2 Sheets—Sheet 1.

B. WILLIAMS.

Self-Adjusting Bridge.

No. 204,407. Patented May 28, 1878.

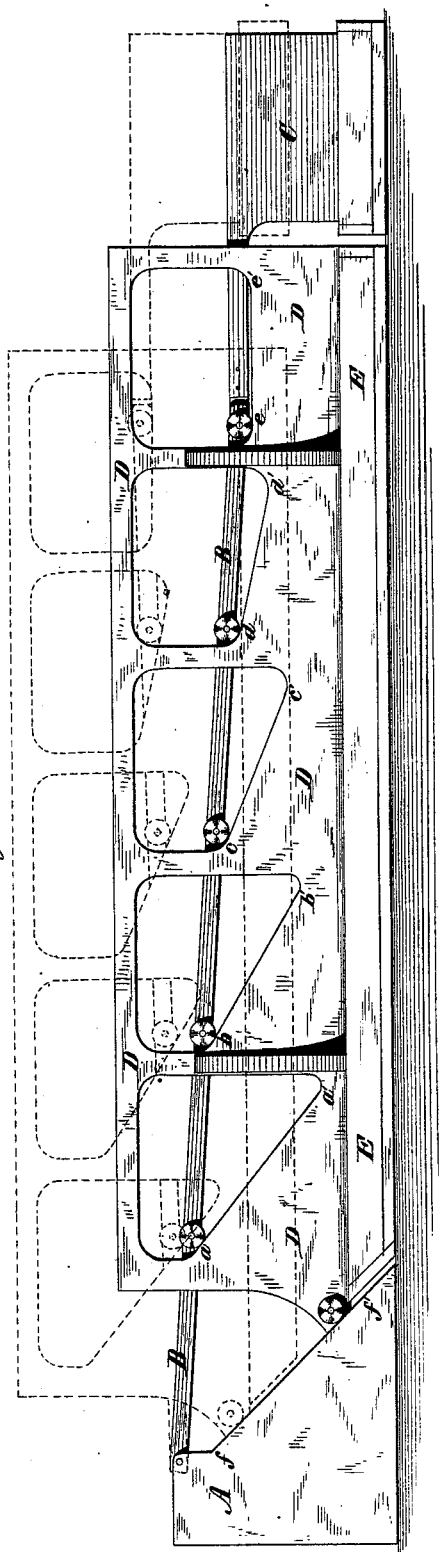

Fig. 1.

Witnesses.

Harry King

D. R. Cowl

Inventor.

Benzette Williams

by his attys

Stansbury & Munn

2 Sheets—Sheet 2.

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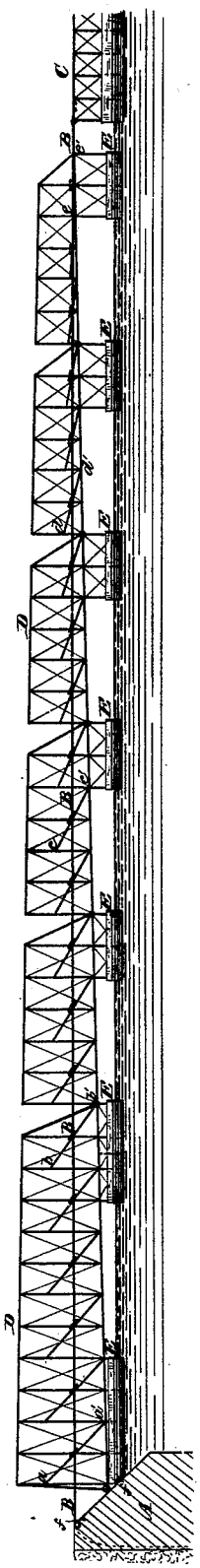

Fig 2.

Witnesses.

Harry King

A. M. Stansbury

Inventor.

B. Williams

by Stansbury & Munn.

his attys

UNITED STATES PATENT OFFICE.

BENEZETTE WILLIAMS, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN SELF-ADJUSTING BRIDGES.

Specification forming part of Letters Patent No. **201,407**, dated May 28, 1878; application filed April 17, 1878.

To all whom it may concern:

Be it known that I, BENEZETTE WILLIAMS, of Chicago, county of Cook, State of Illinois, have invented a Method of Constructing a Self-Adjusting Bridge, which can be used as an approach or apron to a floating dock or platform, ponton-bridge, or other marine structure.

The nature of my invention is such that, while it admits of the floating dock, ponton-bridge, or other structure, as the case may be, varying in elevation with any rise or fall of the water upon which it floats, an even and regular grade will be maintained between the floating structure and any stable point. One end of the said approach or apron, being connected with the floating structure, rises and falls with it, the other end being attached to a point on shore or other fixed object, while as many intermediate points as desirable are supported by a floating substructure, and still kept in line with the two ends; and I do hereby declare the following to be a full and correct description of my invention in its relation to other parts or structures with which it is combined.

In Figure 1 of the drawings forming part of this specification is an elevation of all the combined parts; and Fig. 2 is an elevation of a number of sections or spans, the heavy black lines showing the position of the bridge at low water, while the dotted lines represent its position at high water.

The part marked A represents a fixed abutment, pier, dock, or any object to which one end of the approach or apron (marked B) is attached, the other end, being connected to a floating dock or platform, ponton-bridge, or other marine structure, represented by the part marked C. The part marked D represents a floating substructure or support for the intermediate points of the apron, consisting of any number of parallel trusses, made in any way to give the required strength and stiffness. They may be made in one continuous length throughout the whole substructure; or they may be divided into any number of sections or spans, being connected with each other by a hinged joint. The trusses rest upon and are secured to a float or a series of floats. (Represented by the part marked E.) The floats can be made in any suitable manner to insure a proper amount of displacement and to present the least resistance to water-currents and floating obstructions.

The substructure D carries a series of inclined planes or tracks, (marked *a a'*, *b b'*, &c.,) which are continually varied in inclination, the last one of the series, *e e'*, being horizontal. Each of these inclined planes or tracks acts as a support for the apron B, the bearing being taken upon one or more rollers, wheels, or trucks, or upon a sliding rider. The apron may also be suspended from the riders or rollers below the inclined supports. There may be any desired number of these inclined planes, tracks, or supports, and they may be constructed in any suitable manner, either of wood or iron beams, and built in line with the trusses as part of the individual members thereof; or they may be placed to one side, separate from the trusses, having distinct supports, as ties attached to cross-beams overhead or struts attached to cross-beams underneath.

On the structure marked A, *f f'* represent inclined guides, of any desirable number and with any given angle of inclination, along which the substructure of the apron moves in its ascent and descent during a rise or fall of the water; hence the substructure has both a horizontal and a vertical movement in shifting from one position to another, the horizontal movement having a ratio to the vertical movement depending upon the inclination given the guides. Since it is necessary that the grade of the approach or apron shall be uniform and regular throughout its length, it is evident that the inclination of each support, as *a a' b b'*, &c., must be such as to keep it so—*i. e.*, so that at any position of the roller or rider on the support the apron at that point will be maintained in a line with the two ends.

To determine the inclination which each respective support should have, let us take a straight line crossing a horizontal straight line at the angle which the guides on the part A are to make with the horizontal. Take a third straight line of the length of the given apron—that is, the distance from the point of attachment at A to the roller resting on the horizontal support *e e'*. If intermediate points

be located on the line corresponding to the points where the bearings of the apron B are to be taken, and if one end of the line be moved along the diagonal line between the limiting-points for high and low water, the other end being kept constantly in the horizontal line, then each of the intermediate points will locate a slightly-curved line inclined to the horizontal, which is the true mathematical position for the inclined-plane support. No two of these lines will have the same inclination or the same degree of curvature; but they fulfill the exact conditions necessary to kept the apron in the prescribed position during all stages of the water.

It, however, is not necessary to the practical success of my invention that the surface of the inclined supports should have the exact mathematical curve described, for within the limits of possible and desirable grades these curves are approximately straight lines, and a straight support, at or near the inclination thus defined, will answer the purpose equally well.

Neither is it necessary that the apron B shall have at all times an exact position in an invariably straight line, as slight variations therefrom, caused by inaccuracy of construction or the variable positions of the sections into which the trusses may be divided, will be provided for by having the apron at the various points of support sufficiently flexible to allow for the necessary variation from the true line.

It is apparent that, as the apron B is attached to a fixed object, A, and as the guides and supports are inclined toward A, the rollers or riders of the apron, and the apron therewith, are held from moving down to the lowest point on the inclines by a tensile force acting in the apron B, and by a compressive force in the substructure D, which is taken against the guides *f f'* by bearing-rollers of thrust-blocks attached to the substructure, thus preventing the same from moving horizontally beyond what is necessary for an equilibrium between the horizontal and vertical forces applied to the said guides *f f'*.

If, however, the guides and supports of the substructure and the abutment, respectively, be inclined from instead of toward A, the above-described action of forces will be reversed, and we will have a structure which will fill the same purposes as the one shown in Fig. 1.

The arrangement as described and shown in Fig. 1 is the one I mostly prefer. I do not, however, limit myself to either.

The guides *f f'* can be placed upon the floating substructure instead of upon the fixed abutment A, and the bearing taken upon rollers or thrust-blocks secured to A, or upon rollers distributed throughout the length of the guides, and the same purposes be accomplished.

I do not limit myself to either method; but under some circumstances would prefer one arrangement, and under some the other.

The approach or apron B may be made in any manner to suit the purpose for which it may be designed. Generally, however, it will consist of riders rolling on the inclined supports, with cross-beams carried by the riders extending from truss to truss, upon which stringers or subsidiary girders will rest, and upon which a roadway for railroad or highway purposes, or a platform for a floating dock, or an approach to a ferry, or any structure to be used for a similar marine purpose, may be built. The stringers or subsidiary girders may be made to take the longitudinal strains in the apron; but generally tie-rods, performing the office of ties and nothing more, will be used, these tie-rods being connected to the riders or to the cross-beams at one end and the fixed abutment or dock A at the other end.

The ponton substructure, when under the influence of the weight of the apron or dead load, will move along the guides *f f'* on A until a sufficient vertical force or weight is brought upon them to counteract the horizontal retreating force in the substructure, thus causing a disturbance from the position it would take in the water if unrestrained. This disturbance can be counteracted by a weight or load applied to the end of the substructure near to A.

The disturbance caused by the tendency to rise in the same manner under the effects of a variable or living load, and to again subside after the load has been removed, can be reduced to an unimportant minimum by a proper proportion between the area of flotation or displacement and the applied load.

The substructure is to be stiffened and strengthened laterally, in both a horizontal and vertical direction, by any approved method of bracing.

The boats, floats, or pontons are to be built of any material and form adapted to the particular case.

If the bridge extends out from shore, the boats are to be anchored in a suitable and sufficient manner.

The apron is to be attached to the floating-dock platform or ponton-bridge C by means of a jointed connection allowing the requisite flexibility, or in any other suitable manner. It may be permanently secured or inclosed in its position; or it may be a floating drawbridge, which can be swung out of position to allow the passage of vessels or any floating object which requires a clear passage.

I do not confine myself to any particular method of construction in the parts and combination of parts described. They may be made of any material adapted to such purposes, and in any manner desired, so far as general form and matters of detail are concerned, and the complete structure can be used for any of the purposes named, or for any kindred marine purposes whatever.

I am aware that a system of constructing a track, roadway, or other marine structure upon parallel inclined supports, in combina-

tion with a substructure which is expected to maintain the track or roadway in a horizontal position and at a constant elevation during all stages of the water, thus enabling the track or roadway to be connected at each end with fixed points on adjacent objects, has been proposed as an improvement in floating draw-bridges. To this I lay no claim.

My invention is for a track, roadway, platform, apron, or other structure constructed upon inclined supports which have a successively-varying angle of inclination, substantially as described, these inclined supports forming part of, or being supported on, a ponton substructure which is expected to keep the whole length of the track, roadway, platform, or apron in one plane during any stage of the water, but not necessarily in a horizontal position, one end only of the apron maintaining a constant elevation, the other end, during a change in the height of the water, moving in the arc of a vertical circle about the fixed end, and all intermediate points at the same time moving in arcs of vertical circles about the same end, with radii equal to their respective distances from the fixed end, thus adapting the platform or apron to uses as a bridge or approach connecting a structure of fixed elevation with another of varying elevation, as the connection of a fixed shore-span of a bridge or an abutment with a floating draw-bridge, which constantly varies in height with the water.

My invention is especially adapted to uses as a ponton-bridge and approach to other ponton-bridges in the crossing of navigable water-courses, where long and gradual grades are needed to overcome the variations of high and low water. It is also well adapted to uses as a railway or wagon-way approach to a ferry or to a floating dock, and to numerous other marine purposes where changes in height of water are to be met.

What I claim as new in my invention, and desire to secure by Letters Patent, is—

1. The system of inclined planes or tracks marked *a a'*, *b b'*, *c c'*, *d d'*, and *e e'*, in combination with the substructure marked D, the float marked E, and the inclined guides marked *f f'*, each successive inclined plane or track having an angle differing in inclination from the one preceding it, the angle being determined substantially as described, the substructure D being self-adjusting, and compelled by the buoyancy of the water and the tension on the apron B to follow the guides *f f'* in shifting from one position to another.

2. The combination of the inclined planes marked *a a'*, *b b'*, *c c'*, *d d'*, and *e e'*, having a regulated vertical and horizontal movement, with the approach or apron marked B, the fixed abutment, dock, or pier marked A, and the floating dock, platform, or bridge marked C, in such manner as to support the apron at any number of points, and to maintain the same in a continuous line or plane at any stage of the water, thus rendering the floating dock or bridge C, which is variable in height, accessible, when in any position, from the fixed structure A.

3. The combination of the whole, to wit, the abutment or dock marked A, the apron marked B, the floating dock or bridge marked C, the substructure marked D, the floats marked E, the inclined planes or supports marked *a a'*, *b b'*, *c c'*, *d d'*, and *e e'*, and the inclined guides marked *f f'*, together with rollers or riders, as described, to be used as a permanent bridge, dock, or approach to a dock or ferry, or any similar marine structure, substantially as set forth.

In testimony that I claim the foregoing as my own invention I affix hereto my signature in presence of two witnesses.

BENEZETTE WILLIAMS.

Witnesses:
F. A. JOHNSON,
THOS. S. MCCLELLAND.