# United States Patent

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[54] **SUBMERSIBLE BARGE ROLL CONTROL SYSTEM**
**6 Claims, 4 Drawing Figs.**


[52] **U.S. Cl.** ..... **114/44,** 61/65
[51] **Int. Cl.** ..... **B63c 1/08**
[50] **Field of Search** ..... 114/48, 44; 61/65



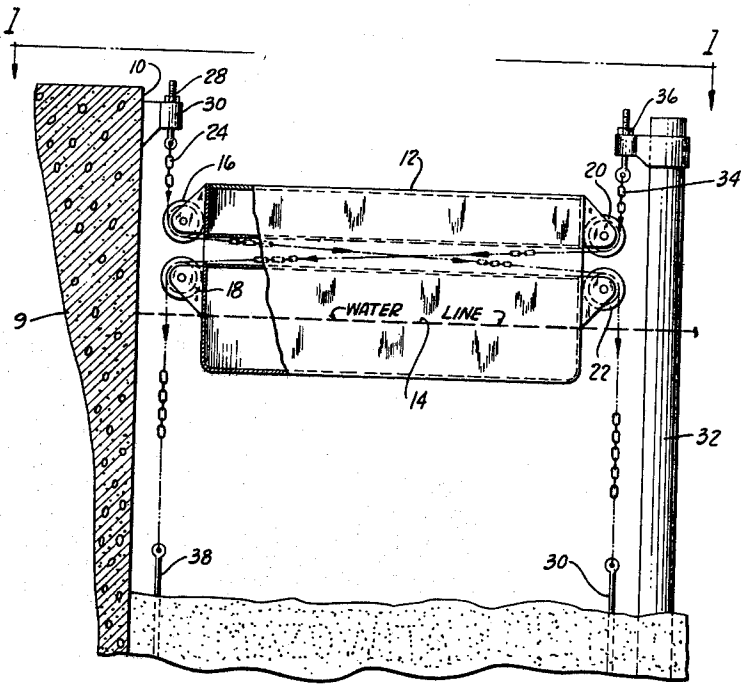
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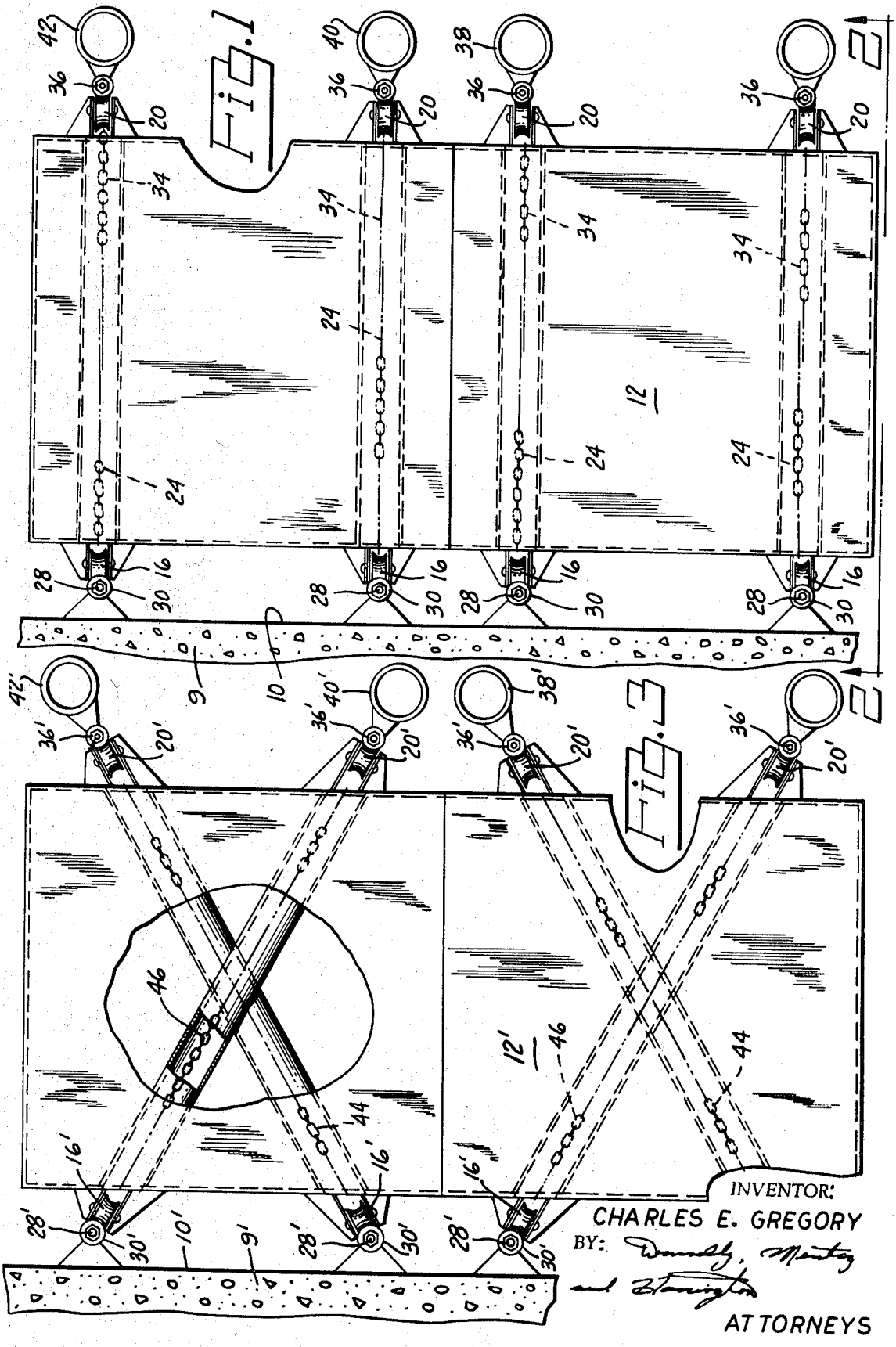
**ABSTRACT:** A dry dock comprising a submersible barge located between a pier and piling, sheaves carried by the sides of the barge, and chains trained over the sheaves and extending across the barge in crisscross fashion whereby the barge is maintained in a stable condition regardless of the location of the centers of gravity of the barge and a ship or boat carried by the barge with respect to the center of buoyancy of the barge.

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SHEET 1 OF 2



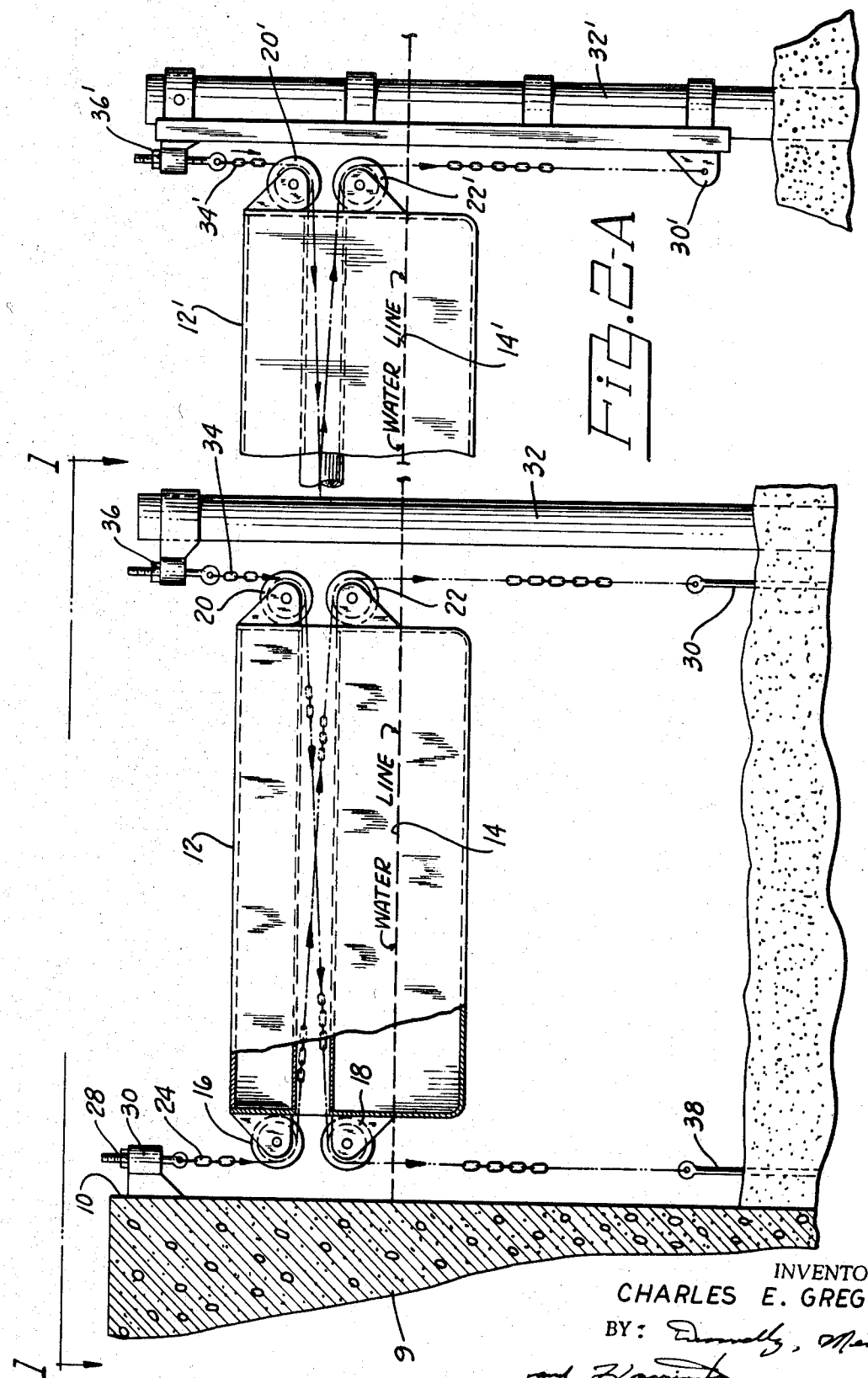



Fig. 2-A

Fig. 2

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# SUBMERSIBLE BARGE ROLL CONTROL SYSTEM

## GENERAL DESCRIPTION OF THE INVENTION

The improvements of my invention can be applied to a barge used as a dry dock. The barge, which is submersible, may be lowered under the hull of a ship. The barge can be pumped to expel water contained in its watertight chambers, thereby causing the barge to raise the hull of the ship where repairs can be made.

As the submerged barge is pumped in this way preparatory to raising the ship, the center of gravity of the combined load of the ship and the weight of the barge rises substantially above the center of buoyancy of the barge. The center of buoyancy lowers, of course, as the water line becomes lower with respect to the barge. This normally introduces an unstable condition tending to cause the barge to tip laterally in one direction or the other.

The width of the barge usually is substantially less than the length of the barge, and tipping then tends to occur about the longitudinal centerline of the barge after the ship is raised. Stability of the barge with respect to a transverse axis thus is not a problem since the center of buoyancy is capable of being shifted longitudinally with respect to the centerline of the barge as the hull of the ship becomes tilted in a direction causing the bow to rise or fall with respect to the stern.

The improvements of my invention comprise a means for maintaining lateral stability of the barge. In the use of a relatively short barge, my invention is capable also of improving longitudinal stability. In providing such stability I locate pairs of sheaves on the sides of the barge at spaced locate locations. A chain anchored at one end thereof the pier extends over one sheave of a first pair of sheaves and across the barge. It then is trained over another sheave of a companion pair of sheaves on the opposite side of the barge. The other end of that chain then is anchored either to an anchor post or to an adjacent piling. A second chain is anchored at an upper location on the piling and extends over the second of the pair of sheaves on the said opposite side of the barge and then across the barge in a lateral direction. That same chain passes over the other of the first pair of sheaves and is anchored at its other end either to the pier or to an anchor post. Sheaves and crossover chain are provided at selected locations along the barge, the number of chains and sheaves depending upon the length of the barge.

## BRIEF DESCRIPTION OF THE FIGURES OF THE DRAWINGS

FIG. **1** shows a plan view of a submersible barge.

FIG. **2** is an end view of the barge shown in FIG. **1**.

FIG. **2A** shows a modification of the anchor and piling structure.

FIG. **3** is an alternate embodiment of the invention, which is capable of providing both longitudinal stability and lateral stability of the barge.

## PARTICULAR DESCRIPTION OF THE INVENTION

In FIG. **1** numeral **10** designates the edge of a pier. A barge **12** floats in the water adjacent the pier. The water line is indicated in FIG. **2** by the reference character **14**. On the left-hand side of the barge, as indicated in FIG. **2**, there is rotatably mounted a sheave **16**. Directly under the sheave **16** is a companion sheave **18**. A pair of sheaves **20** and **22** is secured also the right-hand side of the barge as shown in FIG. **2**. These correspond to the sheaves **16** and **18**, respectively.

A chain **24** is anchored at one end to the pier by means of an anchor member **26**. This includes an adjustable elements **28** to which the chain **24** is connected whereby the tension of the chain **24** can be adjusted.

The chain **24** is trained over the sheave **16** and is extended transversely across the barge. The chain **24** then is trained over sheave **22** on the opposite side of the barge. The other end of the chain **24** is anchored to an anchor post **30**, which is driven into the bottom of the waterway.



A piling **32** is driven into the bottom of the waterway and extends vertically on one side of the barge. A chain **34** is anchored to the top of the piling **32** by means of an anchor element **36**. The chain **34** is trained over the sheave **20**, is extended transversely across the barge and then trained over the sheave **18**. The opposite end of the chain **34** is anchored to anchor post **38**, which is driven into the bottom of the waterway. The chains **24** and **34** cross over at approximately the center of the barge.

The barge defines an interior chamber, which may be filled with water and emptied by a suitable pump mechanism not shown. When the barge is filled, it tends to sink. When it is empty it rises. When the barge is submerged below the surface of the water, a ship may be positioned over the barge. The ship may be raised then by evacuating the water ballast from the barge. The chain and sheave arrangement maintains stability of the barge as it is raised.

The center of buoyancy of the barge, upon being raised, falls considerably below the center of gravity of the ship and the barge itself. This tends to produce an unstable condition which tends to tilt the barge and its load with respect to a vertical plane passing through the geometric center of the barge. The presence of the chains and sheaves prevents lateral tilting of the barge in either direction.

In FIG. **1**, I have shown other pilings at **38**, **40** and **42**. These are arranged in a straight line of the same side of the barge **12**. Each piling serves to anchor one end of a chain that corresponds to the chain **34**.

Because the barge **12** usually is long with respect to its width, longitudinal stability would not be a problem. If a tendency existed for the barge to tilt in either longitudinal direction, the center of buoyancy would change sufficiently to cause a restoring force couple that would maintain stability. If, however, the barge is relatively short so that longitudinal stability might be a problem, the chains that extend over the barge may be crossed, as indicated in FIG. **3**. Each chain, then, would provide both longitudinal stability and lateral stability. The chains are indicated schematically in FIG. **3** by reference characters **44** and **46**. Each of the other elements of the FIG. **3** construction, however, may be common to the FIG. **1** construction, and for this reason the reference characters used in FIG. **3** are the same as those used in FIG. **1**, although prime notations have been added.

The pulleys **16** and **20** may be offset in a longitudinal direction relative to each other in order to permit clearance between the crossover chains, thereby avoiding frictional drag of one chain upon the other.

I claim:

**1**. A submersible barge roll-control control system comprising a barge adapted to be mounted adjacent a pier, said barge having an internal chamber from which water can be evacuated to produce a buoyant condition, said barge when submerged in a waterway being positioned under a ship to be repaired, a pair of sheaves mounted on one side of said barge adjacent the pier, a second pair of sheaves mounted on the opposite side of said barge, a first chain anchored at one end thereof adjacent said pier and trained over one of said first pair of sheaves and one of said second pair of sheaves, the other end of said first chain being anchored at a location spaced from the pier, a stationary structure extending vertically from the water adjacent the other side of said barge, and a second chain connected to said stationary structure and extending over the second of said second pair of sheaves and the other sheave of said first pair of sheaves, the other end of said second chain being c anchored adjacent said pier, said chains crossing each other at a location intermediate the sides of the barge, said sheaves and chains maintaining lateral stability of the barge thereby eliminating roll as the barge is raised, the center of buoyancy of the barge falling below the effective center of gravity of the barge and its load.

**2**. The combination as set forth in claim **1**, wherein said stationary structure is in the form of piling driven into the bottom of the waterway adjacent the said opposite side of said barge,

said second chain being anchored to said piling and the first chain being anchored to said pier, the other ends of said chains being anchored to the bottom of the waterway.

3. The combination as set forth in claim 1, wherein said stationary structure includes multiple pilings arranged along the said opposite side of the barge at longitudinally spaced locations, multiple pairs of sheaves mounted on said barge at said opposite side, a multiple pairs of sheaves mounted on said barge at said one side, each of said spaced pairs of sheaves having trained thereover roll-control chains anchored at each end thereof, said roll-control chains crossing over each other at a location intermediate the sides of said barge.

4. The combination as set forth in claim 2, wherein said stationary structure includes multiple pilings arranged along the said opposite side of the barge at longitudinally spaced locations, multiple pairs of sheaves mounted on said barge at said opposite side, a multiple pairs of sheaves mounted on said barge at said one side, each of said spaced pairs of sheaves having trained thereover roll-control chains anchored at each end thereof, said roll-control chains crossing over each other at a location intermediate the sides of said barge.

5. The combination as set forth in claim 3, wherein said roll-control chains cross each other at a location intermediate the sides of the barge and extend in independent directions whereby both lateral stability and longitudinal stability are maintained to avoid roll with respect to either a longitudinal axis or a transverse axis for said barge.

6. The combination as set forth in claim 4, wherein said roll-control chains cross each other at a location intermediate the sides of the barge and extend in independent directions whereby both lateral stability and longitudinal stability are maintained to avoid roll with respect to either a longitudinal axis or a transverse axis for said barge.