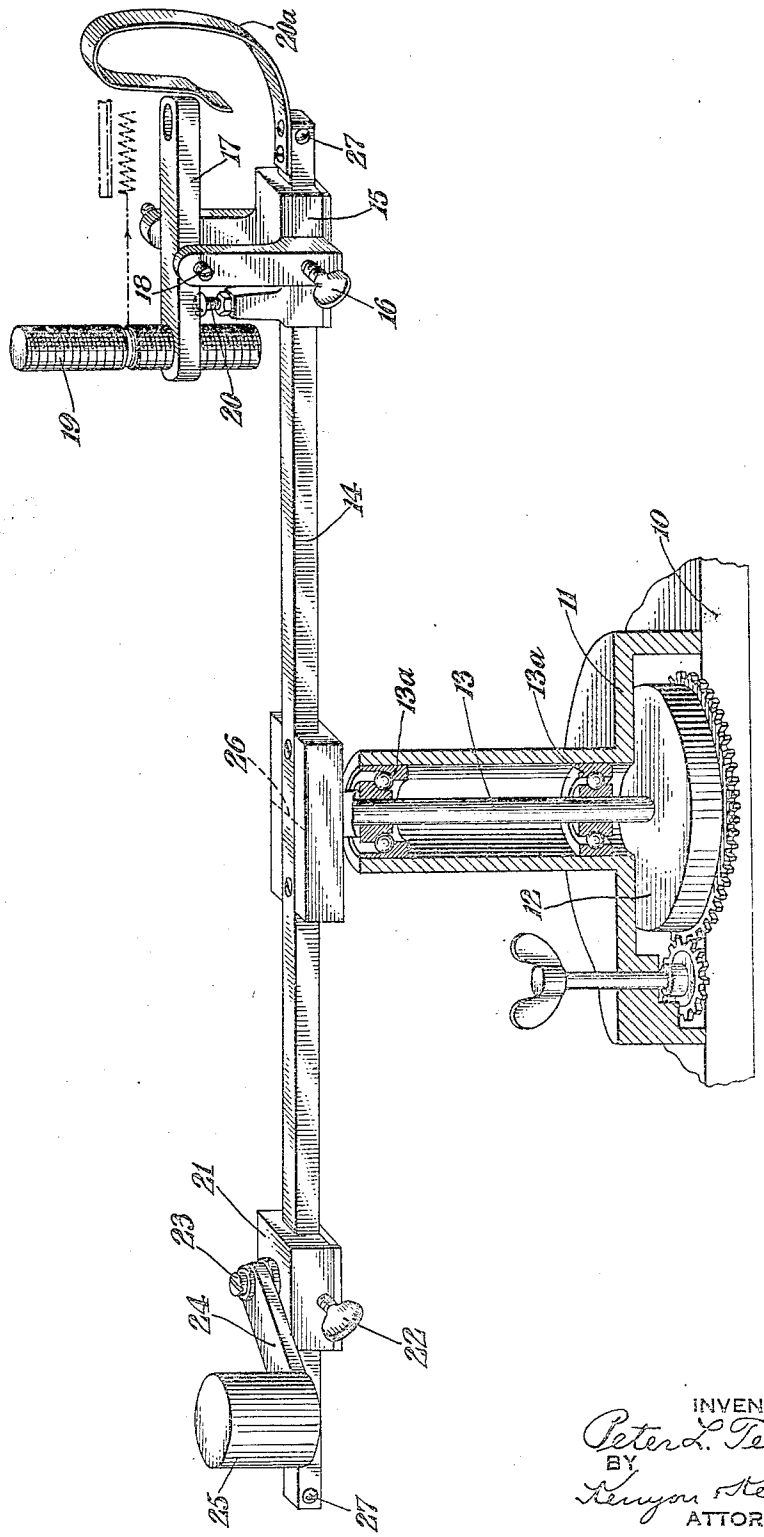
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APPARATUS FOR INVESTIGATING AND DEMONSTRATING THE LAWS OF CENTRIFUGAL FORCE

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APPARATUS FOR INVESTIGATING AND DEMONSTRATING THE LAWS OF CENTRIFUGAL FORCE

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This invention relates to an apparatus for investigating and demonstrating the laws of centrifugal force.

An object of this invention is to provide a simple, inexpensive and efficient apparatus suitable for use in schools, classrooms and elsewhere, whereby to demonstrate the laws of centrifugal force—that is, that the force is radial for uniform rotation, that the force is proportional to the radius, and that the force is proportional to the square of the revolutions per minute.

An apparatus embodying the invention comprises a rotating arm or bar, on one end of which is carried a horizontally pivoted and balanced member into which is screwed a vertical member. When the bar is rotated, the centrifugal force causes the vertical member to tilt and the force necessary to do this is easily measured. At the other end of the rotating member is carried a member capable of swinging freely in a horizontal plane, which acts as a counterweight and when the bar is rotated, follows the direction of the centrifugal force, thereby demonstrating that the force is radial.

Other objects, novel features and advantages of the invention will be apparent from the following specification and accompanying drawing, wherein:

The figure represents a perspective view of an apparatus embodying the invention.

10 indicates the base of the apparatus, on which is supported a housing 11, and within the housing is arranged a spring motor 12 which drives the shaft 13 mounted on the bearings 13a. On the upper end of the shaft 13 is supported an arm or bar 14. At one end of the bar 14 is mounted a frame 15 slidably affixed thereto, its position on said bar being fixed by the thumb screw 16. The frame 15 carries a pivoted and balanced member 17 which is normally horizontal, being balanced on the pivots 18. Into the end of the member 17 nearest the axis of rotation of the bar 14 is screwed a vertical piece 19 which is threaded its entire length, and the height of which piece 19, with respect to the horizontal member 17 is adjusted at will, by means of the said screw threads. The horizontal position of the member 17 when the piece 19 is screwed therein is maintained by the adjusting screw 20. When the member 17 is tilted by the action of centrifugal force, as will be explained, the tilting of the members 17 and 19 can be made audible as well as visible, by attaching a tempered steel piece 20a or bell or other similar mechanism, to the frame 15, positioned so that the tilting of the member 17 will cause the member 17 to strike the piece 20a, making an audible sound.

The position of the member 17, when the piece 19 is not mounted on one end, is normally horizontal and in this position it is balanced both for gravity and for centrifugal force. The member 17 is preferably made of aluminum or other light metal to minimize the effect of slight error in locating the pivots 18 at the proper geometric axis of symmetry of the member 17.

On the other end of the bar 14 is mounted a frame 21, also slidably affixed thereto, its position on the bar being fixed by the thumb screw 22. The frame 21 carries a member 25 which is of a weight sufficient to serve as a counterweight and is mounted on the arm 24 and is pivoted about the screw 23 which permits the member 25 to rotate freely in a horizontal plane. A slit or other mark 26 is placed at the center of the bar 14 and at its axis of rotation, to permit accurate measurement of the radius to the center of the vertical piece 19; and at the two ends of the bar 14 are placed the bolts 27 or other obstructive instrumentalities to prevent the members 15 and 21 from flying off the bar 14 when rotated.

The above described apparatus is made use of as follows: The bar 14 is caused to rotate by the spring motor 12, the speed of rotation being regulated as desired. As the speed of rotation increases, the centrifugal force caused thereby increases, until it becomes sufficient to tilt the members 17 and 19. Due to the balance in the member 17 in the normally horizontal position which is set by the adjusting screw 20, the weight of member 17 as well as the centrifugal force acting on it will be balanced, and the centrifugal force required to tilt the members 17 and 19 will

be only that which is necessary to tilt the member 19, with which the investigator need only be concerned. Although the tilting force will decrease as the combination 17 and 19 tilts, it is only the initial force required to tilt the combination in which the observer need be interested, for the purpose of demonstrating the laws of centrifugal force. The centrifugal force necessary to tilt the combination 17 and 19 can then be measured when the apparatus is stopped, by passing a string around the center of the vertical piece 19 and tying the other end to a combination spring and ruler or other measuring instrumentality, and noting the force required to tilt the combination 17 and 19 by hand, the combination spring and ruler being pulled in as nearly a horizontal direction as possible and in a direction which would intersect the axis of rotation of the bar 14.

By moving the frame 15 along the bar 14, the radius can be varied, and by varying the revolutions per minute of the spring motor 12, the rotation of the bar 14 may be likewise varied, and after taking a number of readings of the centrifugal force necessary to tilt the combination 17 and 19—the observer will note that the centrifugal force required will vary proportionally with the radius, and with the square of the revolutions per minute. Likewise, by varying the height of the member 19 with respect to the member 17, the observer may note the effect on the centrifugal force required to tilt the combination 17 and 19.

As the bar 14 rotates, the combination 21 to 25 mounted on the other end of said bar 14, being of sufficient weight, serves as a counterweight to approximate dynamic balance, and no matter in what direction the arm 24 is pointed initially, it will point radially when the speed of rotation of the bar 14 is uniform, with the mass 25 at the farthest distance from the axis of rotation—from which action it is demonstrated that centrifugal force is radial. Further experiments with the combination 24—25 may be performed to demonstrate this law, as, for instance, on a sudden stopping of the bar 14 with the hand or otherwise, the combination 24 and 25 will rotate about the bearing 23 from the furthest radial position in the same direction of rotation as the bar 14 (combination 24 and 25) before the bar 14 was stopped.

The revolutions per minute of this apparatus need only range between 25 and 120, which is a sufficient range to show the effect of revolutions per minute on centrifugal force action and the maximum revolutions per minute (120) is so low that no danger can follow due to the loosening of any piece.

By means of the above described apparatus, the laws of centrifugal force may be simply and accurately checked. The entire apparatus is compact, may be easily set up wherever desired and is safe at all times.

It is apparent, of course, that various modifications may be made in the structure of the device, without in any way departing from the spirit of the invention as defined in the appended claims. The apparatus may also be used in other ways than those specifically described.

I claim:

1. In an apparatus for demonstrating the laws of centrifugal force, a rotatable support, a radially arranged lever pivotally mounted on said support, said lever extending toward and terminating short of the axis of said support, a weight carried by the inner end of said lever, and means to limit movement of said inner end of said lever toward said support.

2. In an apparatus for demonstrating the laws of centrifugal force, a rotatable support, a radially arranged lever pivotally mounted on said support, said lever extending toward and terminating short of the axis of said support, a weight carried by the inner end of said lever, means to support the inner end of said lever, said lever and weight being so mounted as to oppose solely by gravitation the action of centrifugal force.

3. In an apparatus for demonstrating the laws of centrifugal force, a rotatable support, a radially arranged lever pivotally mounted on said support, said lever extending toward and terminating short of the axis of said support, means for radially adjusting said lever, a weight carried by the inner end of said lever, and means to limit movement of said inner end of said lever toward said support.

4. In an apparatus for demonstrating the laws of centrifugal force, a rotatable support, a radially arranged lever pivotally mounted on said support, said lever extending toward and terminating short of the axis of said support, means for radially adjusting said lever, a weight carried by the inner end of said lever, means to support the inner end of said lever, said lever and weight being so mounted as to oppose solely by gravitation the action of centrifugal force.

5. In an apparatus for demonstrating the laws of centrifugal force, a rotatable support, a radially arranged lever pivotally mounted on one end of said support, said lever extending toward and terminating short of the axis of said support, a weight carried by the inner end of said lever, means to limit movement of said inner end of said lever toward said support, and a counterweight rotatably mounted on the other end of said support.

In testimony whereof, I have signed my name to this specification.

PETER L. TEA.