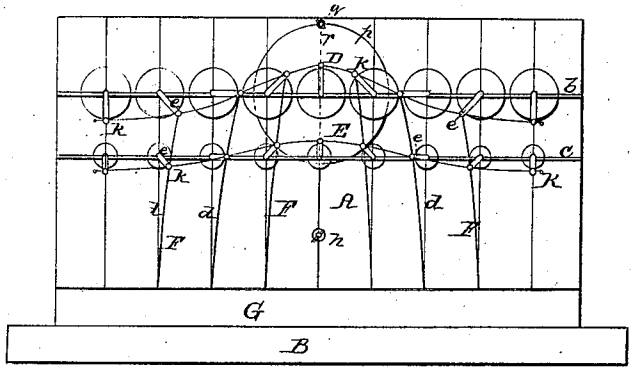
C. S. Lyman,

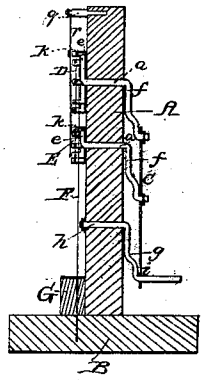
Illustrating Wares,

No. 71,190, Patented Nov. 19, 1867.

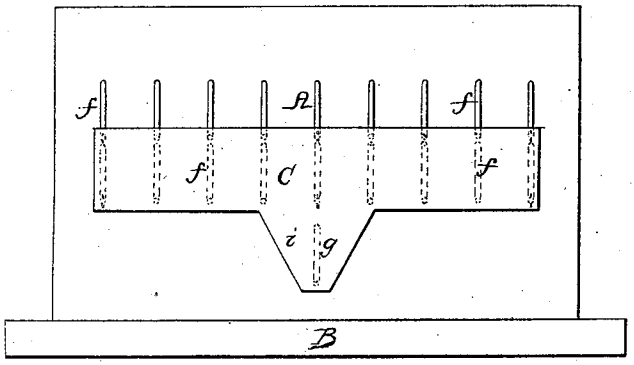
Fig; 1.



Fig; 3.



Fig; 2.



Witnesses;
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Inventor;
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United States Patent Office.

CHESTER S. LYMAN, OF NEW HAVEN, CONNECTICUT.

Letters Patent No. 71,190, *dated November* 19, 1867.

IMPROVEMENT IN APPARATUS FOR ILLUSTRATING WAVES.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL PERSONS TO WHOM THESE PRESENTS MAY COME:

Be it known that I, CHESTER S. LYMAN, of the city and county of New Haven, and State of Connecticut, have invented a new and useful Instrument or Apparatus for Illustrating the Formation of Waves; and I do hereby declare the same to be fully described in the following specification, and represented in the accompanying drawings, of which—

Figure 1 is a front elevation,

Figure 2 a rear view, and

Figure 3 a vertical central and transverse section of it.

This instrument serves to exemplify the motions of particles of water among themselves, when acted upon by gravity and the wind, the combined operations of such forces producing what are termed "waves."

In carrying out my invention, I make use of an upright board, A, mounted on a base, B. Extending through such board is a series of short arbors, *a a a*, &c., arranged at the intersections of horizontal and vertical lines *b c* and *d d d*, marked on the surface of the board A, or arranged thereon in manner as shown in fig. 1.

From each end of such arbors a crank, *e* or *f*, is extended, all of the cranks *f*, at the rear of the board A, being parallel to each other, and having their wrists extended into and so as to turn in bearings within a plate, C. An auxiliary crank, *g*, projected from an arbor, *h*, arranged on the board A, also has its wrist going through an extension, *i*, of the plate C. (See figs. 2 and 3.) Each wrist *k* of each of the front cranks *e* should be applied to the crank so as to be capable of being freely revolved on the axis of the wrist, and there should be a hole made transversely through the wrist, to receive one of two flexile wires D E, one of which goes through the wrists of one series of the cranks, and the other through those of the other series.

Furthermore, in connection with the two series of cranks, I employ a series of flexile wires, F F F, &c., which, at their upper ends, are made to clasp the wrists of the upper set of cranks. The said wires F go through the wrists of the lower set of cranks, and extend down to and are inserted in a bar, G, fixed on the base-board and against the board A. Each crank *e* of the lower series has a length half, or about half, that of each crank *e* of the upper series, and is arranged below its fellow-crank of the upper series a distance of about one-ninth of the length of the wave to be produced.

The arrangement of the cranks of each series, *e e e*, &c., *f f f*, &c., (there being nine cranks in each of such series,) is such, that when each end crank of both series is vertical, and extends below the horizontal line of the arbors of the series, the two middle cranks of the two series will be vertical, and will project above the horizontal line joining their axes.

The next cranks to the outside ones are arranged at angles of forty-five degrees to the horizon, and project below the horizontal line of their axes. The next cranks are horizontal, and the succeeding ones, or those next to the middle cranks, project above their junction line at angles of forty-five degrees therewith, the arrangement of the several cranks being as exhibited in fig. 1.

A series of circles, having their centres in the axes of the cranks, may be drawn on the face of the board A in manner as exhibited in fig. 1.

The rotary motions of the extremities of one or more series of cranks represent the motions of as many corresponding particles of water, during the formation of a wave.

The lower of the flexile wires D E is to exhibit an ideal wave below the surface of the water, or the positions successively assumed by a line of particles, which, when they are at rest, will be horizontal.

The areas between the two wires D E and the series F F F, while the cranks are being revolved, exhibit the forms successively assumed in wave-motion, by the rectangular areas of water included between the horizontal lines passing through the axes of the cranks and the vertical lines joining such axes, these horizontal and vertical lines serving to exhibit the positions of the particles or spaces when the water is in a state of rest.

By laying hold of and revolving the auxiliary crank, the several cranks of each of the two series will be revolved synchronously, and will produce wave-motions of the two flexile wires D E.

Instead of the mechanism hereinbefore described for effecting the synchronous rotary movements of the said cranks, other or equivalent mechanism may be employed. A series of gears, or an endless band running

around pulleys, may be substituted. I intend to use any proper devices for imparting to the several cranks, of either or both series, motions as set forth.

The positions of the cranks of each series on the face of the board A are such that each differs in its angular arrangement from the preceding, as well as from the following one, by the same fractional portion of a revolution as the distance between the axes of motion of two next adjacent cranks bears to the length of the wave, or the distance between the two external cranks of the series.

The length of each of the smaller cranks, with respect to that of the larger ones, depends on the vertical distance of one below the other, it being approximately as one to two, for a vertical distance corresponding to one-ninth of the wave length.

The largest circle, *p*, drawn on the face of the board A, has a circumference equal in length to the length of the wave, the radius of the circle being equal to the height of a revolving pendulum which makes a beat in the same period as that in which the wave makes one oscillation.

From an arm, *q*, projecting from the zenith of the great circle, a wire, *r*, projects downward through a hole in the wrist of the middle crank *e*. The said wire *r* turns freely on the arm *q*. This wire represents a pendulum of the length of the diameter of the circle *p*. While the wave of the wire D is being produced, the wire *r* will stand perpendicularly to the wire D, and serve to indicate the positions of the mast of a vessel whose hull may be floating on the wave.

I do not confine my invention to two series of cranks, and their flexile wires D E, as one or more of such series may be employed, each additional series, with its flexile wires, being made by their operation to indicate the form, or approximate form, of the wave at the distance of the series below the first or upper series. Nor do I confine my invention to the number of cranks in each series, as hereinbefore specified, as such may be varied as circumstances may require.

I claim as my invention—

A combination of one or more flexile wires D E, one or more series of cranks *e f*, and mechanism for revolving such cranks synchronously, the whole being arranged and applied together, and to a board or its equivalent, substantially in manner, and so as to operate as and for the purpose as specified.

I also claim the arrangement and combination of the series of flexile wires F with one or more flexile wires D E, one or more series of cranks *e f*, and mechanism for revolving such cranks synchronously, the whole being applied substantially in manner and so as to operate as specified.

I also claim the combination and arrangement of the pendulum or wire *r* with the flexile wire D and its series of cranks, arranged and applied in manner and to operate together substantially as hereinbefore explained.

I also claim the arrangement and combination of horizontal and vertical lines going through the axes of the cranks, substantially as represented in the drawings, with the system of movable wires, or mechanism for producing the wave-motion, as set forth.

I also claim the combination and arrangement of the circle *p* with the system of movable wires, or mechanism for producing wave-motion, as specified.

Dated at the city and county of New Haven, Connecticut, September 19, 1867.

C. S. LYMAN.

Witnesses:

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SIMEON E. BALDWIN.