Dec. 16, 1924. 1,519,189

T. E. BROWN

DRAWBRIDGE

Original Filed April 29, 1922 2 Sheets-Sheet 1

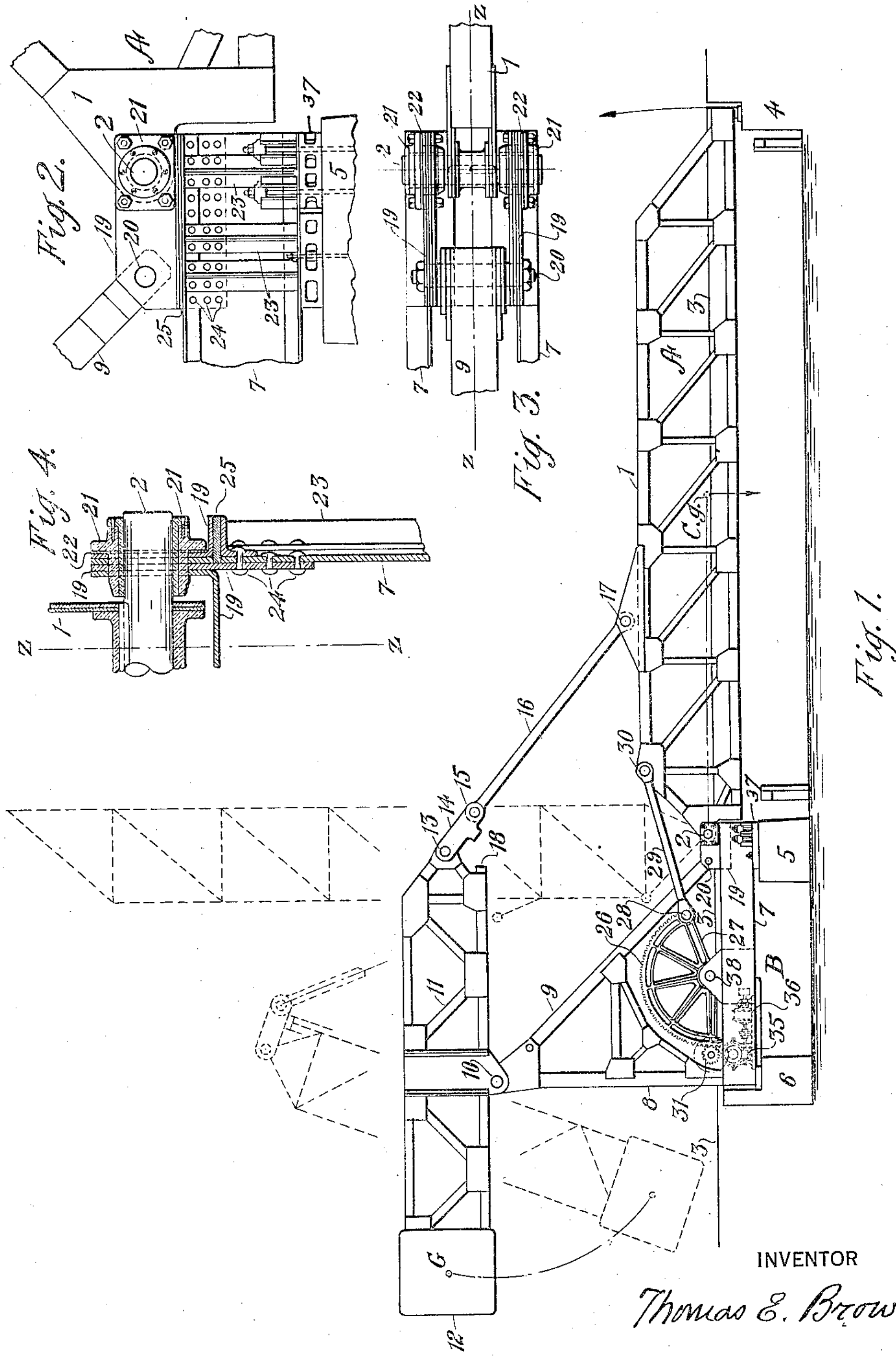

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

INVENTOR

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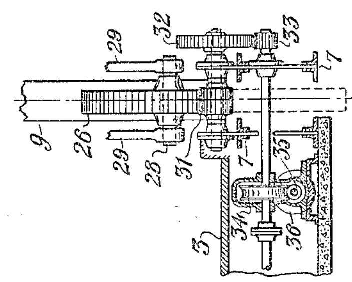

Fig. 7.

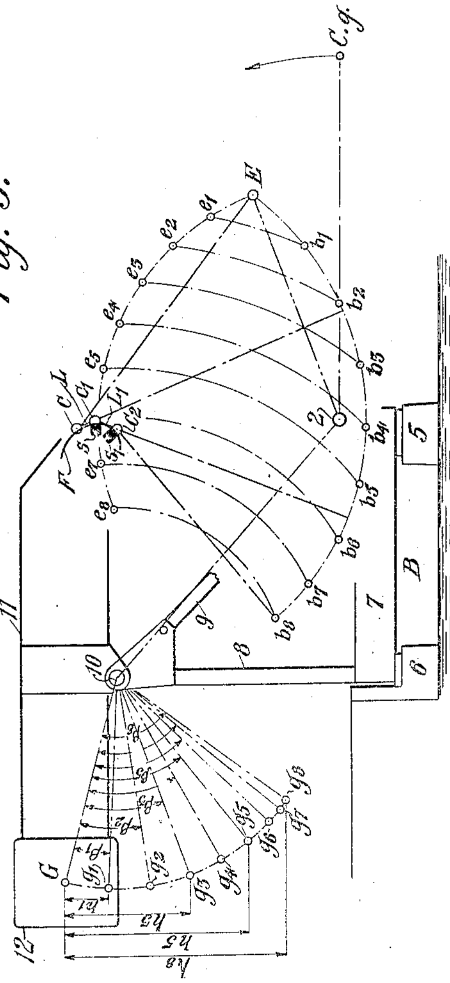

Fig. 5.

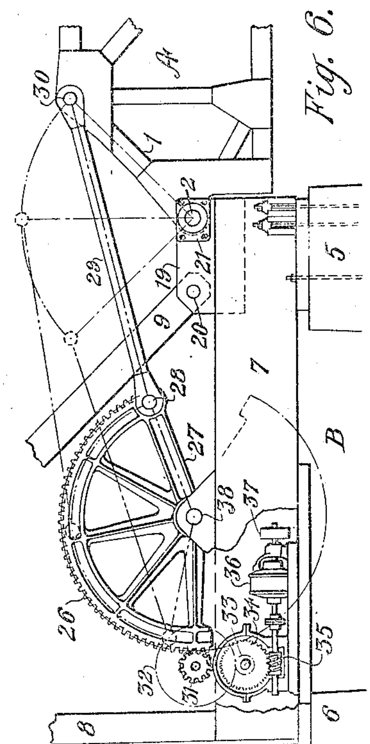

Fig. 6.

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UNITED STATES PATENT OFFICE.

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DRAWBRIDGE.

Application filed April 29, 1922, Serial No. 557,442. Renewed May 27, 1924.

To all whom it may concern:

Be it known that I, THOMAS E. BROWN, a citizen of the United States, and a resident of the borough of Manhattan, in the county of New York and State of New York, have invented a certain new and useful Improvement in Drawbridges, of which the following is a specification.

This invention relates to an improved form of that type of bascule bridge which has long been known as the "draw bridge" and which consists essentially of a pivoted movable span with balancing beams pivotally supported above the bridge and connected at their outer ends to the movable span by tensional connections, balance being effected by heavy weights attached to the inner ends of said beams.

This invention is an improvement on the bridge shown and described in my U. S. Letters Patent No. 1,270,925, July 2, 1918, and, as in said patent, one of the objects of my invention is avoidance of the parallelism of the usual construction of such bridges whereby I am enabled to so place the counterweight that said counterweight remains always back of and does not pass between its supporting frames.

Another object of my invention is an improved construction of the fixed supports for the trunnion of the movable span whereby the horizontal components of the counterbalancing forces acting between the counterweight supporting frame and the trunnion of the movable span are carried in the most direct manner, while the vertical components are carried directly to the pier, and all moments from the counterweight forces on the trunnion supports are avoided.

And another object of my invention is an improved operating mechanism whereby the speed of the moving span is automatically decreased as the span approaches its seat, so that the span seats itself gently, even without the aid of the operator, and danger of excessive impact with the seat is avoided.

Other objects and advantages of my invention will be understood from the description and the drawings.

Referring to the drawings:

Fig. 1 is a side view of a bridge of my construction.

Fig. 2 shows the trunnion supporting parts and post foot at a larger scale.

Fig. 3 is a plan view of Fig. 2.

Fig. 4 is an enlarged section of part of Fig. 2.

Fig. 5 is a diagram showing the preferred method of locating points of rotation of the tensional connection, and

Figs. 6 and 7 show the operating mechanism at a larger scale.

Similar characters refer to similar parts in all the figures.

In general, numerals refer to material details of the structure and letters to main parts and geometric elements. Referring more especially to Fig. 1, A is the movable span of a bascule bridge, and B the fixed or tower span. 1 is a truss of said span A and 2 the trunnion or pivot about which it rotates. 4, 5 and 6 are piers supporting the bridge. The fixed span B comprises the members or girders 7 which rest on the piers 5 and 6 and are preferably in pairs, and carry the floor 3 of the fixed portion of the bridge and support the trunnion 2 of the movable span A. Said members 7 support the posts 8 and 9 which in turn carry the pivot 10 of the balance beam 11. Said posts 8 and 9 and members 7 form a tower or counterweight carrying frame of which said members 7 form the base. Base 7 is preferably supported on piers 5 by means of bed plates 37.

On the inner or shore end of the balance beam 11 and carried by said beam is the counterweight 12, and at the other end of said beam 11 is a pivot 13 to which is connected the short link 14 which in turn is connected by pivot 15 to the long link 16, said long link 16 being connected to the truss 1 by the pivot 17.

18 is a stop, suitably placed on beam 11, to arrest the rotation of link 14 about pivot 13. Thus rotation of the links 14 and 16, during the first portion of the movement of the span 1, takes place about pivot 13 and so continues until said link 14 contacts with stop 18, after which rotation of link 16 takes place about pivot 15, and the positions of said pivots 13 and 15 and stop 18 are such that the counterweight substantially balances the movable span 1 in all its positions.

The inclined post 9 terminates at its lower end at substantially the same level as the trunnion 2 and is preferably connected to plates 19 by a pin 20, said pin 20 being located sufficiently far back of the trunnion 2 to permit of full opening of the bridge without interference of truss 1 with post 9, the said post 9 being preferably in line with truss 1, i. e., both having the same plane of symmetry.

Dotted lines show the movable span in its open position. It will be understood that in general the description refers to one side of the bridge only and that the parts described will usually be duplicated on the other side of the bridge.

It will be seen from Fig. 5 and the dotted lines in Fig. 1, that the angular motion of the balance beam and counterweight about the counterweight pivot, differs from the angular motion of the span about its pivot, and that the counterweight remains always outside of the fixed counterweight supporting structure.

The location of pivots and stops, such as will cause the counterweight to balance the movable span in all its positions, may be determined by the formulæ and method described in my hereinbefore mentioned U. S. Letters Patent, but I prefer to use the graphic method fully described in my U. S. Letters Patent No. 1,302,302, April 29, 1919.

Thus, referring to Fig. 5, having chosen a suitable position E for the pivot 17 on the movable truss 1, I rotate said pivot into various positions e_1, e_2, e_3, etc., corresponding to various positions g_1, g_2, g_3, etc., of the center of gravity G of the counterweight 12, which may be found as described in said patents by the principle of virtual work, i. e. by determining the required heights of fall h_1, h_2, h_3 of the center of gravity G of the counterweight 12.

I then rotate the positions e_1, e_2, e_3, etc., about the counterweight pivot 10, through angles equal (but in reverse direction) to the corresponding angles B_1 B_2 B_3, etc., of motion of the counterweight, thus forming a curve E, b_1, b_2, b_3, etc., which is the path of the pivot 17 relatively to the balance beam 11, said balance beam 11 being considered as fixed in position.

I then find centers such as C, C_1, C_2 corresponding to arcs of the curve E b_1, b_2, b_3, etc., which centers can be found by trial, but I prefer to construct the evolute F of the curve E b_1, b_2, b_3, etc., and choose the points C, C_1, C_2 at intersections of tangents to said evolute. The positions so found for the centers C, C_1 and C_2 determine the length of the short links L and L_1 and the positions of the stops S and S_1.

Mathematically accurate balance of the movable span requires a flexible connection having an infinite number of points of rotation and continuous stops forming a curved saddle of the form of the evolute F, but I find that three pivotal points as indicated in Fig. 5 give an accuracy of balance well within the requirements of practice, and that in general two pivotal points as shown in Fig. 1 are sufficient.

Referring to Figs. 2, 3 and 4, Figs. 2 and 3 show the form of support preferred for the trunnion of the movable span, and Fig. 4 is a vertical section through one end of a trunnion, the line Z—Z representing the vertical central plane of the truss 1. The trunnion 2 rotates in the trunnion bearings 21 which are preferably cylindrical in form and fitted into holes, bored to receive them in plates 19, whereby the loads on said bearings are transmitted directly to plates 19 and directly through said plates to pin 20 of inclined post 9. The flanges and bolts on trunnion bearing 21 serve only to hold said bearing in place and prevent its turning.

It will be noted that said trunnion bearings 21 are external to and preferably symmetrically placed with respect to truss 1.

Spacing washers 22 of suitable thickness may be used for lining up the bearings axially to allow for the unavoidable inaccuracies of the riveted work. This arrangement has the advantage that the bearings may be readily removed for repairs or renewals.

The use of the bridge pin 20, connecting the inclined post 9 to plates 19, permits of the body of said post being made narrower than the space between said plates 19 and hence the width of the body of said post 9 need not exceed the width of the truss 1.

I prefer to fix the plates 19 on the girders 7 and carry the vertical components of the forces to the piers by means of stiffeners 23 on said girders 7. It will be noted that bed plates 37 extend under stiffeners 23 and until vertically under the lower end of the inclined post 9.

With this construction the horizontal component of the counterbalancing forces acting through the trunnion 2 is met and balanced directly in the plates 19 by the horizontal component of the forces in the inclined post 9, and therefore no moments from said forces exist, and the metal usually required to provide for such moments may be entirely omitted, and it will be readily understood that so far as the balancing forces are concerned stability exists independently of that portion of members 7 extending between piers 5 and 6 and that the function of said portion of members 7 is simply to support loads and forces which occur between said piers. This construction admits of plates 19 being fabricated separately from members 7, whereby the trunnions 2 on opposite sides of the bridge may be readily placed in exact alignment, and the holes for the rivets 24 reamed or drilled in the field to suit. This avoids the great difficulty of aligning the trunnions across the bridge after said trunnions are fixed to heavy masses of metal such as members 7 and posts 8 and 9.

Leveling plates 25 may be used to adjust the trunnion bearings to exact level.

Referring more particularly to Figs. 6 and 7, I prefer to operate the bridge by means of a segmental gear or bull-wheel 26 and crank arm 27 and crank pins 28 and connecting rods 29, said connecting rods 29 being connected to truss 1 by a pin 30. Connecting rods 29 are preferably in pairs, one on each side of post 9. The gear segment is operated by pinion 31 and wheel 32, and said wheel 32 in turn by pinion 33 and worm wheel 34 and worm 35. Said worm 35 being coupled to the shaft of the motor 36. 37 is a brake wheel on the shaft of motor 36.

It will be seen by reference to the figures that as the moving span A approaches its lowered position, the line of the connecting rods 29 approaches closer and closer to the center 38 of the gear segment 26 and thus the leverage of the machinery becomes greater and greater and the speed of the span A slower and slower until the span A seats itself gently on toe pier 4 (see Fig. 1) whether the motors are stopped or not.

Also it will be noted that the machinery by reason of its great leverage in the lowered position of the span A, has great power in starting the span from its seat, and similarly has great power to hold the span against wind pressure when said span is in its fully opened position. The angularity between crank arm 27 and connecting rod 29, when the bridge is in its lowered position, is made as small as necessary so said members act as a toggle or lock to hold the movable span on its seat when in its lowered position, and thus the usual expensive toe locks and lock operation mechanism can be be dispensed with.

The introduction of the worm gearing simplifies the mechanism by eliminating the usual high speed spur gearing and avoids the disagreeable noises incident thereto.

This form of operating machinery permits of placing the motors and associated parts below the bridge floor, and avoids the expensive machinery houses usually found necessary.

Now, having described my invention, what I claim is:

1. In a drawbridge, the combination of a hinged span, a balance beam carrying a counterweight and having angular motion unequal to the angular motion of said span, a connection from said beam to said span, links joining said connection to said beam and stops located on said beam to contact with said links and change the rotational length of said connection to effect substantial balance of said span throughout its motion.

2. In a drawbridge, a hinged span, a balance beam carrying a counterweight, a support for said beam, a connection from said beam to said span, links joining said connection to said beam and stops on said beam to contact with said links and change the effective length of said connection as said span moves to its various positions.

3. In a drawbridge, a hinged span, a balance beam carrying a counterweight and having angular motion differing from the angular motion of said span, a connection from said beam to said span, links joining said connection to said beam and stops to contact with said links and change the point of rotation of said connection on said beam to vary the ratio of the lever arms of said connection about the pivot of said beam and the pivot of said span, whereby said span is balanced in all its positions.

4. In a bascule bridge, a movable span, a fixed structure supporting a counterweight, an inclined post forming a part of said fixed structure and adjacent to the movable span, members forming the base of said structure and supporting said inclined post, said members extended forwardly under said post and said movable span mounted above said members and at the level of the lower end of said inclined post.

5. A bridge comprising a movable span and a fixed span, an inclined post on said fixed span and adjacent to said movable span, girders forming the base of said fixed span, said inclined post and said movable span mounted above said girders and at the same level.

6. In a bascule bridge, a movable truss having a pivot at its heel, a fixed counterweight supporting frame having an inclined post, the foot of said post adjacent to said pivot and at the level of said pivot, plates joining the foot of said post with said pivot whereby the horizontal component of the counterbalancing forces is carried directly between said post and said pivot, a bed plate supporting said frame and said bed plate extended until vertically under the end of said inclined post.

7. In a bascule bridge, a movable span having trunnions at each side thereof, a fixed tower part having inclinded posts adjacent to said trunnions and terminating substantially at the level of said trunnions, plates joining said posts and said trunnions, supports for said plates, said plates movable with respect to said supports for adjustment of the alignment of said trunnions across said bridge.

8. In combination with a bascule bridge having a movable span and a fixed tower part, a crank arm pivoted on said fixed tower part, connecting rods pivotally attached to the extremity of said crank arm and directly connecting said crank arm and

said movable span, a segmental gear affixed to said crank arm, a pinion associated with said gear and means to rotate said pinion to raise and lower said movable span.

9. In a bascule bridge having a movable span and a fixed tower part, a crank arm pivotally supported on said fixed tower part, connecting rods pivotally attached to the extremity of said crank arm and directly connecting said crank arm and said movable span, a segmental gear affixed to said crank arm, a pinion meshing with said gear, and said crank arm having angular motion greater than the angular motion of said span.

10. In a bascule bridge having a movable span and a fixed tower part, a crank arm pivotally supported on said fixed tower part, connecting rods pivotally attached to the extremity of said crank arm and directly connecting said crank arm and said movable span, a segmental gear affixed to said crank arm, a pinion meshing with said gear, the angle between said crank arm and said connecting rods being so small, when said span is in its lowered position, that said arm and said rods form a toggle to lock said span in said lowered position.

THOMAS E. BROWN.