(No Model.)

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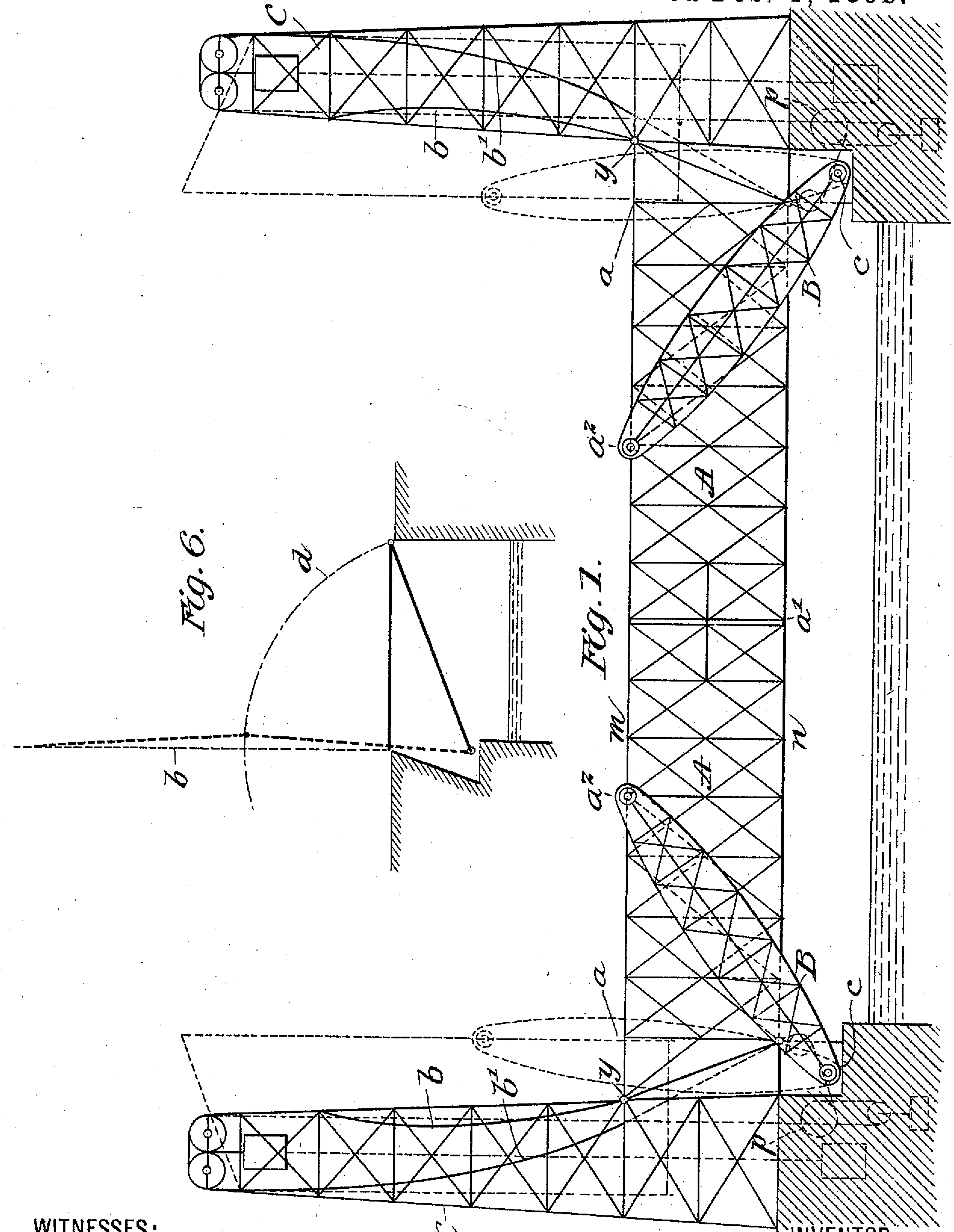
M. WADDELL.
DRAWBRIDGE.

No. 598,167.

Patented Feb. 1, 1898.



WITNESSES:
Frank S. Ober
Harry Bailey

INVENTOR
Montgomery Waddell
BY
Wm. A. Rosenbaum
ATTORNEY

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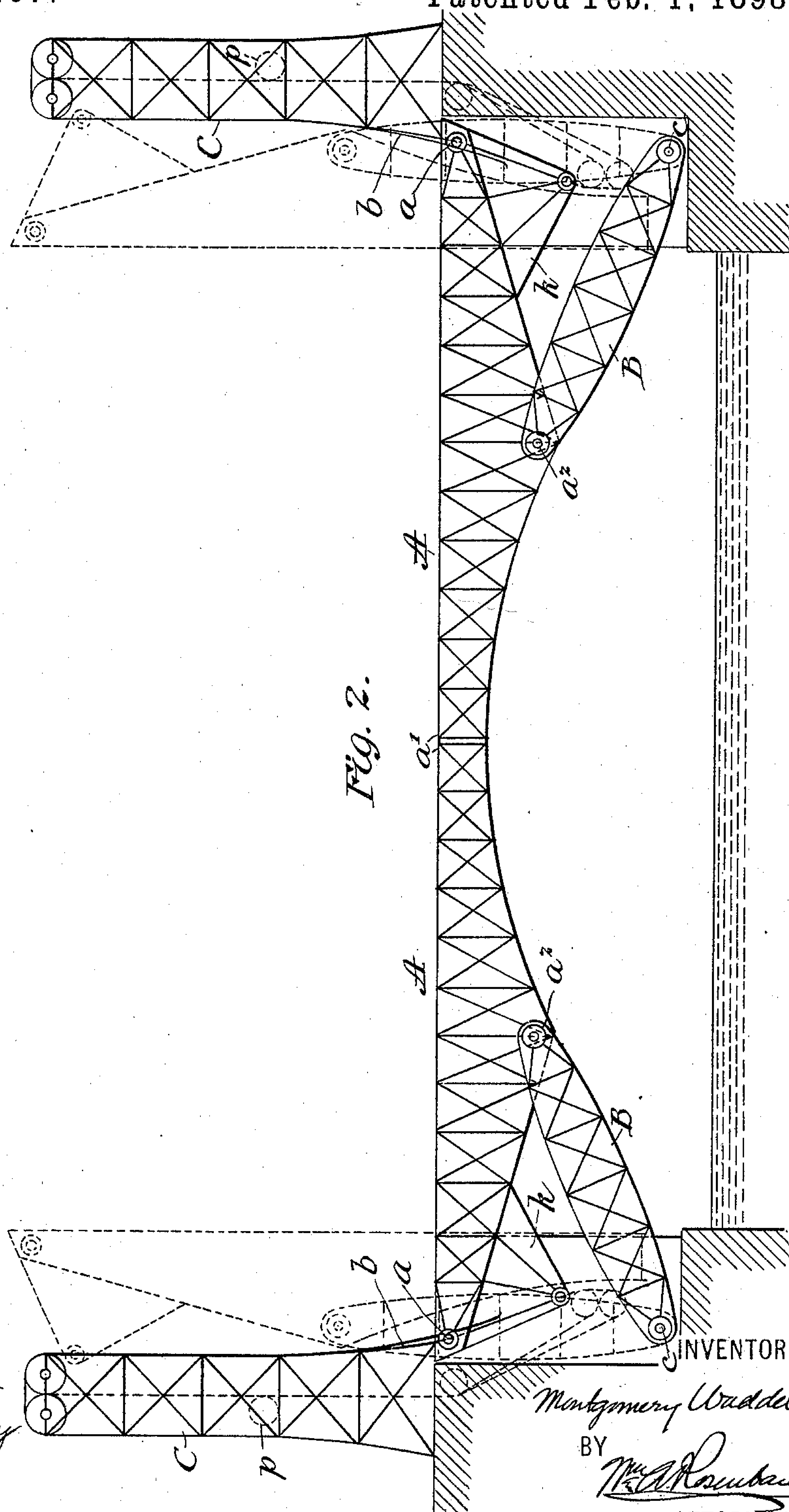

WITNESSES:
Frank S. Ober
Harry Bailey

INVENTOR
Montgomery Waddell
BY
Wm. A. Rosenbaum
ATTORNEY

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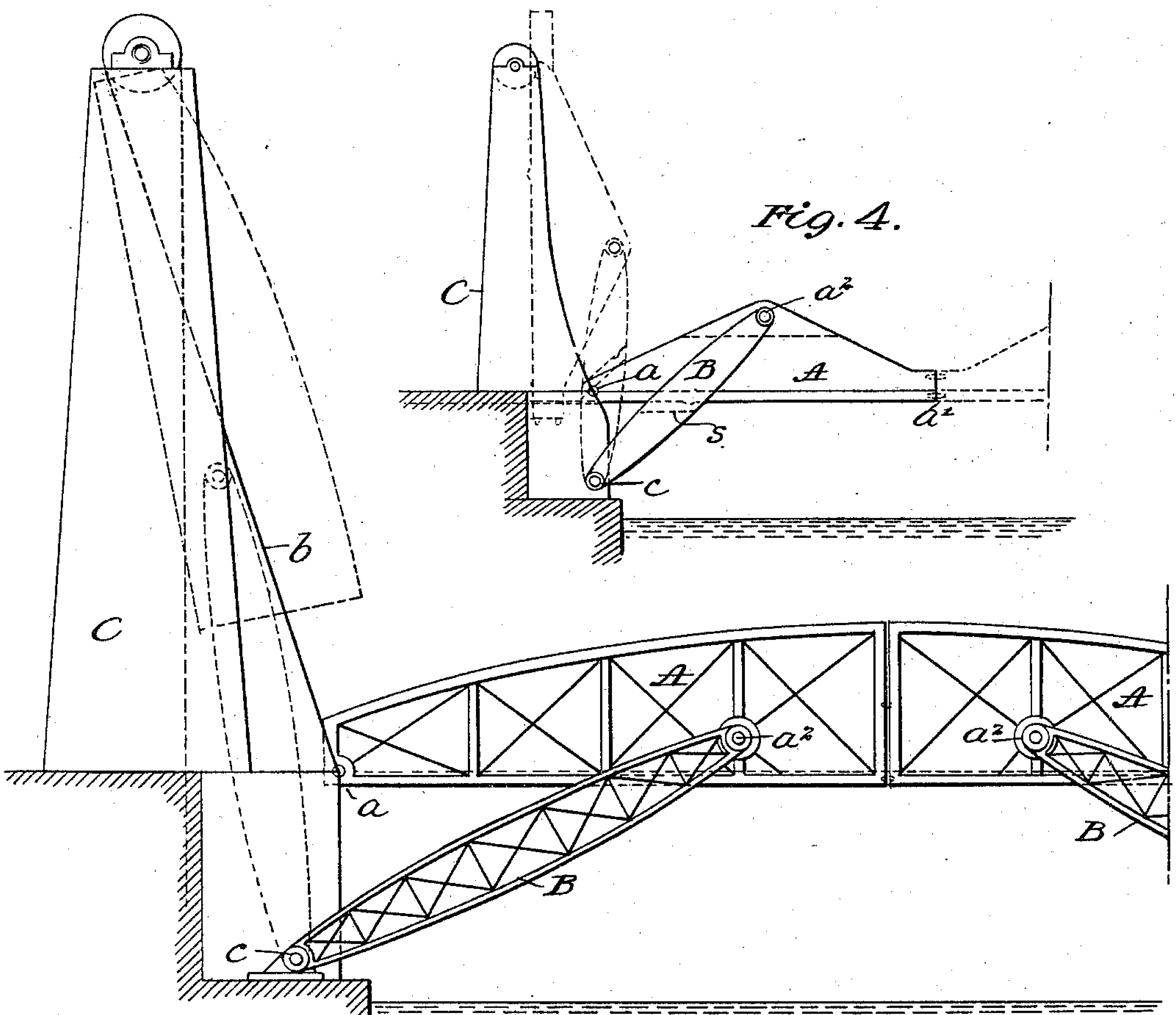

Fig. 4.

Fig. 3.

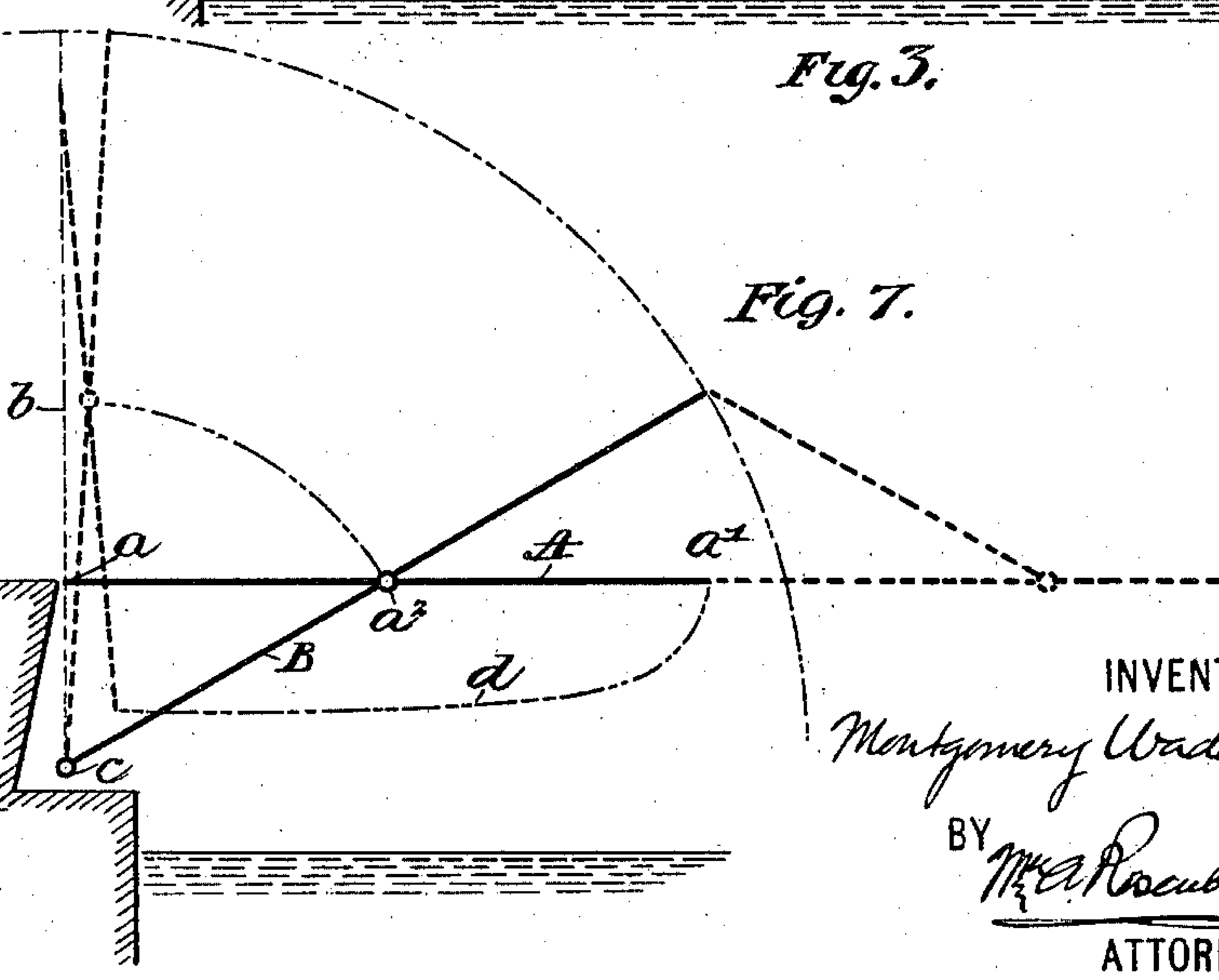

Fig. 7.

WITNESSES:
Frank S. Ober
Harry Bailey

INVENTOR
Montgomery Waddell
BY M. A. Rosenbaum
ATTORNEY

(No Model.)

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M. WADDELL.
DRAWBRIDGE.

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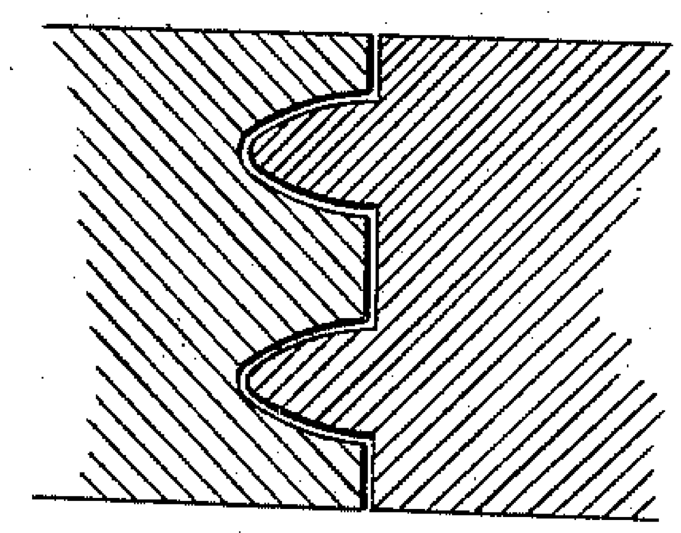
Fig. 13.



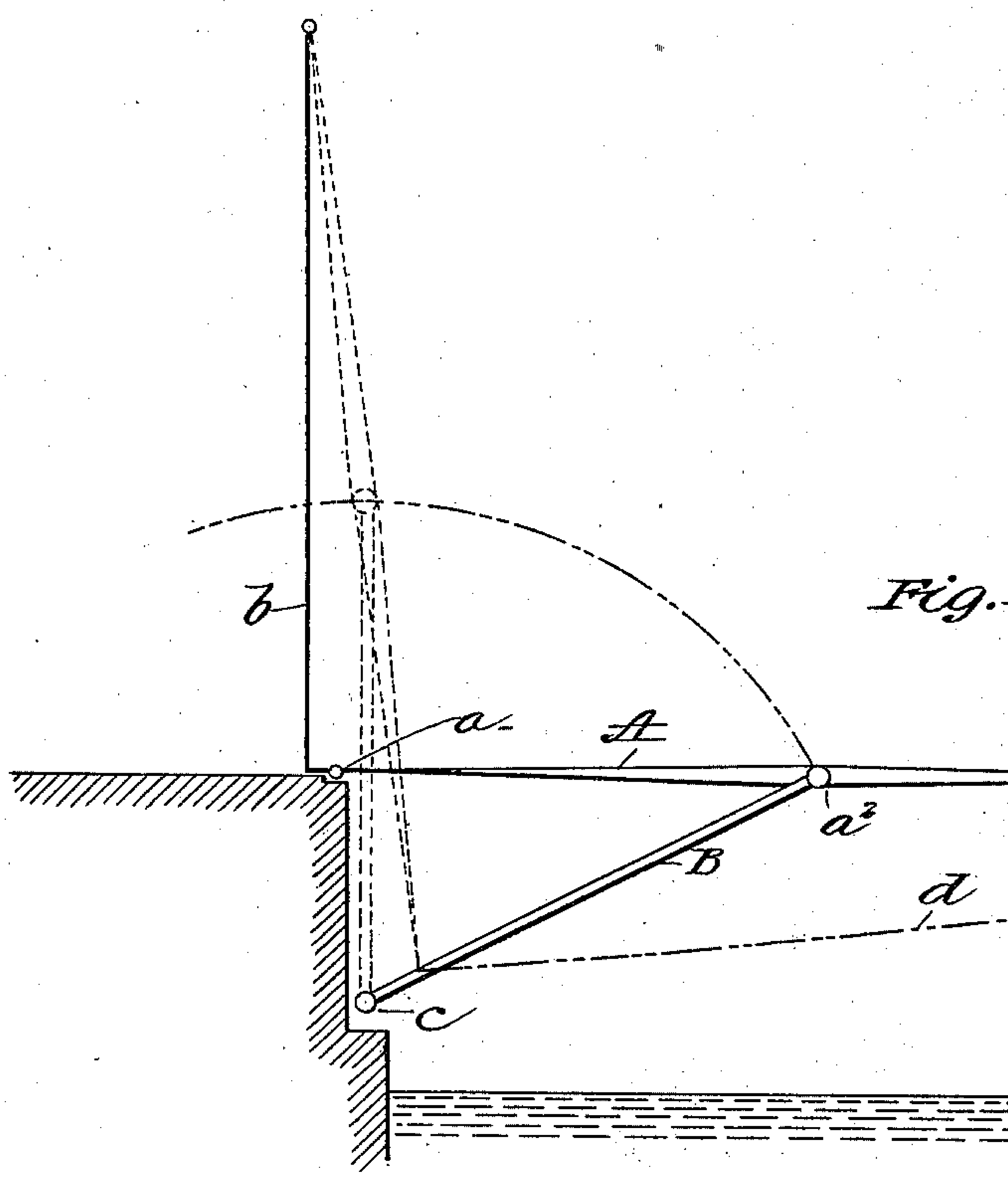
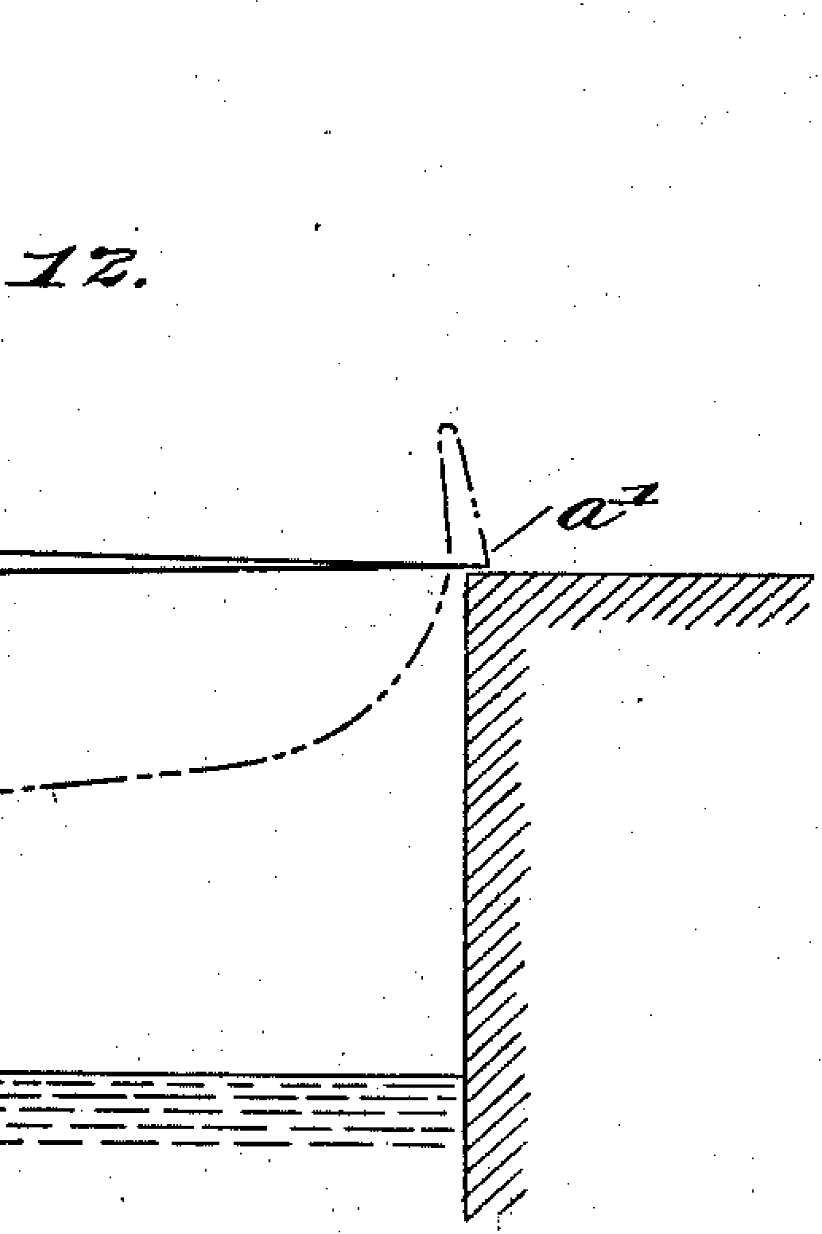
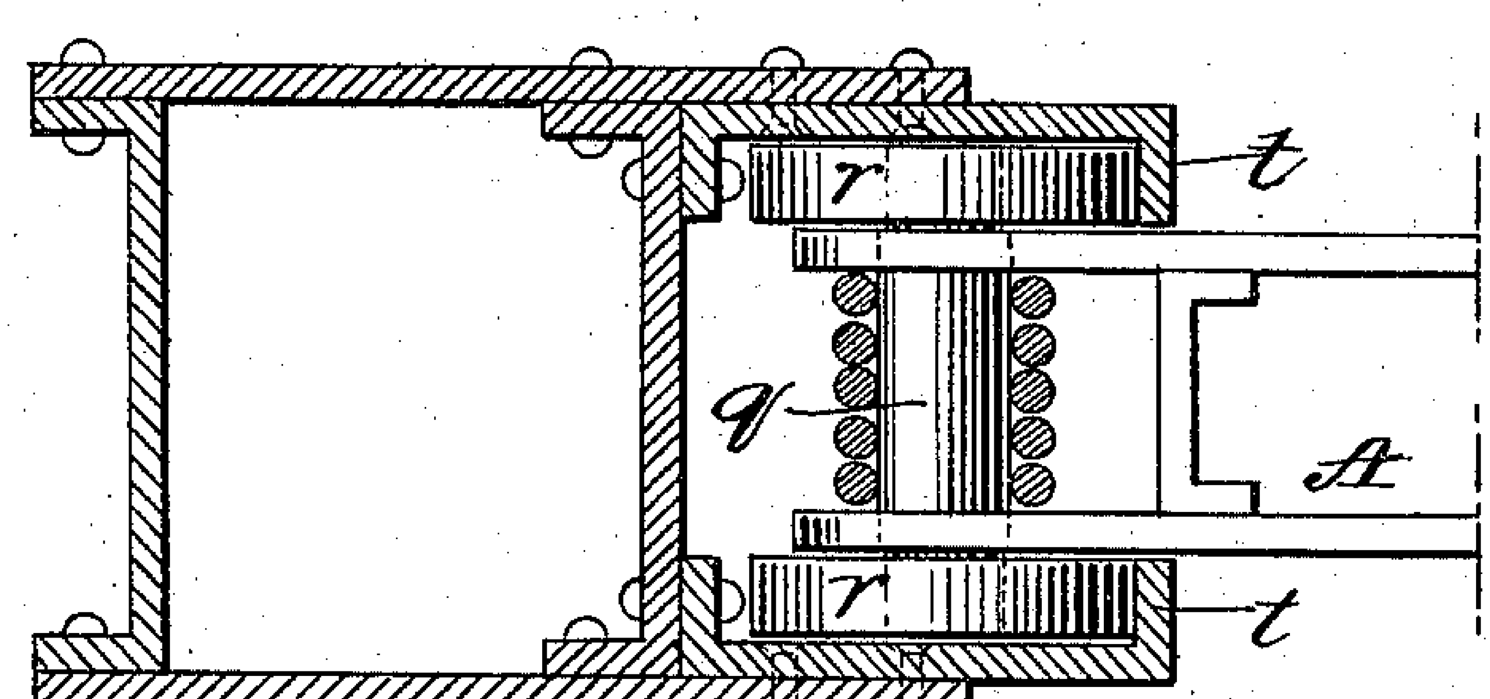



Fig. 12.

Fig. 5.



WITNESSES:
Frank S. Ober
Harry Bailey

INVENTOR
Montgomery Waddell
BY Wm. A. Rosenbaum
ATTORNEY

(No Model.)

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M. WADDELL.

DRAWBRIDGE.

No. 598,167.

Patented Feb. 1, 1898.

Fig. 8.

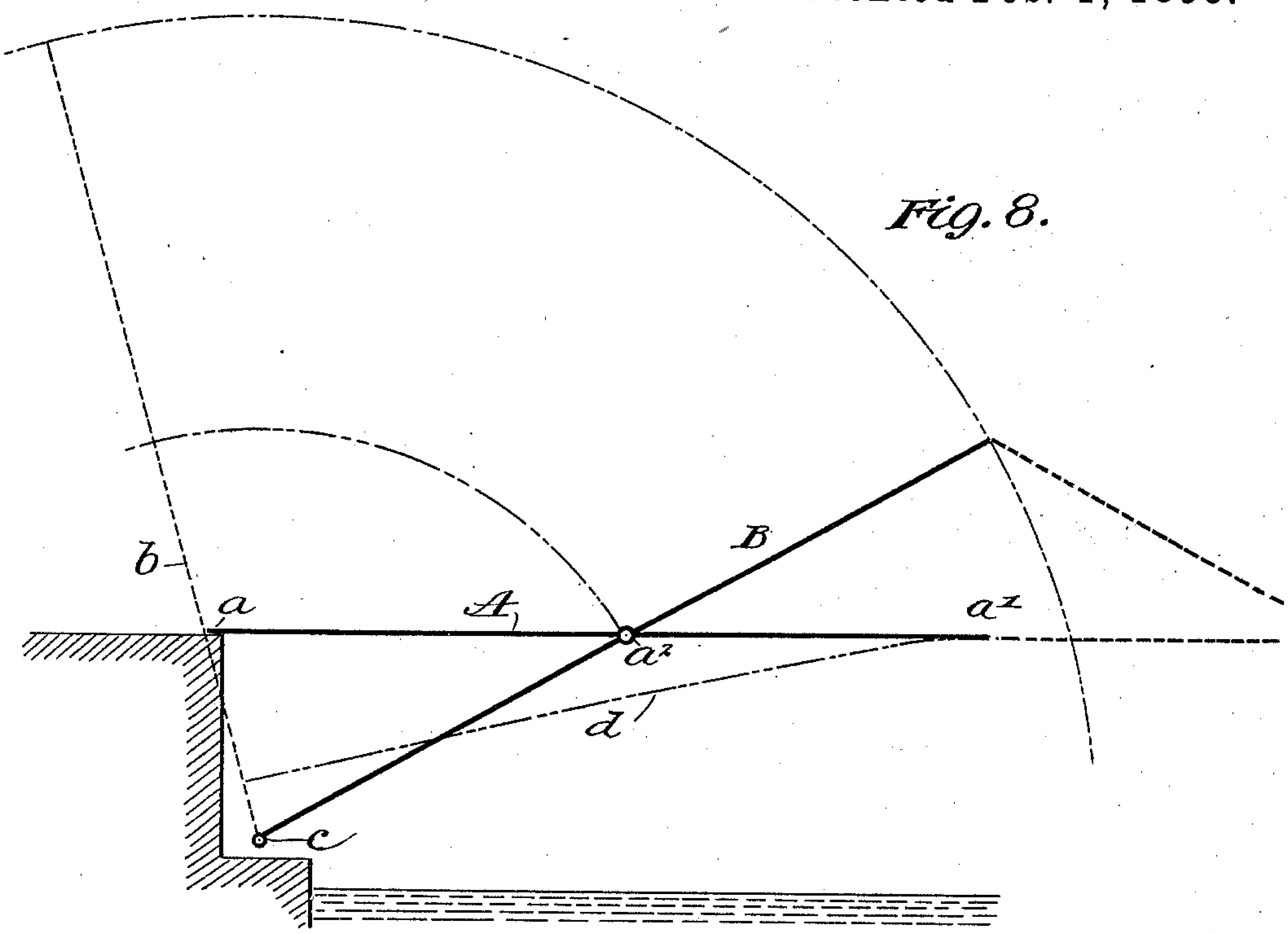
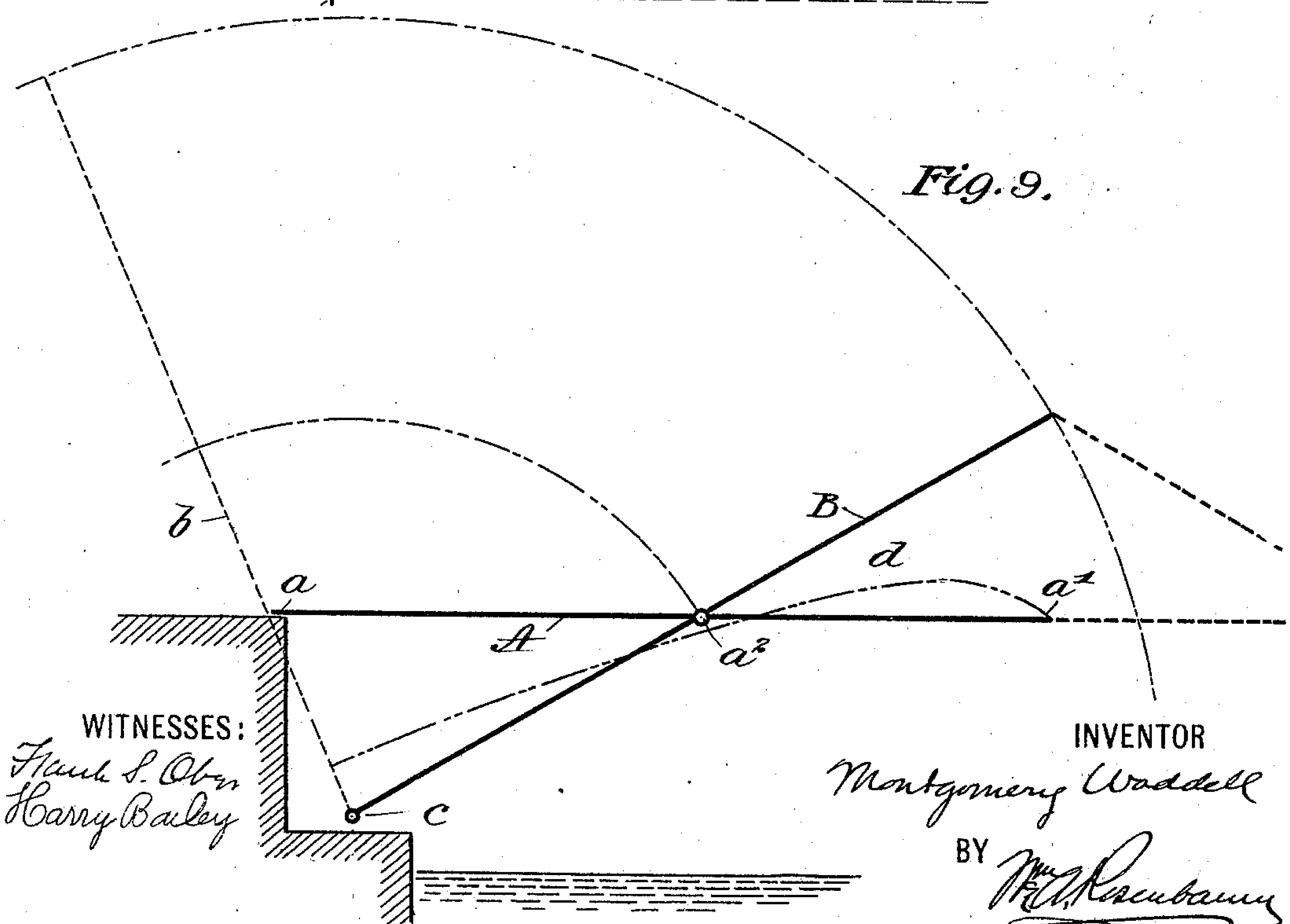


Fig. 9.



WITNESSES:

Frank S. Ober

Harry Bailey

INVENTOR

Montgomery Waddell

BY

Wm. A. Rosenbaum

ATTORNEY

(No Model.)

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M. WADDELL.

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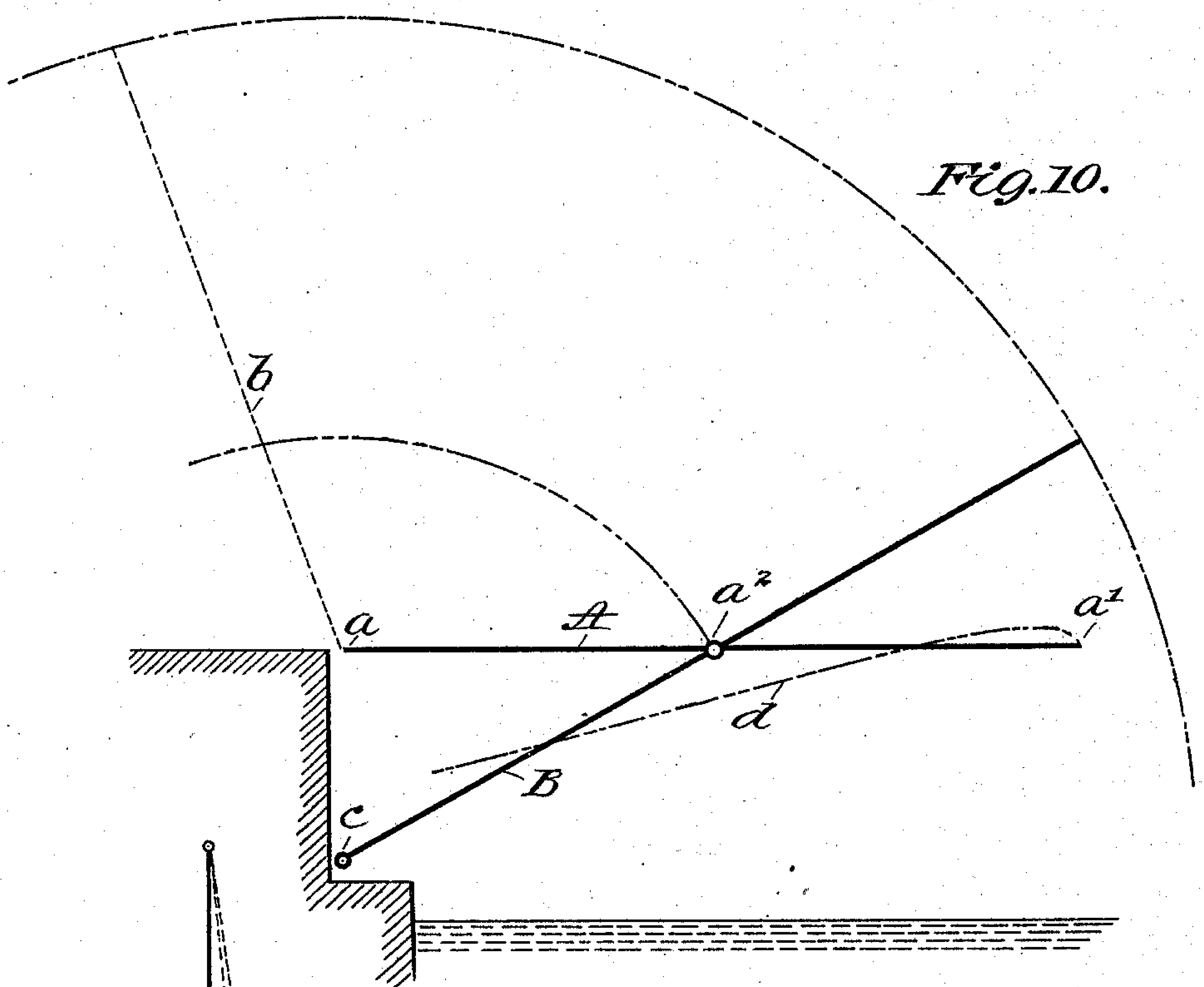

Fig. 10.

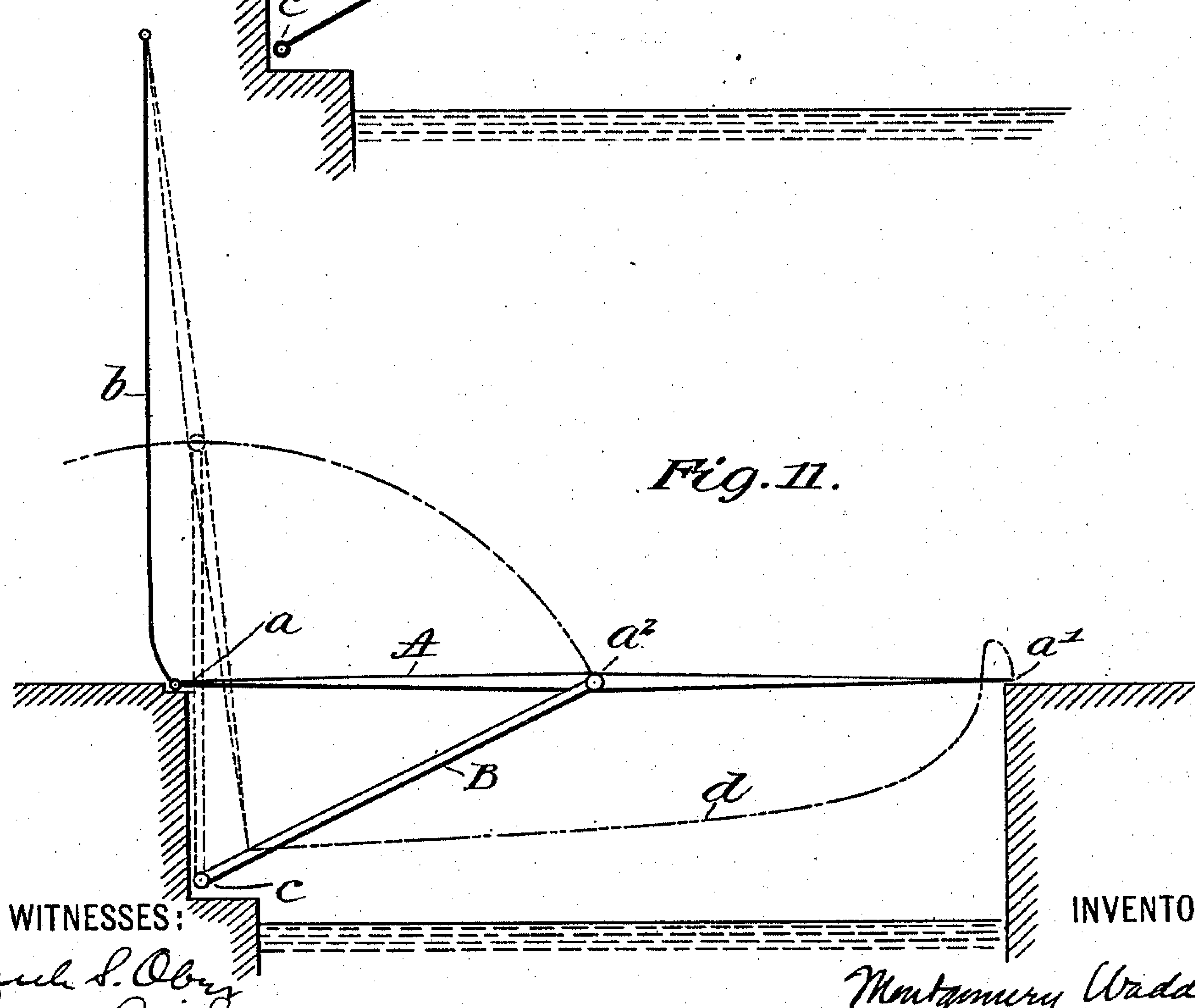

Fig. 11.

WITNESSES:

Frank S. Ober

Harry Bailey.

INVENTOR

Montgomery Waddell

BY

Wm. W. Rosenbaum

ATTORNEY

UNITED STATES PATENT OFFICE.

MONTGOMERY WADDELL, OF NEW YORK, N. Y.

DRAWBRIDGE.

SPECIFICATION forming part of Letters Patent No. 598,167, dated February 1, 1898.

Application filed April 6, 1897. Serial No. 630,969. (No model.)

To all whom it may concern:

Be it known that I, MONTGOMERY WADDELL, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Drawbridges, of which the following is a full, clear, and exact description.

This invention relates to opening bridges in which the opening section has a motion in a vertical plane and in which the raising and lowering devices are usually rigged upon a tower or other upright structure at one end of the moving section.

My bridge may be made with a single or double moving span and when double without the aid of a supporting-pier in the middle of the river or gap over which the bridge is constructed.

An object of the invention is to provide a bridge in which the distribution of power exerted throughout its motion may be predetermined, so that the maximum may occur at the end of the stroke instead of at the beginning, if it is so desired.

Another object is to provide a bridge of this character in which the tendency to bend the tower or the "bending moment" in the tower in raising and lowering is the least possible.

A further object is to have the movements of the bridge directly and positively under the control of the moving engine or motor, and a still further object is to have the construction such that when the bridge is closed the supporting devices shall be under compression instead of under tension.

The bridge I have invented consists of a floor span or truss pivotally supported upon a bracing lever or leg which is pivoted at a fixed point and located below the floor-span, the point of pivotal connection with the floor-span being preferably located between its extremities. At the inner or shore end of the floor-span a tower is erected, upon which a guide for the inner end of the span is constructed. Suitable draft devices are applied to this end of the span, which when in motion cause the end of the span to travel up or down along the guide. At the same time the span swings bodily upon the hinged bracing-lever, causing the outer end of the span to leave its normal position and swing to a position beneath and in an upright plane with the inner end. When the bridge is double, there are two floor-spans both acting in the same manner, but on opposite sides of the river or gap, and controlled by the same or separate motors.

The bridge in its simplest form consists, essentially, of a movable section or floor-span A, one or more pivoted bracing levers or legs B, and a tower C, upon which the draft devices and guides for the movable section are rigged. These are the main features of the single bridge, and for the double bridge the same parts are duplicated, each moving section or floor-span extending substantially half-way across the stream, channel, or gap over which the opening portion of the bridge is constructed.

The drawings illustrate the invention with the fewest lines possible for the sake of clearness, the details of construction not being essential parts of the invention.

The simplest form of the single bridge is illustrated in Figures 11 and 12, wherein the movements of the moving parts are plotted in diagrams. The draft devices are applied to one end only of the moving section A, and this end will be designated as the "inner" end and lettered a. The opposite end of the section will be designated as the "distant" end and is lettered a'. When the bridge is closed, if it be a single bridge, the two ends of the moving section will rest, respectively, upon the opposite sides of the gap. If it is a double bridge, the inner end of the moving section will rest on one side of the gap, while the distant end will abut against the distant end of the duplicate portion of the bridge. It is desirable to operate the bridge with as low a tower as possible consistent with a low bridge, to accomplish which the inner end of the moving section should rise to substantially the top of the tower, while the distant end should be brought to a point as far below the floor-line of the bridge as possible without causing it to sweep too deeply into the space below the floor-line; but for the distant end to take this position below the floor-line it should first clear the distant support, and this requires that the initial movement shall be either horizontal or upwardly inclined. For this purpose a fixed guide for the inner end of the section is provided, the movement along which determines the initial direction of movement of the distant end, as will now be fully explained.

In the accompanying drawings, Fig. 1 is a side elevation of a complete double bridge of the type known as the "through" drawbridge. Fig. 2 is a side elevation of an arched drawbridge. Figs. 3 and 4 show two forms of double truss-bridges. Fig. 5 is a sectional detail of the guide. Figs. 6 to 12, inclusive, are diagrams illustrating the movements of the bridge in opening and closing, with variously-directed guides. Fig. 13 is a detail of an interlocking joint.

Referring to the diagrams, the dotted line *b* indicates the direction of the guide for the inner end of the moving section. In Fig. 6 the guide is vertical and the pivot between the floor-span and the leg is located at the distant end of the span, so that the said distant end would travel through the arc *d*. In Fig. 7 the guide is vertical and passes through the point *a* and through the pivot-point *c* of the leg B. While *a* is being lifted along the guide *b* to carry A to its open position, (shown in the dotted line,) *a'* describes the movement indicated by curve *d*. This is owing to the fact that while *a* is moved vertically the section turns upon its pivot a^2 and simultaneously moves bodily with the swing of leg B on its pivot *c*. This movement of *a'* may be used when the distant end is normally unsupported or when it does not interlock with an adjoining portion of the bridge or when its support is removable, like a bolt, because under those conditions the initial movement of *a'* may be directly downward, as shown. If the distant end is supported upon a pier or interlocks with another portion of the bridge, it is necessary that the initial movement of *a'* shall clear it from its support before it begins to move downward. This is accomplished by shaping the guide as shown in Fig. 8, wherein it will be seen that the guide *b* instead of being vertical is inclined backward in a straight line radiating from the point *c*, *a* being carried back slightly to reach it. The guide here causes *a'* to draw horizontally and then take a substantially straight downwardly-inclined course along the line *d*. In this case the dipping of *a'* into the space below the bridge is less, and consequently a lower bridge is possible. Fig. 9 shows the straight guide inclined backward still more, and this provides for an upward sweeping initial movement of *a'* while finally bringing it to a point below the floor of the bridge. This motion is useful where the double span is used to simultaneously lift and draw the abutting ends apart. Fig. 10 shows the inclined guide radiating from *a* instead of from *c*, which gives a shallower upward sweep to *a'*. Fig. 11 shows the guide curved backward slightly at the lower end and then straightened out into a vertical line. This first lifts *a'* from its distant support and then sweeps it downward on substantially the same curve as in Fig. 7. In Fig. 12 the guide first leads directly backward and then turning a sharp corner leads vertically upward. This gives about the same motion to *a'* as in Fig. 11, except that it is sharper. Thus it will be seen that with a moving section pivoted upon a swinging leg any motion of the distant end desired may be obtained by properly directing the guide for the inner end.

The construction of the guide is merely that of a track upon which suitable trucks or rollers or other antifriction devices on the end of the moving floor-span run. Fig. 5 shows a cross-section of one form of the guide. The end of the floor-span A is pivoted upon a pin *q*, carrying two rollers *r*, which travel on tracks *t*. The tracks are formed of channel-irons, between the flanges of which the rollers are confined.

The principle herein described may be applied to various types of bridges.

Fig. 1 illustrates what I call a "continuous through drawbridge." It is constructed with upper and lower parallel chords *m* and *n* and overhead or sway bracing. The leg B is pivoted to the upper chord and the raising and lowering cables connect to the inner end of the lower chord. The bridge-span proper terminates at and outside of the tower; but in order that it may be guided in its initial movement the upper chord is extended to the point *y* to engage with guide *b*; but here a compound guide is necessary, because the point *y* runs out of the tower at the upper end of its movement, and so a second guide *b'* is formed in the tower, into which the end of the lower chord runs as soon as the bridge has been sufficiently elevated. This provides for guiding the bridge throughout its movement and lessens the bending moment in the tower.

Fig. 2 shows an arched drawbridge in which the two pivotal points of the leg are substantially in the curve of the arch, thus making the base of the arch the distance between *c* and *a*. This bridge when open stands entirely clear of the tower and in its movement enters it only a short distance at the base. The guide extends along the front posts of the tower; but the point *a* travels through the lower end of it only. A knee *k*, however, is formed on the inner end, the apex of which engages with the guides and travels the full length.

In Fig. 3 the pivot of the floor-span is shown located in the side trussing at a point between the upper and lower chords and nearer the distant end of the span. The guide is straight and backwardly inclined from the point *a* and commences at a point outside of the tower, which necessitates an addition to the tower at the base to support it.

Fig. 4 shows the floor-span constructed with an A-truss, its pivoted connection with the leg being at the apex of the truss. The guide here is curved at the base and straight but very slightly inclined backward through its upper course. This throws the floor of the moving section into a true vertical position when open. It also provides for an easy separation and jointer of male and female interlocking parts at the distant ends. This figure also shows the addition of a supplemental support for the floor-span when in its closed position. This consists of a shelf or ledge *s*, formed on the leg.

It is obvious that the connection between the leg and the moving section may be at the extreme distant end of the latter, as shown in Fig. 6, although this may not be a desirable construction under all circumstances. It is also obvious that in nearly all forms of the double bridge where the connection between the moving section and the leg is at a point intermediate of the extremities of the moving section the leg may be extended beyond the pivot to a point directly over the two distant ends of the moving section where they will rest against each other to form a hinged arch when the bridge is closed. This is illustrated in Figs. 7, 8, 9, and 10.

The tower is a desirable although not an essential feature of the invention. Other means for lifting the inner end of the moving section may be provided.

The invention is subject to many modifications and to various details of construction affecting particularly the location of the various pivots, the relation in location between the extremities of the moving section and pivots and in the raising and lowering devices, all of which are comprehended by the principle of the invention herein described.

In this bridge the power required at the beginning of the opening movement may be comparatively small, because it is then largely supported upon the leg or legs, and the work to be done is merely that required to swing the leg on its pivot and to swing the span on its pivot, about which it is nearly balanced; but as the bridge approaches the fully open position the load becomes greater, which fact is an advantage in that other retarding devices become unnecessary. Thus it is possible to regulate the power required to operate the bridge in any given position by the location of the pivots *c* and a^2 and the direction of the guides.

When the bridge starts upon its upward movement, the lateral strain upon the guide and tower is greatest, but as the bridge is then at the lower end of the tower the bending moment of the tower is very small. As the bridge rises, the lateral strain becomes less and less owing to the fact that the center of gravity of the moving parts is approaching the tower. When the bridge is entirely open, the bending moment is practically zero, as then the stress is in the vertical line of the tower.

Another advantage of this bridge over other vertically-swinging pivoted bridges is that it can be opened and closed quicker because it traverses the most direct course in moving from one position to the other. The ordinary pivoted drawbridge must swing through the arc of a circle of which my bridge only traverses the radius.

In my bridge an endless rope connected to and leading in opposite directions from the inner end of the moving section and wound around a winding-drum is positively driven by a motor, and to reverse the direction of movement of the bridge merely requires the reversal of the motor. In the double bridge the leg is the main support for the floor-span, the stress in which is compression instead of tension.

The motive power is indicated at *p* in the several figures. In double bridges a single motor might be used for operating both sections uniformly; but one of the advantages of this bridge is that the abutting ends of the two sections may interlock with each other by a male and female joint, as shown in Figs. 3 and 4, and still not require that the sections shall move in exact unison in opening and closing, for by directing the guide, as in Fig. 8, the interlocking joint separates and joins properly whether the sections move together or not. From this it follows also that one half of the bridge may be opened while the other half remains closed.

Having thus described my invention, I claim—

1. In an opening bridge, the combination of a movable floor-span, a lever pivoted at a fixed point, located below the same and to which the span is bodily attached, a support upon which one end of the span rests when the bridge is closed, lifting means attached to the other end of the span and means for clearing the supported end while simultaneously lifting the other end, substantially as described.

2. In an opening bridge, the combination of a section, both ends of which are movable, a tower adjacent to one end, provided with a guide in which the near end of the section moves, a pivoted lever located below the section and upon which the moving section turns, and means for raising and lowering the guided end of the section.

3. In an opening bridge, the combination of two movable floor-spans whose outer or distant ends abut against each other when the bridge is closed, and two pivoted supporting-levers respectively therefor, the abutting spans forming an arch of which the levers constitute a continuation, substantially as described.

4. In an opening bridge, the combination of

two movable floor-spans whose outer or distant ends are respectively provided with the male and female parts of an interlocking joint, and means whereby either or both of said spans may be bodily moved in a substantially longitudinal direction to separate the parts of the joint and lift the shore or near ends of the spans to open the bridge.

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

MONTGOMERY WADDELL.

Witnesses:
FRANK S. OBER,
HARRY BAILEY.