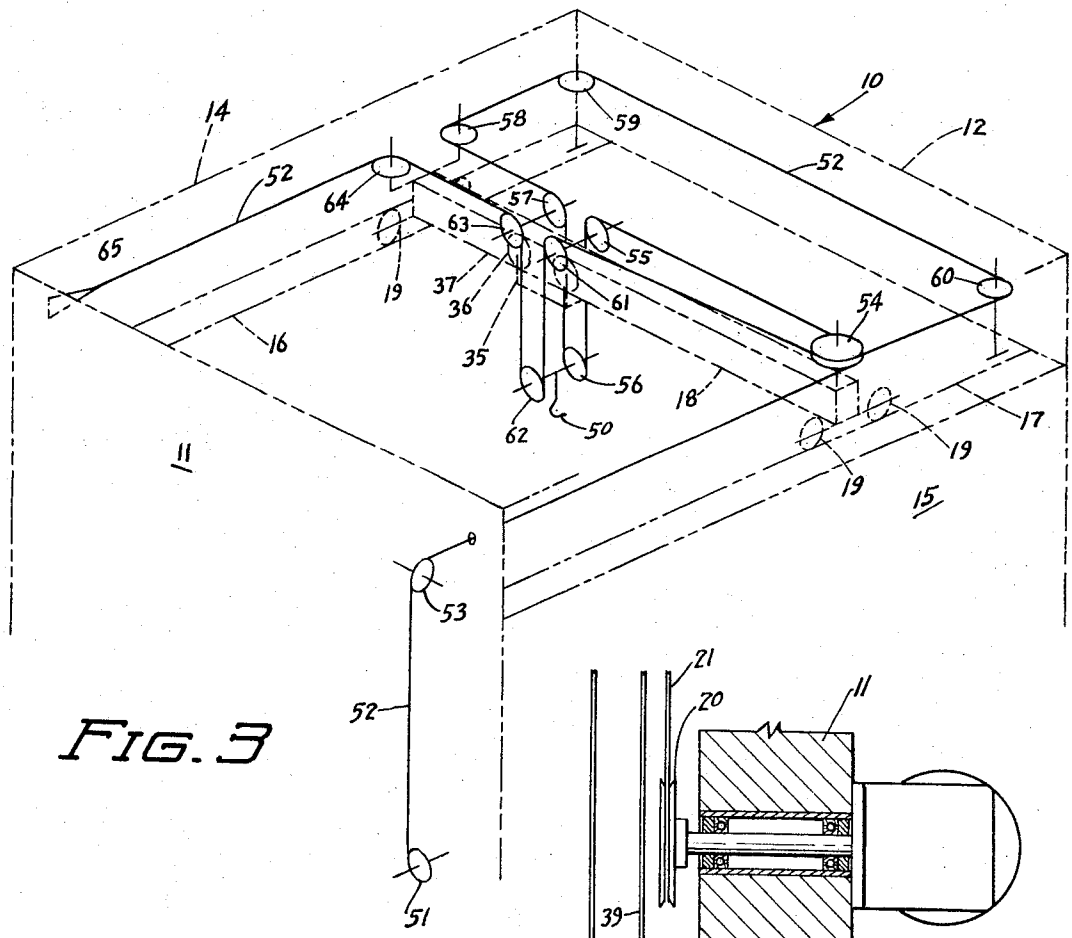


FIG. 3

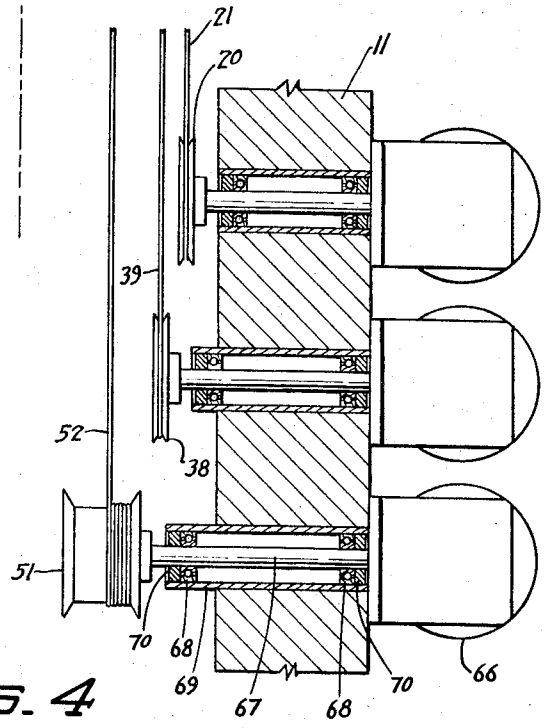


FIG. 4

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United States Patent Office 3,344,933 Patented Oct. 3, 1967

3,344,933

REMOTE CONTROL CRANE SYSTEM

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Filed Apr. 8, 1966, Ser. No. 541,371
10 Claims. (Cl. 212—24)

This system relates to a remote control load handling system which can be operated from outside of a totally enclosed space. More particularly, the invention relates to a remotely controlled overhead crane for hoisting and lowering loads of substantial weight in areas which are not safely accessible to an operator, or in a space which is cramped so as not to permit room for an operator or driving and hoisting mechanism carried by the crane.

The system of the present invention is applicable to situations where it is desirable and necessary to eliminate electrical components, such as electrical cables and motors, from the confines of an enclosed space because of the possibility that they may be damaged or their characteristics altered by the influence of atomic radiation. The system is also effective for lifting and transporting materials of a biological nature or hazardous chemicals where fumes and explosions must be confined.

The system comprises a cross member, such as a bridge crane, adapted to be moved along a pair of spaced apart side rails, a carriage adapted to be moved back and forth across the cross member between the side rails and a hoist adapted to raise and lower material relative to the carriage. The drive system comprises an arrangement of pulleys, shafts and cables by which the load handling system can be operated and controlled from the outside of a totally enclosed space within which the crane is mounted. According to one form of the invention the cables are passed through small holes in the boundary wall of the enclosed space. As an alternative the crane system may be dirven from pulleys and drums retained within the enclosed space and driven by electric motors or other driving devices coupled with the pulleys and drums by flexible or rigid drive shafts running in seals through the boundary wall.

The invention is illustrated in the accompanying drawings in which the same parts are identified by corresponding numerals and in which:

FIGURE 1 is a schematic isometric view showing the drive system for the bridge cross member of the crane system;

FIGURE 2 is a similar schematic isometric view showing the drive system for traversing the carriage or trolley carried by the cross member of the crane system;

FIGURE 3 is a similar schematic isometric view showing the drive system for the hoist carried by the carriage; and

FIGURE 4 is a schematic plan view, partly in section, showing a drive system in which the drums and pulleys are mounted inside of an enclosed space and driven from outside of the enclosed space through appropriate seals.

For clarity, the several drive systems are shown independently, but it will be understood that in any installation the several separate drives are combined into a single composite system.

Referring now to FIGURE 1, which shows schematically the means for fore and aft movement of a bridge crane, the enclosure is indicated generally in phantom lines at **10** and includes a front wall **11**, back wall **12** and side walls **14** and **15**. Mounted within the enclosure **10** existing between the front wall **11** and back wall **12** is a pair of parallel spaced apart tracks or rails **16** and **17**. A bridge crane **18** extends transversely across the enclosure between rails **16** and **17** and is provided at each end with a pair of wheels or rollers **19** which engage the side rails **16** and **17** to support and guide the bridge crane in its fore and aft movements. For some uses it is desirable that rails **16** and **17** and wheels **19** be toothed.

An actuating drum **20** for moving the bridge **18** fore and aft on rails **16** and **17** is mounted for rotation on wall **11**. Although shown on the outside of that wall, it will be understood that alternatively it may be mounted on the inside of the wall and driven from the outside. The pulley or drum **20** may be hand cranked or powered by an electric motor or other prime mover.

A cable **21** is anchored at **22** to one end of bridge **18**. Cable **21** extends rearwardly from the bridge along the inside of sidewall **15**, over an idler pulley or sheave **23** mounted adjacent the back wall **12** of the enclosure, thence back along the inside of side wall **15** to an idler **24** mounted adjacent front wall **11** of the enclosure, around drum or pulley **20**, over another idler **25** mounted adjacent enclosure front wall **11** and thence back to anchorage **22** on the bridge **18**.

It will be seen that as drum or pulley **20** is rotated in a clockwise direction tension is exerted on that portion of cable **21** extending over idlers **24** and **23** to the anchorage **22** at bridge **18**. This tension causes bridge **18** to be moved along the rails **16** and **17** toward the back wall **12** of the enclosure. At the same time the bridge exerts tension on that portion of cable **21** extending from anchorage **22** over idler **25** to drum or pulley **20** to maintain the cable under substantially uniform tension. To move the bridge in the opposite direction the direction of movement of actuator drum or pulley **20** is reversed.

For stability, to prevent canting of bridge **18**, is is desirable that the bridge drive mechanism including pulley or drum **20**, cable **21** and idlers **23-25** be duplicated at the opposite end of the bridge. Alternatively, a dead cable stabilizing system, as illustrated, may be employed.

The stabilizing cable **26** is anchored at **27** in the front wall **11** of the enclosure. From that anchorage cable **26** extends rearwardly along the inside of enclosure side wall **14** and clockwise around a double grooved idler **28** journalled for rotation on vertical axis at one end of bridge **18**. Thence cable **26** extends along bridge **18** to a companion double grooved idler **29** at the opposite end of the bridge. Cable **26** extends around idler **29** in the opposite or counterclockwise direction and thence rearwardly along enclosure side wall **15** to an idler **30** mounted adjacent the back wall **12** of the enclosure for rotation on a vertical axis. Cable **26** extends counterclockwise around idler **30** along back wall **12**, counterclockwise around companion vertical axis idler **31** and thence along side wall **14** to idler **28**. Cable **26** then extends counterclockwise around idler **28** in the other groove, along bridge **18**, clockwise around the other groove of idler **29** and then along side wall **15** to an anchorage **32** in wall **11**. A turnbuckle **33** or similar tensioning device maintains the stabilizing cable **26** taut.

It will be seen that as the bridge is caused to travel by the bridge traversing system the taut stabilization cable will insure that both ends of the bridge are moved together at the same rate. As the bridge is traversed, the length of cable **26** between anchor **27** and idler **28** becomes longer as the length of cable on the opposite side of the enclosure between idler **29** and idler **30** becomes shorter. Similarly, the length of cable between anchor **32** and idler **29** becomes longer as the length of cable on the opposite side of the enclosure between idler **28** and and idler **31** becomes shorter. This occurs simltaneously and at the same rate.

Referring now to FIGURE 2, there is shown the means by which a carriage or trolley **35** is carried on a pair of

wheels 36 on each side of the carriage, back and forth along the length of bridge 18 on a pair of parallel tracks or rails 37 carried by the bridge member. An actuating drum or pulley 38 is mounted adjacent wall 11. The actuating means may be manual or powered as corresponding actuating means 20. Drum or pulley 38 is shown mounted on the inside of wall 11, but it may likewise be mounted on the outside and preferably all of the actuating means are on the same side of the wall.

The carriage traversing cable 39 extends from drum or pulley 38 up and over an idler 40 along wall 11 to a vertical axis corner idler 41, and thence along side wall 15 to a double grooved idler 42 supported at one end of bridge 18 for rotation about a vertical axis. From double grooved idler 42 cable 39 extends to a vertical axis capstan 43 which is freely mounted upon a base attached to the carriage 35 and the cable is wrapped one turn around the capstan in one direction. From the capstan the cable 39 extends to one of a pair of vertical axis idlers 44 supported by bridge 18 at its opposite end. Cable 39 then extends along side wall 14 to a corner vertical axis idler 45, along back wall 12 to a further companion corner idler 46 and along side wall 15 to the other groove of double grooved idler 42. In this second pass, cable 49 extends around idler 42 in the opposite direction and extends to capstan 43 around which it is also wrapped one turn in the opposite direction from the first pass. The cable 39 then extends to the other of a pair of vertical axis idlers 47 at the opposite end of bridge 18, along side wall 14 to a corner idler 48, along front wall 11 to idler 49 and thence back down to the actuating drum or pulley 38.

It will be seen that as the actuating means 38 is rotated in a clockwise direction tension is exerted on cable 39 in its passage over idlers 40, 41 and 42 and exerts a force on capstan 43 which is transmited to the carriage 35 to move the carriage along the bridge 18 toward side wall 15. The tension on the cable is also exerted in its path around idlers 44, 45, 46 and 42 to capstan 43 where it extends in the opposite direction and exerts further tension on capstan 43 to assist in urging it in its path of travel. Movement of the capstan insures maintenance of tension on the portion of cable extending around idlers 47, 48 and 49 from the actuating drum 38. Rotation of the actuating drum 38 in the opposite direction reverses the direction of movement of the carriage 35.

Referring now to FIGURE 3, there is shown the mechanism for raising or lowering a hook member 50 suspended from the carriage or trolley 35. The weight of a load on the hook 50 is always effective to cause lowering of the hook. The illustrated mechanism serves to permit the operator to raise the load and to control lowering of a load suspended from the hook 50. The actuating means includes a drum 51 to which one end of a hoisting cable 52 is attached.

Hoisting cable 52, as shown, extends up and over an idler 53, and through an aperture in the enclosure front wall 11, along the inside of side wall 15 to a double grooved idler 54 carried by one end of bridge 18 for rotation on a vertical axis. Cable 52 extends thence to one of a pair of horizontal axis idlers 55 carried on one side of carriage 35, down and around a horizontal axis idler 56 carried by the hook member and up and over the other of said pair of idlers 57 carried on the same side of carriage 35 as idler 55. Cable 52 extends thence to one of a pair of vertical axis idlers 58 carried by bridge 18 at the end opposite from double grooved idler 54 and thence along the inside of side wall 14 to a corner vertical axis idler 59, along back wall 12 to a further campanion corner idler 60 and along side wall 15 to the other groove of double grooved idler 54. Cable 52 extends around idler 54 in the opposite direction and then to one of a pair of idlers 61 carried by carriage 35 on the opposite side from idlers 55 and 57, down and around idler 62 carried by the hook means, up and over the other of said pair of idlers 63 carried by carriage 35, around the other of said pair of idlers 64 carried by bridge 18 and thence to an anchorage 65 in enclosure wall 11.

It will be seen that as drum 51 is rotated in a counterclockwise direction tension will be exerted upon cable 52 as it is wound about the drum. Tension is exerted on cable 52 in its path around idlers 53, 54 and 55 and around idler 56 to lift the hook mechanism 50. The tension is further transmitted through the cable in its path around idlers 57, 58, 59, 60, 54 and 61 and around idler 62 to exert a uniform upward pull on the opposite side of the hook srtucture. The weight of the load maintains the cable taut in its path over idlers 63 and 64 to the anchorage 65. Any load supported by hook 50 may be lowered by its own weight with drum 51 functioning as a brake to control the rate of lowering.

While each of the motions shown in FIGURES 1, 2 and 3 is completely independent of each of the other two, they may be operated individually or simultaneously in any combination. The arrangements shown make it possible to position the load lifting hook where desired within the confines of the enclosed space and to utilize it in lifting and lowering loads as required.

In those instances where the driving cables pass through the boundary wall the mechanisms are desirably enclosed. It is possible to monitor the cables in the event they might contain contamination of an atomic or biological nature.

In FIGURE 4 there is shown an arrangement by which the cable mechanisms are located on the inside of the boundary wall 11 but driven from motors 66 on the outside of the wall. Each of the drums or pulleys 20, 38 and 51 is secured for rotation with one of the drive shafts 67 which are each journalled in bearings 68 carried in a tubular housing 69 which extends through the boundary wall. The tubular housing 69 is closed by means of appropriate packing 70 to prevent passage of dangerous or obnoxious materials through the shaft housings.

It is apparent that many modifications and variations of this invention as hereinbefore set forth may be made without departing from the spirit and scope thereof. The specific embodiments described are given by way of example only and the invention is limited only by the terms of the appended claims.

We claim:

1. A remote control crane system for operation in an enclosed area comprising:

(A) a pair of parallel spaced apart tracks extending through said area;

(B) a bridge spanning said tracks;

(C) remotely controlled drive means for moving said bridge along said tracks;

(D) a carriage supported on said bridge;

(E) remotely controlled drive means for moving said carriage along said bridge;

(F) hoist means suspended from said carriage; and

(G) remotely controlled drive means for raising said hoist means;

(H) said drive means for said carriage comprising:

(1) a rotatable actuator journalled adjacent the forward wall of said enclosed area,

(2) a free turning capstan on said carriage;

(3) a pair of idler sheaves journalled adjacent said forward wall in association with said actuator, a double grooved idler sheave journalled at one end of said bridge, a pair of single idler sheaves journalled at the other end of said bridge and an idler sheave at each forward and rear corner of said enclosed area, and

(4) a taut flexible cable extending in a loop from said actuator around one of said forward wall idlers to and around said double grooved bridge idler in one direction, in one turn about said capstan in one direction, around one of said pair of single bridge idlers to one of said rear corner idlers, to the other of said rear corner idlers, around said double grooved bridge idler in the

opposite direction, in one turn about said capstan in the opposite direction, around the other of said pair of single bridge idlers to one of said forward corner idlers, and over the other of said forward wall idlers to the actuator.

2. A remote control crane system according to claim 1 further characterized in that:

(A) said drive system for said hoist comprises:

(1) a rotatable actuator journalled adjacent the forward wall of the enclosed area,

(2) a hook member,

(3) an idler sheave journalled adjacent said forward wall in association with said actuator, a double grooved idler sheave journalled at one end of said bridge, a pair of single idler sheaves journalled at the other end of said bridge, a pair of idler sheaves on each opposite side of said carriage, a pair of idler sheaves on said hook member, an idler sheave at each rear corner of said enclosed area, and a cable anchor at said forward wall, and

(4) a taut flexible cable extending from said actuator over said forward wall idler to and around said double grooved bridge idler in one direction, over one of said carriage idlers around one of said hook idlers, over the other of said carriage idlers on the same side, around one of said single bridge idlers, around one of said rear corner idlers, around the other of said rear corner idlers, around said double grooved bridge idler in the opposite direction, over one of said carriage idlers on the opposite side, around the other of said hook idlers, over the other of said carriage idlers on the opposite side and around the other of said single bridge idlers to said anchor.

3. A remote control crane system according to claim 2 further characterized in that said actuator, forward wall idler, carriage idlers and hook member idlers of said hoist drive system are journalled for rotation about horizontal axes and all of said other idlers of said hoist drive system are journalled to rotate on vertical axes.

4. A remote control crane system according to claim 1 further characterized in that:

(A) said drive system for said bridge comprises:

(1) a rotatable actuator journalled adjacent the forward wall of said enclosed area,

(2) a pair of idler sheaves journalled adjacent said forward wall in association with said actuator and an idler sheave journalled adjacent the rear wall of said enclosed area, and

(3) a taut flexible cable extending in a loop from said bridge toward said rear wall and around said rear wall idler, around one of said pair of forward wall idlers to the actuator and around the other of said pair of idlers to said bridge.

5. A remote control crane system according to claim 4 further characterized in that said actuator and idlers of said bridge drive system are journalled for rotation about horizontal axes.

6. A remote control crane system according to claim 4 further characterized in that:

(A) said drive system for said bridge includes a stabilizing means, and

(B) said stabilizing means comprises:

(1) a pair of double grooved idler sheaves spaced apart at opposite ends of said bridge,

(2) a first length of "dead" taut flexible cable extending from the forward wall along one side wall, around the first of said double grooved idlers in one direction, across said bridge, around the second of said double grooved idlers in the opposite direction, and along the opposite side wall to the rear wall, and

(3) a second length of "dead" taut flexible cable extending from the forward wall along the opposite side wall, around the second of said double grooved idlers in one direction across said bridge, around the first of said double grooved idlers in the opposite direction, and along the first side wall to the rear wall.

7. A remote control crane system according to claim 6 further characterized in that:

(A) said stabilizing means also comprises:

(1) an idler at each rear corner of said enclosed area,

(2) said lengths of cable are anchored in the forward wall at one end and are joined together and extend around said corner idlers across said rear wall, and

(3) tension means in said cable adjacent one end to maintain the same taut.

8. A remote control crane system according to claim 7 further characterized in that all of said idlers of said stabilizing system are journalled for rotation about vertical axes.

9. A remote control crane system according to claim 1 further characterized in that:

(A) each of said drive means includes a rotatable actuator mounted on the inside of the forward wall of said enclosed area journalled about a horizontal axis extending through said wall,

(B) a drive shaft for each of said actuators extending through said wall and journalled for rotation about said horizontal axis,

(C) sealing means for each of said drive shafts, and

(D) means outside of said wall for rotating each of said drive shafts.

10. A remote control crane system according to claim 1 further characterized in that the actuator and said forward wall idlers are journalled to rotate on horizontal axes and said capstan and all of said other idlers are journalled to rotate on vertical axes.

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