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A. W. BARNARD.

PENDULUM.

APPLICATION FILED AUG. 21, 1905.

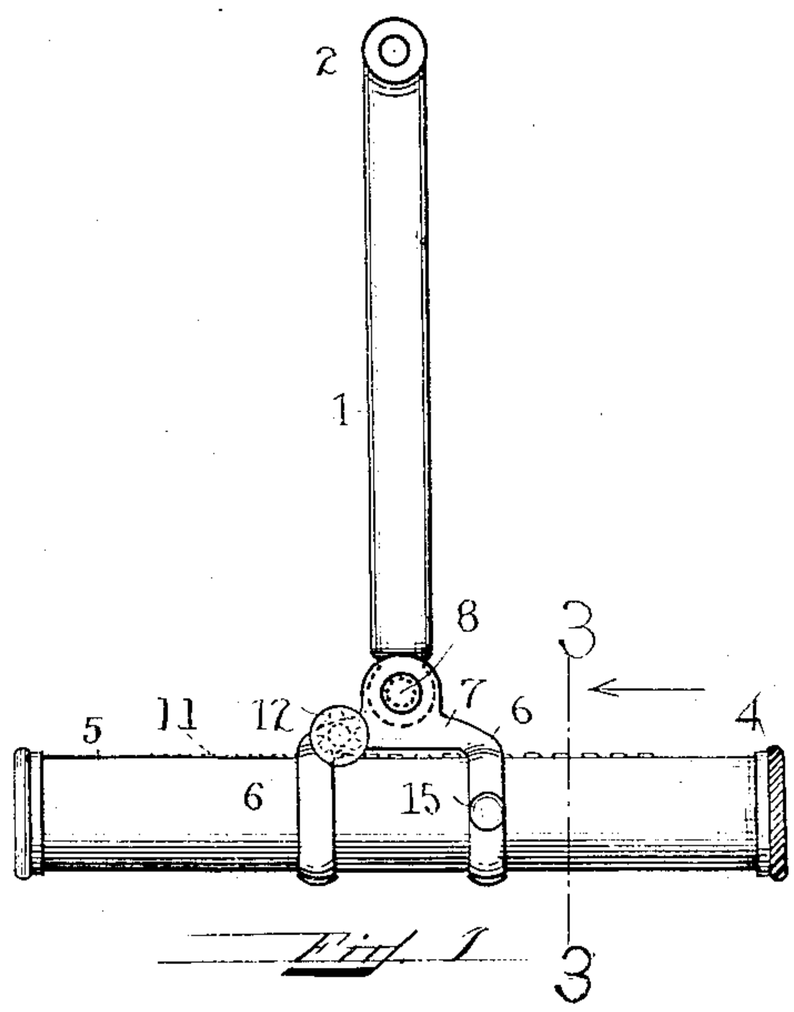

Fig. 1.

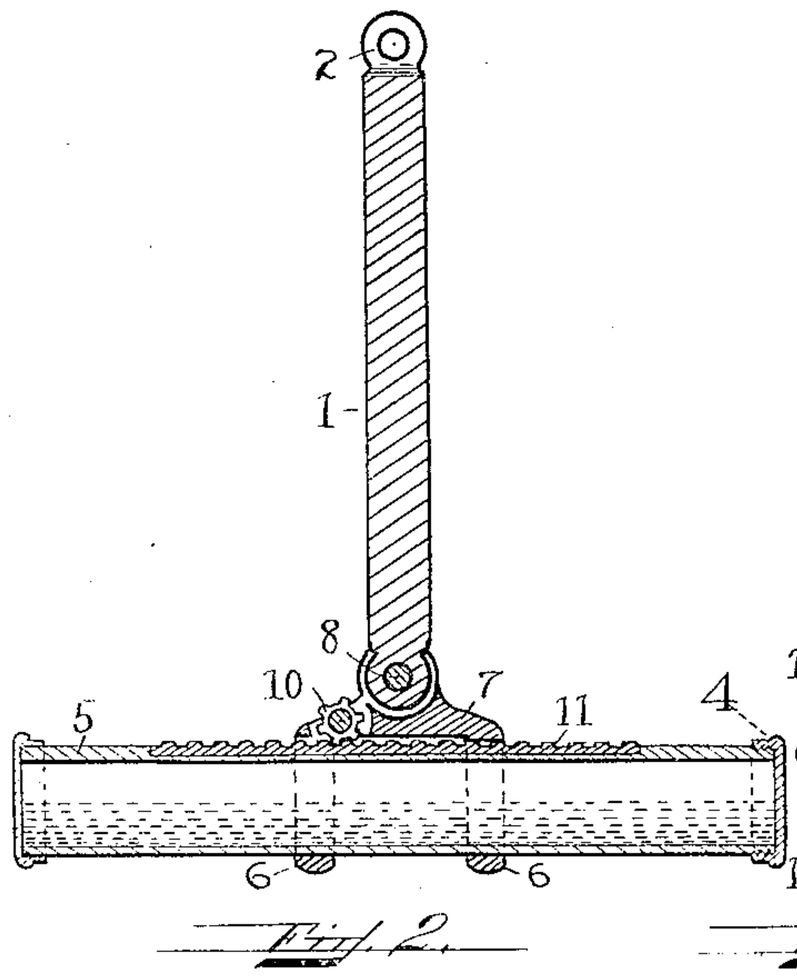

Fig. 2.

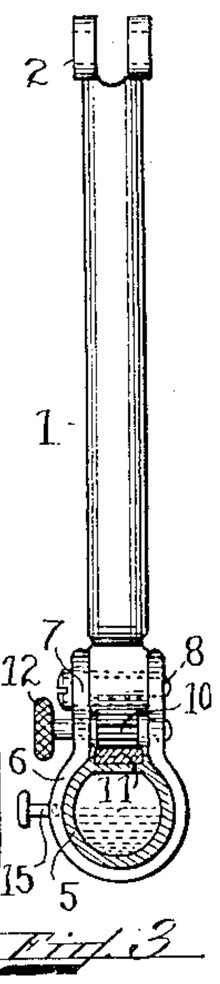

Fig. 3.

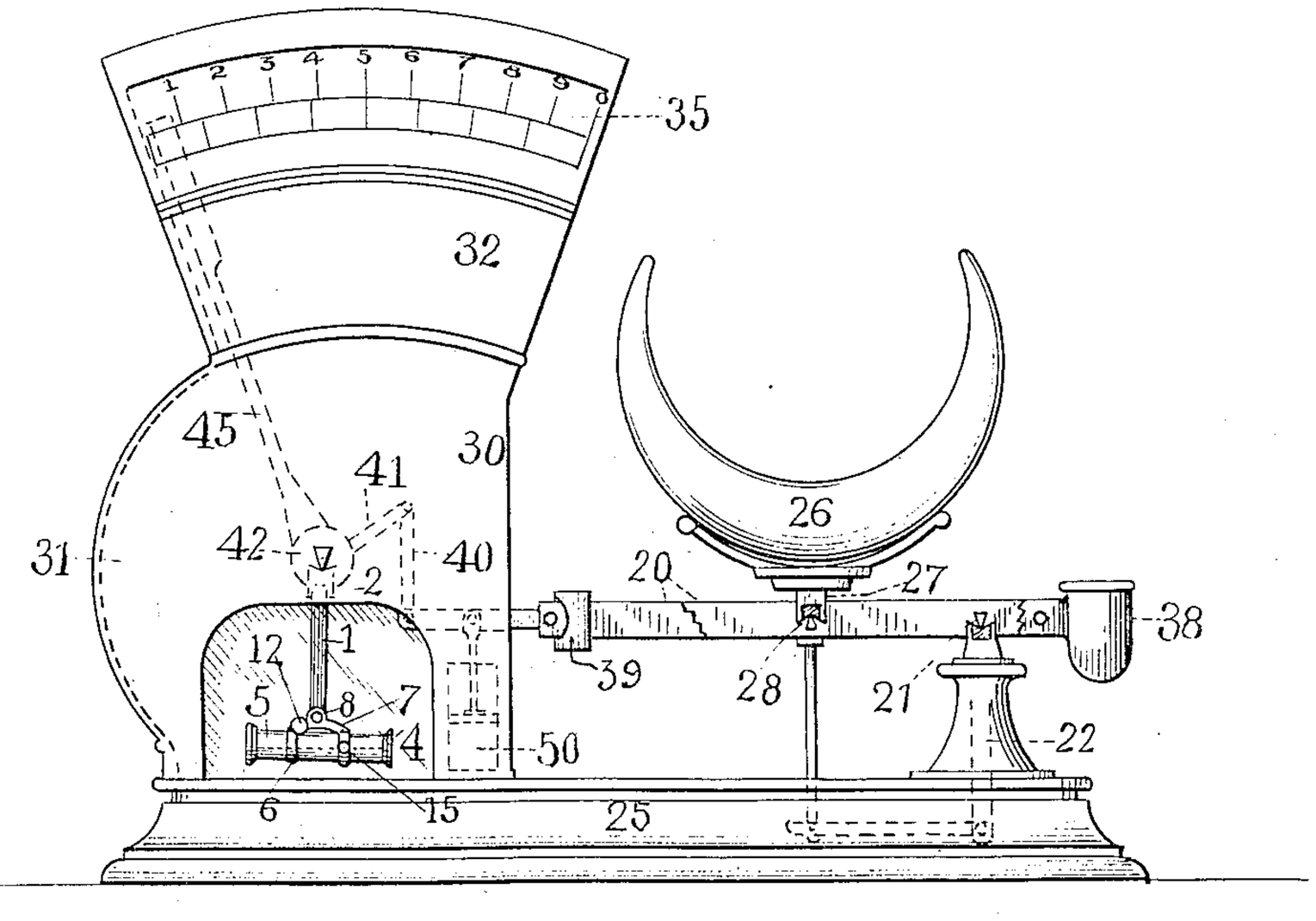

Fig. 4.

Witnesses:
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UNITED STATES PATENT OFFICE.

ARTHUR W. BARNARD, OF NEWTON CENTER, MASSACHUSETTS, ASSIGNOR TO THE BARNARD COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

PENDULUM.

No. 842,130. Specification of Letters Patent. Patented Jan. 22, 1907.

Application filed August 21, 1905. Serial No. 274,991.

To all whom it may concern:

Be it known that I, ARTHUR W. BARNARD, a citizen of the United States, residing at Newton Center, in the county of Middlesex and State of Massachusetts, have invented a new and useful Pendulum, of which the following is a full, clear, and exact specification, reference being made therein to the accompanying drawings.

My invention relates to pendulums, and may be used in connection with weighing-scales and other mechanisms.

In the ordinary form of pendulum, which comprises a weight mounted on the end of a rod or stem, it is a well-known fact that to swing the pendulum through an arc from a vertical position toward a horizontal position a variable increasing force is required.

The object of my invention is to provide a pendulum so constructed that the force required to swing it upward through an arc and away from a vertical position shall have a constant increase rather than a variable increase, and I accomplish this result by having a pendulum-weight in which the center of gravity changes as the pendulum is swung, this change in the position of the center of gravity compensating for the amount of the variable increase in the ordinary pendulum.

The following is a clear description of my invention, reference being made to the accompanying drawings, in which similar numbers refer to similar parts throughout the several views, and in which—

Figure 1 is a side elevation of any pendulum. Fig. 2 is a vertical longitudinal sectional view. Fig. 3 is a cross-sectional view on line 3 3 in Fig. 1; and Fig. 4 is a side elevation of a scale, showing my pendulum applied thereto.

Broadly, my invention consists in providing a pendulum so constructed that its center of gravity changes in position when the pendulum is swung to one side or the other.

The preferred form of my invention comprises a pendulum-rod having mounted thereon a hollow cylinder partially filled with mercury or other heavy liquid and means for adjusting the cylinder on the rod.

Referring to the drawings, 1 designates the stem or rod of the pendulum, provided at its upper end with a boring 2 to receive a spindle, upon which it swings. A hollow cylinder 5, adapted to contain mercury or other heavy liquid and having a screw-cap 4 on one end, acts as a substitute for the weight of the ordinary pendulum. The hollow cylinder 5 is supported by two circular bands 6 on a yoke 7, the latter being pivotally mounted on the lower end of the pendulum-stem and fastened by the screw 8 in order to permit the cylinder to be hung horizontally or diagonally. For the purpose of changing the horizontal adjustment of the cylinder I provide a pinion 10 in the yoke 7, which enmeshes with a rack 11 on the upper side of the cylinder 5, the pinion 10 having a knob or cap 12 in order that it may be turned by the fingers. A screw 15 in one of the bands 6 serves to hold the cylinder after adjustment. Any other suitable means may be employed for the purpose of adjusting the cylinder horizontally and securing it in the desired position.

The operation of my form of pendulum is as follows: When the cylinder 5 is balanced and perpendicular to the stem, the pendulum hangs vertically and the mercury or other liquid lies in the cylinder to an equal depth throughout its entire length. The center of gravity of the pendulum is then in a vertical line passing through the center of the pendulum-rod. If, however, the pendulum be swung to one side, the mercury flows in the opposite direction and gathers in the other end of the cylinder. This movement of the mercury causes the center of gravity of the pendulum to move in a direction opposite to the direction in which the pendulum is swung, and thereby causes the pendulum, impelled by a given force, to move a greater distance than if there were no change in the position of the center of gravity. By experiment, however, I have found that more satisfactory results are obtained if the cylinder 5 is adjusted eccentrically to the pendulum-rod 1—that is, a larger portion of the cylinder being on the side of the pendulum away from the direction in which it swings. When the cylinder is so arranged, the immediate effect is to throw the pendulum-rod out of a vertical position, and therefore tilt the cylinder slightly. To obviate this difficulty, and thus maintain the cylinder horizontally when the pendulum hangs in a normal position, I turn the yoke 7 upon pin 8 until the cylinder hangs horizontally,

and in this way I am enabled to take full advantage of the shifting of the center of gravity of the pendulum due to the flowing of the mercury when the pendulum is swung.

As the amount of change in the position of the center of gravity of the pendulum during its oscillation is affected by the position of the cylinder with respect to the pendulum-rod as regards both horizontal and angular adjustment, the precise arrangement must be determined by adjustment of the parts and testing.

In Fig. 4 is illustrated the method of applying my invention to one form of scale, to which use it is particularly adapted. Where the ordinary form of pendulum is used in a scale to offset the load on the scale-beam, weight is indicated upon a dial by a pointer operated by the pendulum, and as the latter moves in steps of varying length it is necessary to graduate the dial to correspond. In the use of my pendulum, however, the dial may be marked in equal divisions, since the pendulum always moves the same distance to denote a unit of weight irrespective of the portion of its arc of oscillation in which it may happen to be. This fact of course simplifies the preparation and arrangement of dials and saves time and labor in the manufacturing process and at the same time tends to increase the accuracy of the scale.

The scale shown in Fig. 4 comprises a scale-beam 20, fulcrumed at 21 on a support 22, which springs from a base portion 25, and a scoop 26 on a standard 27, pivotally supported at 28 upon said beam. The base supports a casing consisting of body portion 30, provided with an extension 31, and a housing 32, which exposes a dial 35 appropriately marked. On the outer end of the scale-beam 20 is an equalizing-weight 38, and between the pan and the casing is a sliding or tare weight 39. The inner end of the scale-beam 20 is connected by a rod 40 to an arm 41, fixedly attached to an arbor or spindle 42, mounted on knife-edge bearings in the body portion of the casing. Depending from the arbor 42 and fixedly mounted thereon is my pendulum. The latter is so adjusted with reference to the scale-beam 20 through arm 41 and rod 40 that when the scale-beam is in a horizontal and evenly-balanced position the pendulum hangs normally vertical. Also upon the arbor 42 is fixedly mounted a hand or pointer 45, which turns with the arbor and pendulum and is so adjusted with reference to the latter that it is at zero on the dial 35 when the pendulum is vertical. 50 represents a dash-pot device of any construction which serves to reduce the oscillations of the scale-beam.

When in use, the operation is the same as in an ordinary pendulum-scale, with the exception that my pendulum to denote, for instance, pounds in weight will move an equal space for each pound, and therefore will turn the hand 45 an equal space upon the dial 35 for each unit in weight.

What I claim is—

1. In a pendulum, the combination of a stem and a hollow receptacle adapted to contain mercury or other suitable liquid; said receptacle being mounted on, and transversely adjustable in relation to, said stem.

2. In a pendulum, the combination of a stem and a hollow cylinder transversely adjustable in relation to said stem and pivotally mounted on the lower end of said stem; said cylinder being adapted to contain mercury or other suitable liquid.

3. In a pendulum, the combination of a stem and a hollow receptacle transversely adjustable in relation to said stem and pivotally mounted on the lower end of said stem.

4. In a pendulum, the combination of a stem, a hollow receptacle mounted on the lower end of said stem and adapted to contain mercury or other liquid and means to adjust said receptacle horizontally.

5. In a pendulum, the combination of a stem, a hollow receptacle pivotally mounted on the lower end of said stem and means for adjusting said receptacle horizontally.

6. In a pendulum, the combination of a stem, a yoke pivotally mounted on the lower end of said stem, a hollow cylinder supported by said yoke, and means for adjusting said cylinder horizontally.

7. In a pendulum, the combination of a stem, a yoke pivotally mounted on the lower end of said stem, and provided with bands, a hollow cylinder held in said bands and means whereby said cylinder may be adjusted horizontally in relation to said stem.

In testimony whereof I have hereunto set my hand, in the presence of two subscribing witnesses, this 14th day of August, 1905.

ARTHUR W. BARNARD.

Witnesses:
L. P. SLADE,
A. I. GAWFIRD.