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J. A. L. WADDELL.

LIFT BRIDGE.

No. 506,571. Patented Oct. 10, 1893.

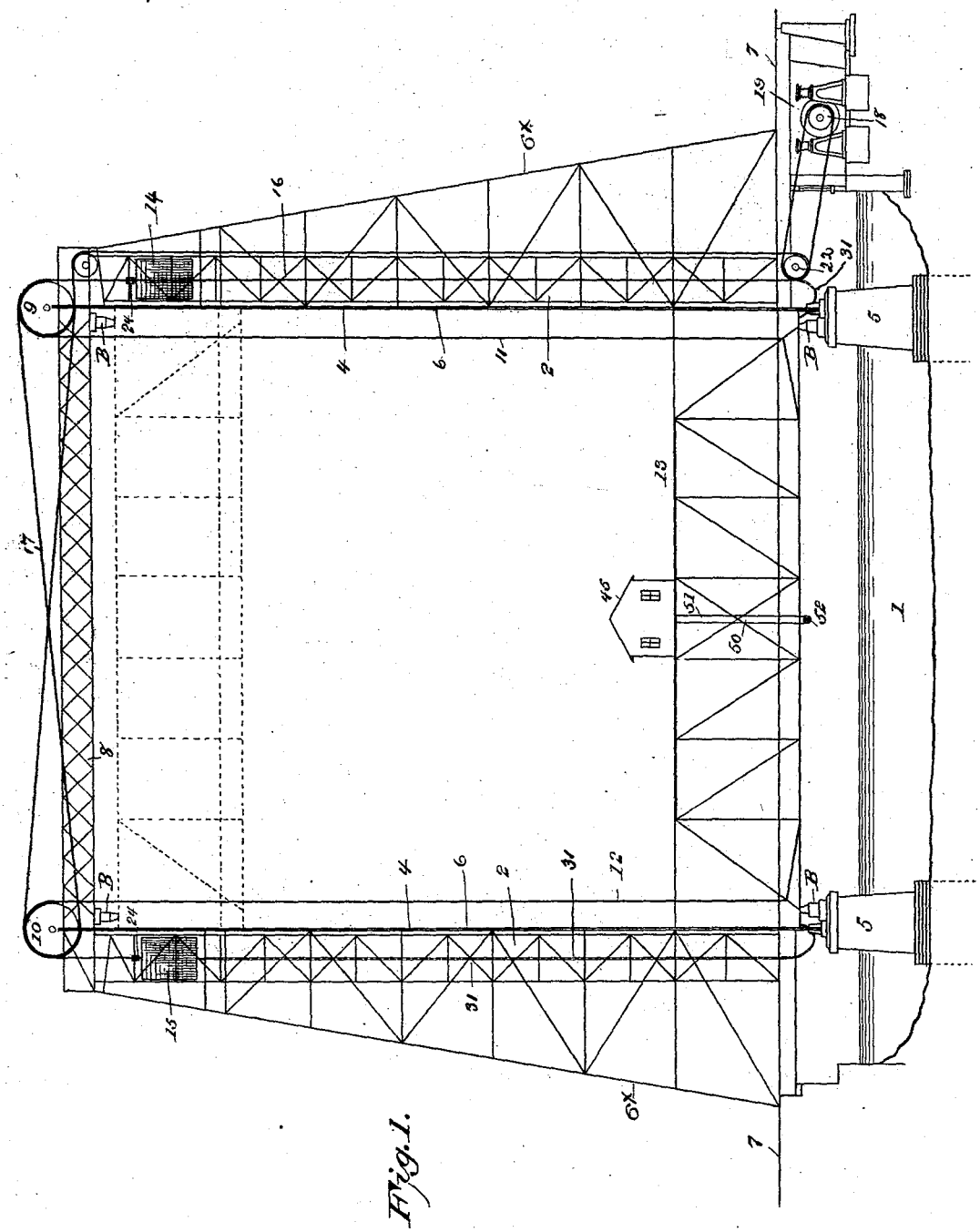

Fig. 1.

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Inventor

Witnesses G. S. Elliott.
E. L. Johnson

by [illegible] Attorney

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Fig. 2.

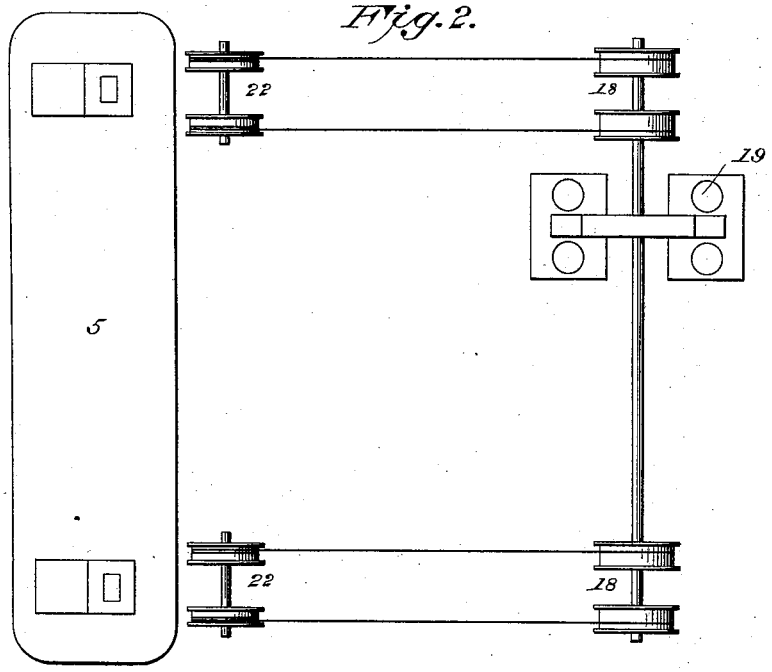
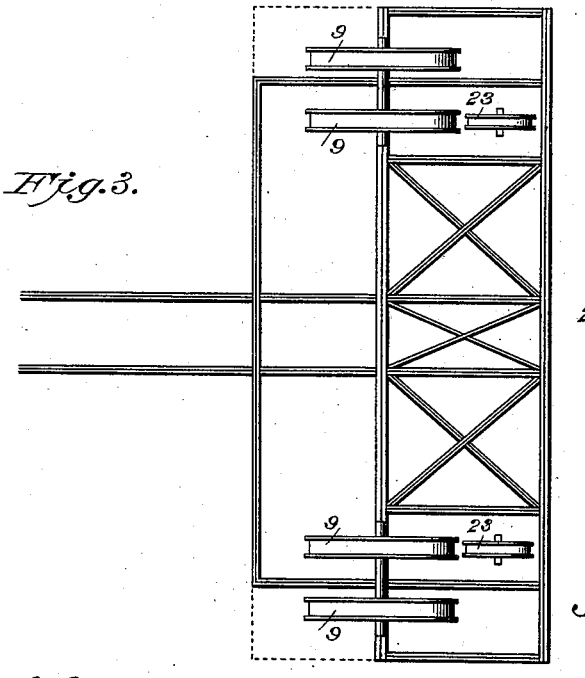


Fig. 3.



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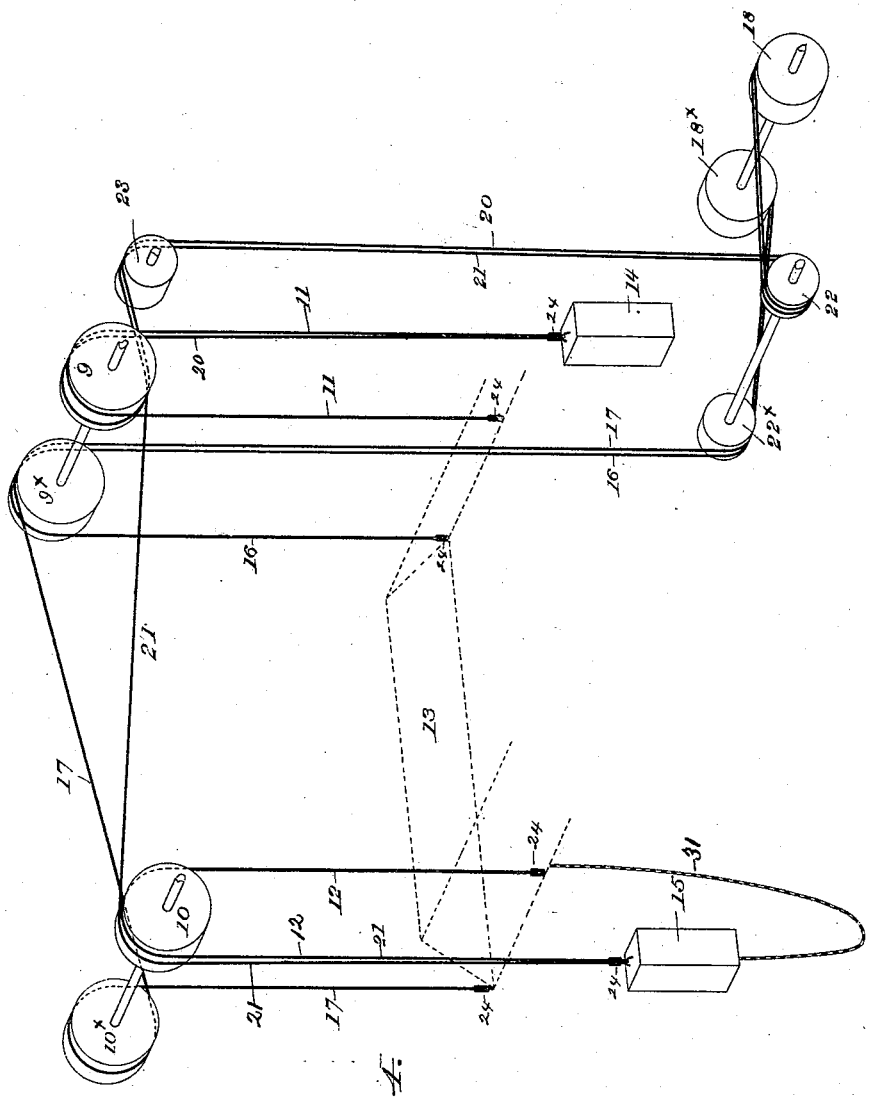

Fig. 1.

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Fig. 5

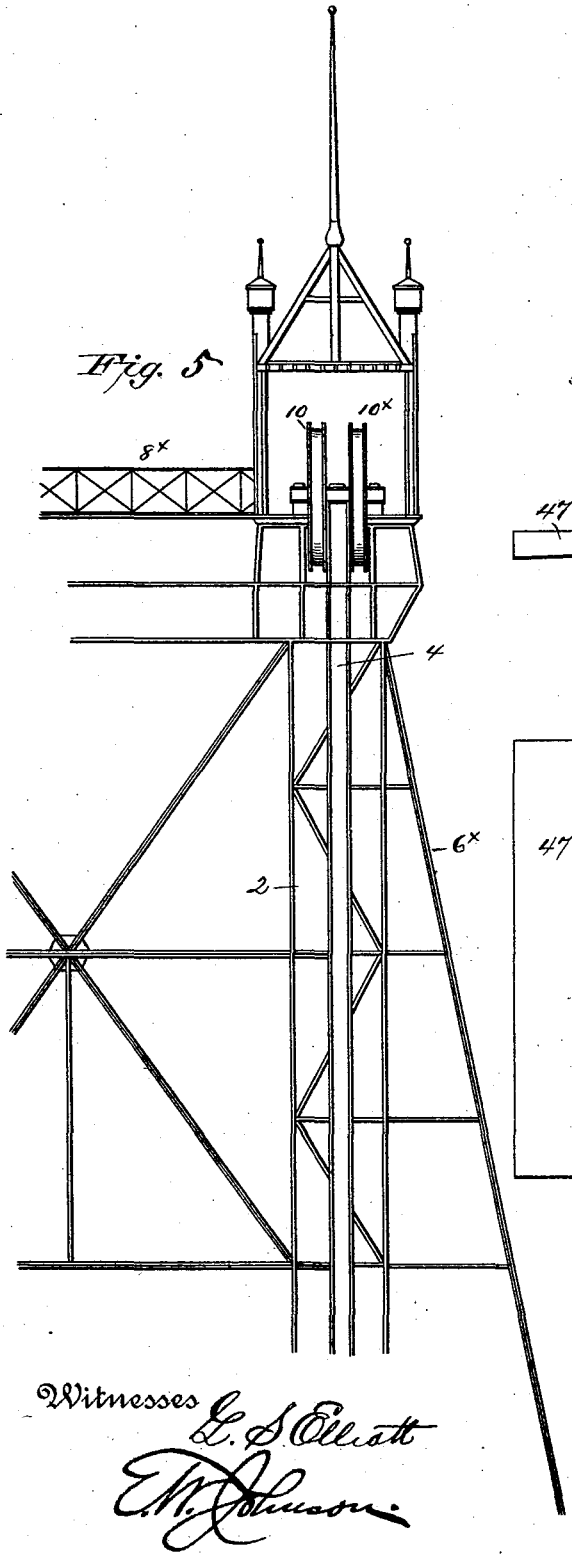


Fig. 6

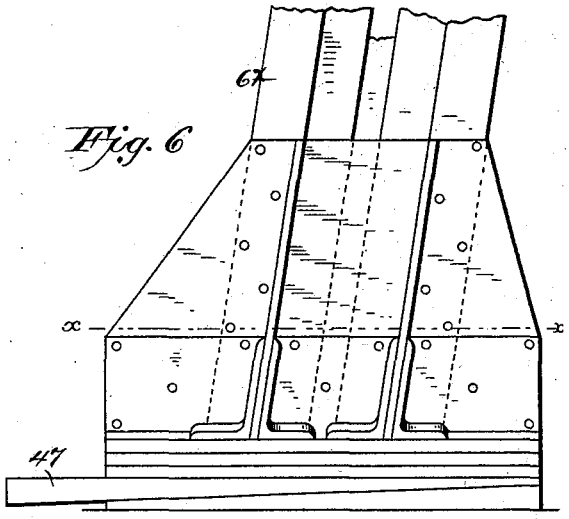
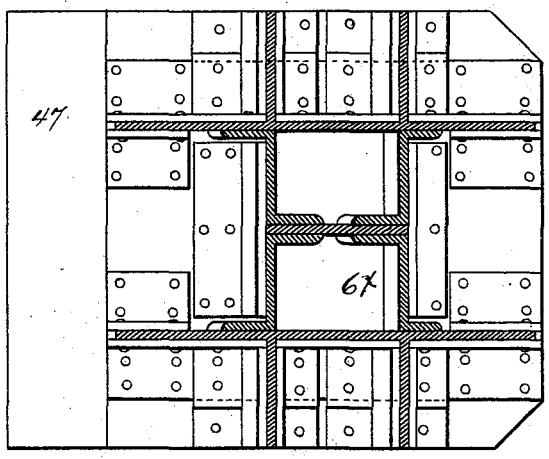


Fig. 7.



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LIFT BRIDGE.

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Fig. 8.

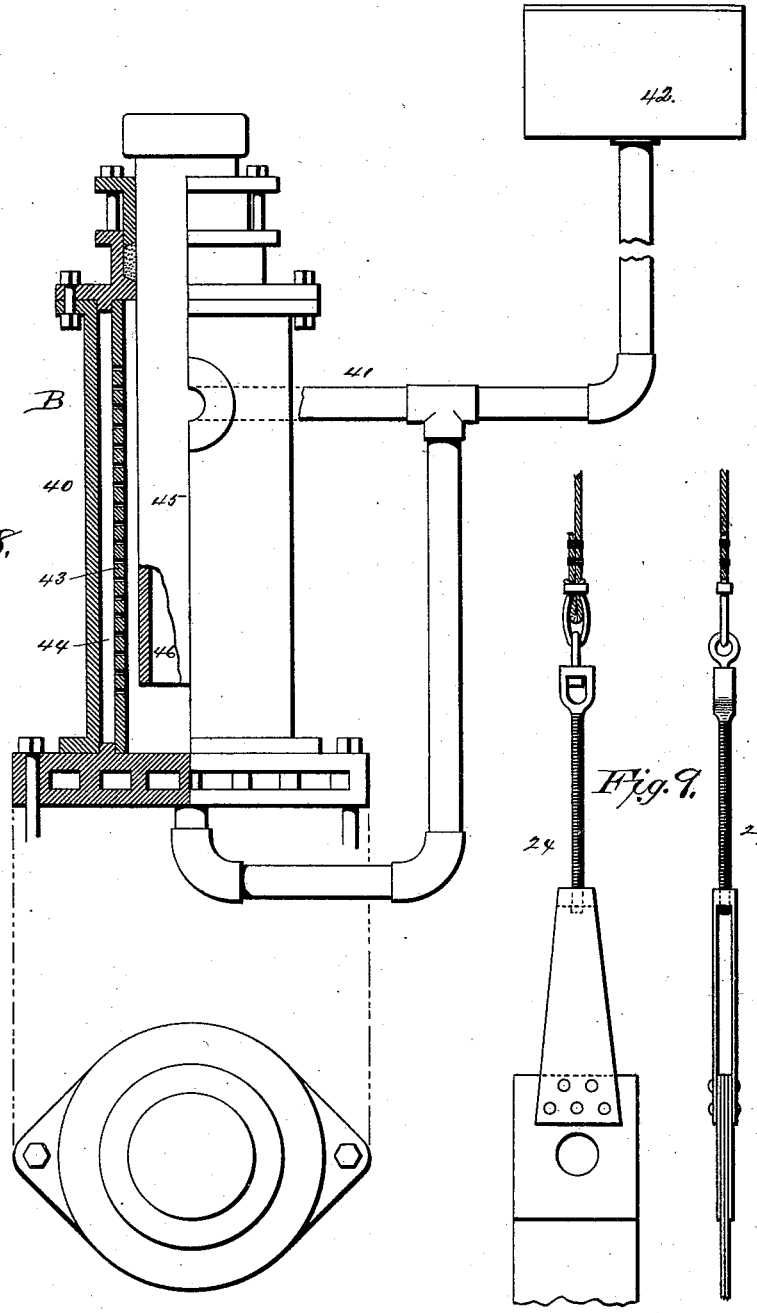

Fig. 9.

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LIFT BRIDGE.

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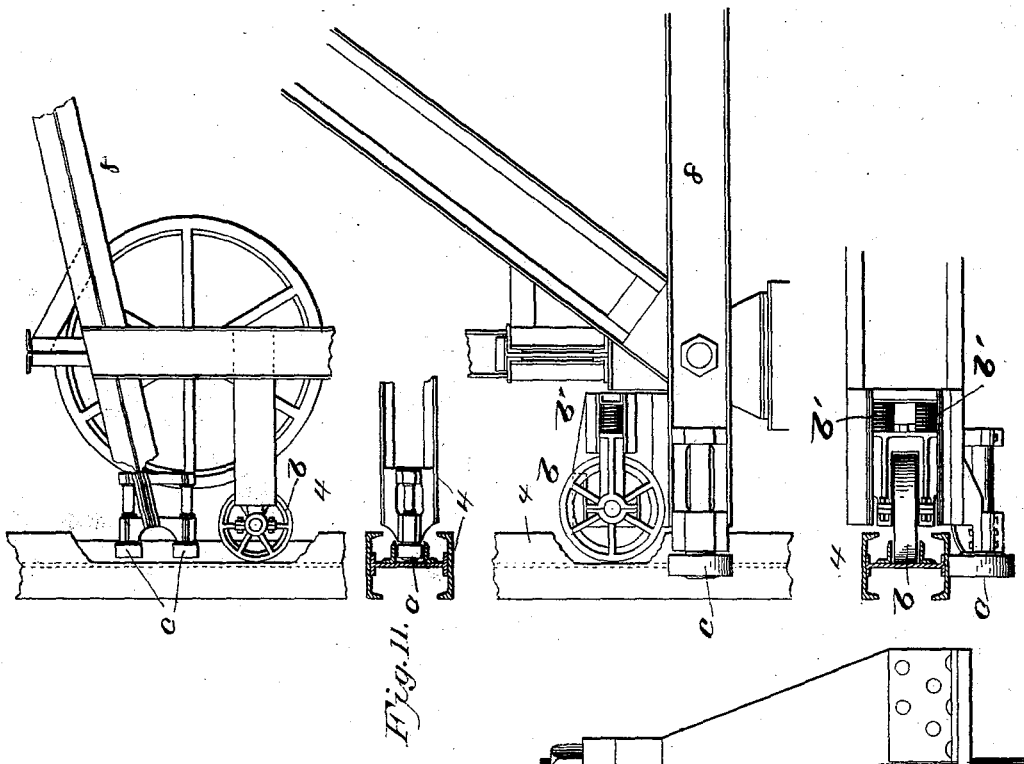

Fig. 11.

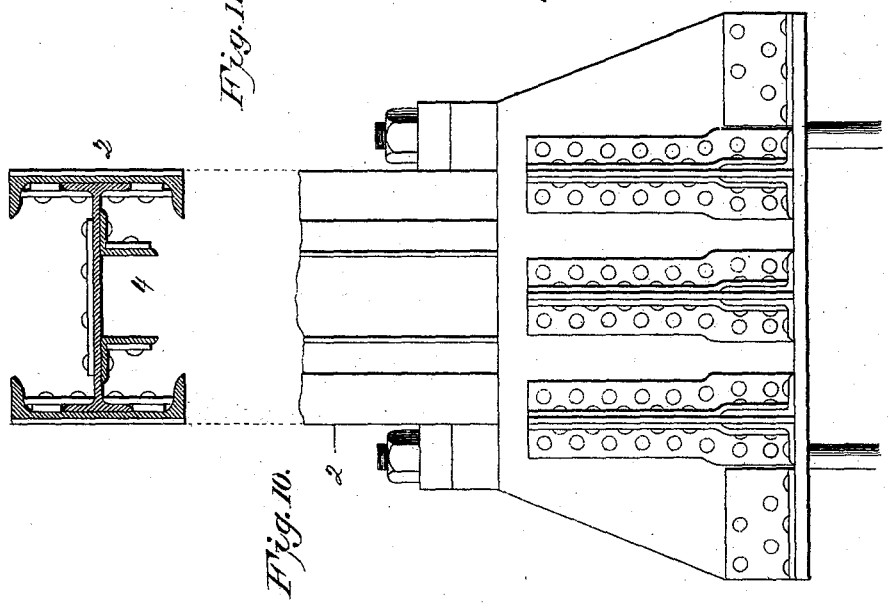

Fig. 10.

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J. A. L. WADDELL.

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Fig. 12.

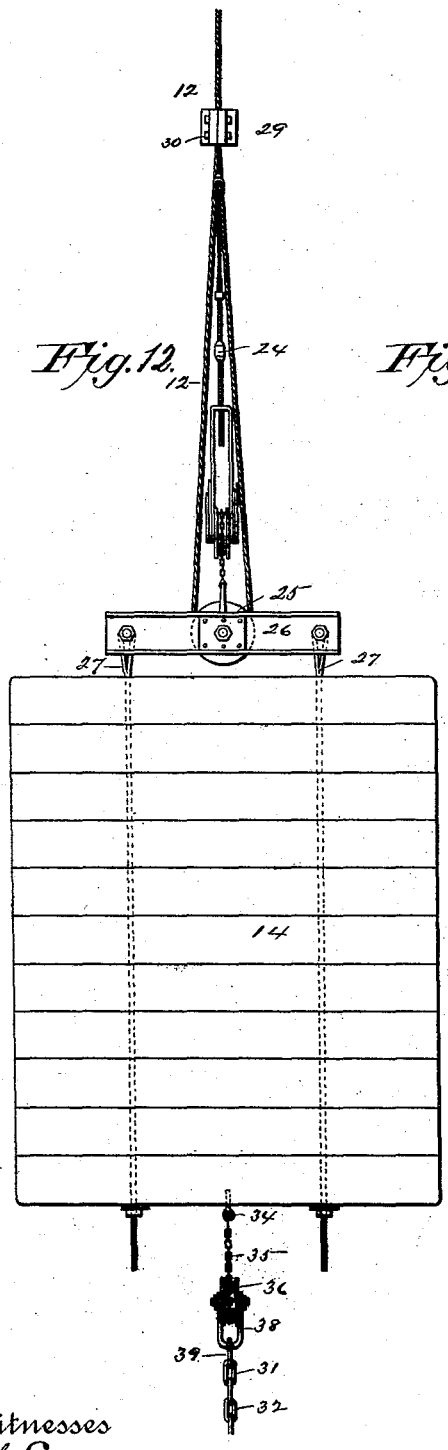


Fig. 13.

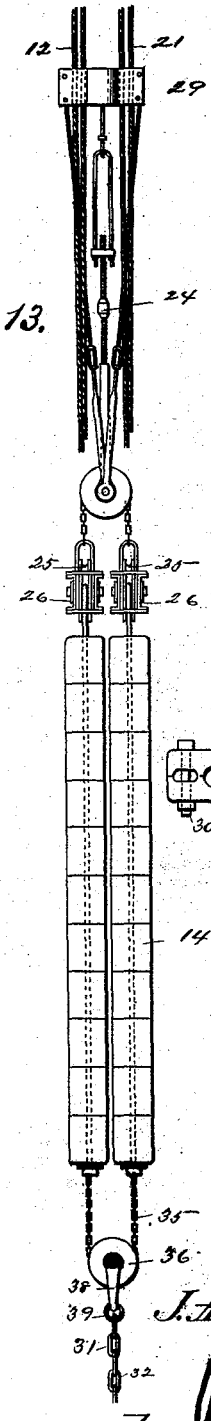
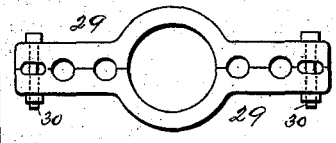


Fig. 14.



Witnesses
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E. M. Johnson

J. A. L. Waddell.
Inventor
By
Attorney

UNITED STATES PATENT OFFICE.

JOHN A. L. WADDELL, OF KANSAS CITY, MISSOURI.

LIFT-BRIDGE.

SPECIFICATION forming part of Letters Patent No. 506,571, dated October 10, 1893.

Application filed November 10, 1892. Serial No. 451,504. (No model.)

To all whom it may concern:

Be it known that I, JOHN A. L. WADDELL, a citizen of the United States of America, residing at Kansas City, in the county of Jackson and State of Missouri, have invented certain new and useful Improvements in Lift-Bridges; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to lift bridges, especially designed for both a maximum span and a maximum lift, and is especially adapted for ship canals and harbors where masted vessels are required to pass beneath the lift span when it is elevated, and where, if required, heavily loaded trains and railway engines may pass over the lift span, when it is lowered to grade, and which furthermore may have sufficient capacity to provide for the separate passage of vehicles and pedestrians over the bridge. This bridge, therefore, requires simplicity and great strength in its structural organization, and its operating mechanism must be such as to secure a superior method of counterbalancing all moving parts as well as for compensating and equalizing the variable strains which may come upon the mechanism, and must furthermore be applied in a direct manner to lessen the friction as well as to reduce to the minimum the load required to be lifted. This can best be effected by a system of cables and counterweights comprising a part of my invention, which invention further consists in certain details of construction hereinafter particularly described and designated in the claims.

Figure 1 is a side elevation of my improved lift bridge, showing the span lowered in full lines and elevated in dotted lines. Fig. 2 is a plan of the pier, lower operating sheaves and drum. Fig. 3 is a plan of the upper operating sheaves. Fig. 4 is a diagram illustrating the position of the sheaves, cables, lift-span and weights. Fig. 5 is an end elevation of the upper portion of the bridge. Fig. 6 is a side elevation of the base of one of the inclined brace columns, with means for adjusting the same. Fig. 7 is a sectional view taken through the line x—x of Fig. 6. Fig. 8 is a side view, partly in section, illustrating the hydraulic buffer and its connections with a reservoir. Fig. 9 shows detail views of the adjusting screws with which the cables are supplied for taking up the stretch thereof. Fig. 10 is a detail view illustrating the base portion of one of the columns of the tower. Fig. 11 refers to detail views of one end of the lift-span, showing the upper and lower guide rollers. Figs. 12 and 13 are side and end views of the weights which are located in the vertical guide columns; and Fig. 14 is a plan view of the coupling plate which connects the cables to each other.

Upon opposite sides of the canal, 1, are two strong well braced towers, 2, each having vertical inner columns, 4, resting upon a pier, 5, and inclined columns or braces, 6, and guys $6^{\times}$ resting upon an abutment, s', 5, and 7, or upon the solid walled side of the canal, the towers being connected at their upper ends by a trussed strut, 8, which extends across the canal to hold them truly in a vertical position, and sometimes sustained laterally against wind pressure when the span is lifted, by inclined guys $6^{\times}$ disposed in the same plane with the vertical columns. The upper ends of the towers on the same side of the canal may also be connected to each other by trussed struts $8^{\times}$. Sheaves 9 $9^{\times}$ and 10 $10^{\times}$ secured to shafts supported in bearings upon the respective towers at their tops immediately over the vertical inner columns, 4, carry cables 11, 12, which are attached at one end to the respective ends of a lift span, 13 and at the other end to counter-weights, 14, 15, which latter are of sufficient weight to properly balance the lift span, a series of these cables and weights upon each end of the span being necessarily employed as hereinafter described, to support a bridge span of sufficient length to permit vessels to pass beneath it. As the bridge is thus counterbalanced and supported by the weights at whatever position it may be placed, it is necessary to provide other means for lifting and lowering the bridge. This I accomplish by means of separate cables for lifting the bridge span, and by means of other cables to pull upon the weights when the span is lowered.

The span is lifted by cables 16, and 17, one of which, 16, is secured to one end of the lift span, 13, and passes over sheave $9^{\times}$, thence down through the tower to a pulley $22^{\times}$, at the base thereof, and thence around a drum, $18^{\times}$, driven by an electric, hydraulic, steam or other motor, 19, hereinafter described. The other cable, 17, is secured to the other end of the lift span, and passes around the sheave $10^{\times}$ and over the sheave $9^{\times}$, and thence passes downwardly through the tower to the drum, $18^{\times}$, and is wound thereon, together with the cable 16, the course and movement of the cables to lift the span being shown in Fig. 4. The counterbalancing weights 14 and 15 are lifted or pulled upon to allow the span to descend by gravity by means of cables 20 and 21. The cable 20 is attached to the weights 14, and passes up to and around the sheave 9 and over a pulley 23, below and outside of the sheave 9, and then passes down through the tower 2, to and around the pulley 22 to the drum, 18 to which it is secured.

The cable 21 is secured to the counter-weights 15 and passing up to and over sheave 10 upon the tower, thence downwardly across to the opposite tower, and beneath sheave 9, around the pulley 23, and down parallel with cable 20 as shown in Fig. 4, to the drum 18, and is wound thereon together with cable 20 to lift or pull upon the weights as shown in Fig. 4, and permit the span to descend.

When the span has descended to the line of grade the motor may still be held open to act with any required power within its capacity, to pull upon the weights sufficiently to allow the span by its consequent preponderance of weight, when the weights are thus acted upon, to solidly rest and be seated upon the pier, and when thus seated may, or may not, be securely held by any preferred form of brake or locking mechanism.

The various cables herein employed are connected to the span or to the weights by turn-buckles, 24, which provide means for adjusting the several cables grouped together to compensate for unequal expansion, and thus distribute the weight uniformly over all the cables.

The weights 14 and 15 are suspended from the looped ends of the cables, 11 and 12, by means of a roller, 25, supported between channel bars, 26, and the loops and cables can be adjusted by the means shown in Figs. 12 and 13 to take up any expansion or contraction which may occur, so that the strain upon all the cables will be equalized. The outer ends of the bars, 26, carry depending rods, 27, which pass through the ends of a series or pile of cast iron counter-weights, which are held thereon by nuts screwed upon the threaded ends of the rods, 27. The weights are grouped in two sections of two or more piles each of weights, each section being held within a vertical shaft or column 4, in the towers, which guides them in their travel and holds the weights in place, each weight being removable, and additional weights being readily attachable if required to balance the span because of rain, snow, or other obstruction.

When a series of looped cables is employed, they may be coupled together, to travel without displacement or friction, by plates, 29, the projecting ends of which are held securely together by bolts, 30. See Fig. 14.

The lower ends of the weights are connected to the end of the span by a counter chain, 31, composed of cast iron links, 32, to pass beneath the inner foot of the tower and upwardly therein, the weight of the chain 31 being such that it will exactly counter-balance the weight of the series of cables connected therewith, while its cost is much less than would be a series of cables.

The end of the counterchain 31 and the several series of weights are connected by eye-bolts, 34, screwing into the bottom weight, chains, 35, connecting the eye-bolts with a pulley 36, having a loop 38, which is connected by an open link, 39, with the end of the cast iron counter-chain. The several groups of weights will thus distribute their power which will exert its full force in a single line of draft, and serve to nicely balance the weights of the several cables throughout their entire movement, as the counter-weight chain 31 will follow and displace them throughout their entire movement.

When the bridge has reached the limit of its upward movement, it is arrested by contact with hydraulic buffers B placed respectively at the feet and at the tops of the towers, which receive the impact or force of the blow and thus relieve the bridge members of the shock which would otherwise be caused, and permit the span to seat itself steadily at the end of either movement.

The buffers B preferably consist of an outer casing, 40, connected by a supply pipe, 41, with a reservoir, 42, containing glycerine or other suitable non-congealing liquid, an inner foraminous cylinder, 43, through the perforations of which the liquid is pressed into an intermediate annular space, 44, and a hollow or cylindrical plunger, 45, which also provides an air chamber 46, to cushion the plunger and receive a portion of the shock. The buffers are also provided with a pipe which connects with the supply pipe 41.

The towers are, when necessary, held truly in position against the strain of the lift span and against wind pressure, which is excessive when the span is raised, by guys $6^{\times}$ extending laterally from the tops of the towers in the same plane with the vertical columns of the towers, and are securely anchored to the abutments or stone walls at a suitable distance from the feet of said columns. A stable tower structure of sufficient height may thus be obtained to permit the largest vessels to pass unobstructed beneath the lift span when it is elevated to the tops of the towers, and

the main guide columns are held truly in position.

The strut connecting the tops of the towers prevents the latter from coming together, to lose their parallelism, when the load is on, and the strain upon the cables extending from tower to tower between the motor, the weights and the lift span serves as a tie to closely bind the upper ends of the towers to the strut, and thus secure stability in the direction of the central line of the bridge.

The cables for raising the bridge and for pulling upon the weights to permit the span to descend are secured to the latter in line with the side trusses and pass over the sheaves and pulleys, as hereinbefore described, to drums, operated by a steam, electric, hydraulic, or other motor located upon one side of the bridge below the elevation of the grade, thus to provide protection, close proximity, and direct communication between the power and the work to be performed, and bring the strains upon the cables in direct line with the trusses of the lift span.

The span is guided in its travel and held laterally against excessive wind pressure by friction rollers, *b* and *c* supported upon axles secured to the ends of the span to rest against the sides of the vertical column and receive the direct force of excessive lateral pressure of the wind, which would otherwise interfere seriously with the vertical movement of the span. The guide rollers *b* abut against the front vertical plain faces of the towers 4 which provide a bearing for the same, and the supports for the guide rollers *b* are provided with springs *b'* which permit said supports and rollers to yield with the longitudinal movement or with the contraction and expansion of the span. Adjacent to the rollers *b* the ends of the span have rollers *c* for preventing lateral displacement of the span, and the axes of these rollers are at right angles with the axes of the rollers *b*, and they contact either with the sides of the column 4 or with angle plates attached thereto.

The vertical towers 2 can be adjusted should they settle and become out of plumb by means of wedge-shaped plates, 47, which are placed beneath the lower ends of the inclined braces 6, and this adjustment is accomplished by loosening the bolts which hold the braces 6 down to their foundations. The wedge-shaped plates can then be moved to make the adjustments by means of jacks which are placed under the feet of the braces 6.

An observatory 45, is placed upon the lift span well above the grade line, and a watchman stationed there can signal the approach of a vessel, or by suitable means start or stop the movement of the operating machinery. When the span has been lifted sufficiently to allow the approaching craft to pass beneath it, the observer will be able to detect it by means of a peeper, 50, consisting of a vertical tube, 51, upon which is journaled a horizontal tube, 52, under the span, which may be swung or turned in any required direction to point to the approaching vessel, the tubes being provided with reflectors and lenses to bring the image in view to the observer.

In the accompanying drawings Figs. 6 and 7 show the structure of the guys $6^{\times}$, which are made up of angle plates and bars riveted together. Fig. 10 shows the form of the vertical column 2, and the inner vertical columns against which the guide rollers carried by the lift-span bear.

Various modifications will readily suggest themselves to a skilled engineer, in carrying out the invention hereinbefore described, without departing from the true spirit thereof, although some of the details of construction herein described are specifically claimed, and only comprise improvements upon well known devices employed for other purposes.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A lift bridge comprising towers, an intermediate lift span, counter-weights for supporting the lift span, and means for pulling upon the weights to allow the lift span to descend by gravity substantially as described.

2. A lift bridge comprising towers, an intermediate lift span, counter-weights for supporting the lift span, and means for relieving the weights of sufficient power to hold down the span by the consequent preponderance of its weight, substantially as described.

3. A lift-bridge having supporting towers between which is located a vertically movable span, counterweights connected to the span and guided within the towers, and a connected series of weights or links attached to the counterweights and to the span.

4. In a lift-bridge a lift span having counterweights attached thereto, a connected series of counterbalancing weights or links extending from the counterweights to the lift span, and cables or ropes attached to the counterweights and to the lift span for hoisting and lowering the span, substantially as shown.

5. In a lift-bridge, a lift span having counterweights attached thereto, a connected series of counterbalancing weights or links extending from the counterweights to the lift-span, and cables or ropes attached to the counterweights and to the lift span, said cables or ropes extending to a drum over which they are wound in opposite directions, for the purpose set forth.

6. In a lift-bridge, a span having counterweights connected thereto, counterbalancing chains attached to the counterweights and to the span, cables or ropes for lowering the span attached to the counterweights and hoisting cables attached to the span, the hoisting and lowering cables being guided to a drum operated by a suitable motor, for the purpose set forth.

7. A lift bridge comprising towers having vertical guide columns, and inclined rear columns, with means for adjusting the same an

intermediate span adapted to be raised and lowered upon the guide columns, and lateral inclined guys located in the plane of the guide columns, substantially as described.

8. A lift bridge comprising supporting towers having vertical columns between which is located the lift-span, said vertical columns carrying the hoisting mechanism, inclined rear columns having means for adjusting the same, the vertical columns being supported upon piers, substantially as shown, and for the purpose set forth.

9. In a lift-bridge the supporting towers having on their adjacent faces guides for a lift-span, the upper portions of said towers having sheaves or pulleys, counterweights located and guided within the supporting towers, inclined brace columns with means for adjusting the same so as to act upon the vertical towers, and lateral guys, the span having means for holding the same in movable contact with the inner faces of the columns, substantially as shown, and for the purpose set forth.

10. A lift bridge comprising towers, an intermediate lift span, and rollers upon the ends of the span outside of the tower columns to prevent lateral displacement of the lift span, substantially as described.

11. A lift-bridge comprising towers or columns with front and side vertical plane surfaces, in combination with a lift-span having rollers adapted to engage with the plane surfaces of the columns, substantially as shown.

12. In a lift-bridge, the main columns or towers having front vertical plane faces forming bearings for guide rollers carried by the lift-span, said guide-rollers being mounted upon yielding supports, in combination with rollers for preventing lateral displacement of the lift-span which are substantially as shown.

13. A lift bridge comprising towers, an intermediate lift span, and hydraulic buffers to receive the upward impact of the bridge span, substantially as described.

14. A lift bridge comprising towers, an intermediate lift span, and hydraulic buffers to receive the downward impact of the lift span, substantially as described.

15. A lift bridge comprising towers, an intermediate lift span, a strut connecting the tops of the towers, and cables extending across from the tops of the towers which support the lift span and act as ties upon the towers, substantially as described.

16. A lift bridge comprising towers, an intermediate lift span, a pulley supported at the top of the tower, a cable carried by the pulley, a counter-weight for supporting the lift span, and a chain counter-weight for balancing the cable, substantially as described.

17. A supporting and elevating tackle comprising a number of cables which are connected to the lift span and to weights, chain counterweights connected to the weights and to the lift-span, and means for adjusting the chain counterweights upon the weights attached to the cables.

18. In a lift-bridge comprising towers and a lift-span, elevating and lowering tackle consisting of a plurality of cables which are connected to the lift-span and to weights, each pair or set of weights having attached thereto a counter balancing chain the opposite end of which is connected to the lift-span, substantially as shown, and for the purpose set forth.

19. A supporting and elevating tackle for lift-bridges, comprising a plurality of cables which pass over a pulley so that said cables will act in unison or together, said cables being connected to counterweights, the counterweights also carrying counterbalancing chains which extend to the lift-span of the bridge.

20. A lift bridge comprising a tower formed of front and rear columns, a lift span between the towers, and adjusting plates under the feet of the rear columns, substantially as described.

21. A lift bridge carrying an observatory upon the lift span, and a peeper suspended from the span to revolve upon a vertical axis to determine when the bridge has passed the tops of the masts, substantially as described.

22. A bridge having a lift-span, a peeper consisting of a vertical tube with lenses, the lower end of the peeper being below the under side of the lift-span, for the purpose set forth.

23. A bridge having a lift-span, in combination, with a peeper for determining when the lift-span has been elevated sufficient to allow the passage of an object beneath the same.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN A. L. WADDELL.

Witnesses:
WM. H. ROWE,
NELLA PAYNE.