A01-534P-Y01

Foucault Pendulum

1. Brief description of the experiment

In 1851, the Frenchman Foucault installed a pendulum with a length of 67m and a weight of 28Kg in a church in Paris, and used it to visually display the rotation of the earth. This instrument miniaturizes the traditional Foucault pendulum, instrumentation, and beautiful in appearance, and can be installed in the school laboratory or the courtyard of the main building of the school. It can not only display the demonstration effect of Foucault pendulum intuitively, but also increase the scientific atmosphere of the school.

For the purpose of this experiment, the instrument uses a variable-speed motor belt to drive the turntable to simulate the rotation of the earth, and uses an hourglass to draw the swing. The 360° scale line is clear, accurate, convenient for positioning, and reliable in intuitive operation.

Due to the rotation of the earth, the moving objects on the earth are subject to two inertial forces, namely the inertial centrifugal force and the Coriolis force. The Foucault pendulum not only visually displays the rotation of the earth, but also shows the existence of the Coriolis force. It is an ideal demonstration device in physics teaching and geography teaching.

2. Experimental principle

The Foucault pendulum uses the deflection of its own wobble plane to display the Earth's rotation.

Taking a certain point in space as the reference frame, observe the Foucault pendulum on the earth. Due to the inertial effect, the pendulum plane maintains the original vibration direction, and the result of the rotation of the earth causes the objects on the ground to deflect relative to the pendulum plane, and the rotation of the earth As a result, the object on the ground is deflected relative to the position of the pendulum plane, and people on the earth are accustomed to taking the earth as a reference object, and they will feel the opposite deflection of the pendulum plane relative to the position of the earth. Due to the rotation of the earth, objects on the earth are subject to two inertial forces, namely the inertial centrifugal force and the Coriolis force. The Foucault pendulum not only visually displays the rotation of the earth, but also shows the existence of the Coriolis force. and action, is the rotation of the swing plane caused by the action of the Coriolis force.

The rotation of the earth is basically constant, very slow, and the angular velocity is

$\omega_0 = 2\pi$ rad/ sidereal day $= 7.292\times10^{-5}$rad/s

Objects on Earth are less affected by it and are not easily noticed. The Foucault pendulum can display this slow change due to its ability to work for a long time, showing the rotation of the pendulum plane.

The deflection direction and deflection angular velocity of the oscillating plane of the Foucault pendulum are related to the geographic location of the Foucault pendulum on the earth. In the northern hemisphere, the wobble plane rotates clockwise; in the southern hemisphere, it rotates counterclockwise; at the poles, the wobble plane has the highest rotational angular velocity, making one revolution per day and night; at the equator, the rotational angular velocity is the smallest and zero. At different geographic latitudes, the rotational angular velocity of the oscillating plane of the Foucault pendulum is

$$\omega = \omega_0 \sin \phi$$

in the formula ω—Rotational angular velocity of the local Foucault pendulum plane

ω_0—Angular velocity of the earth's rotation

ϕ—Geographical latitude of the location of the Foucault pendulum

In the southern hemisphere, ϕ is negative and ω is negative, indicating that the swing plane of the Foucault pendulum in the southern hemisphere rotates counterclockwise.

Alternatively, the rotational angular velocity of the Foucault pendulum plane can be calculated by the following formula

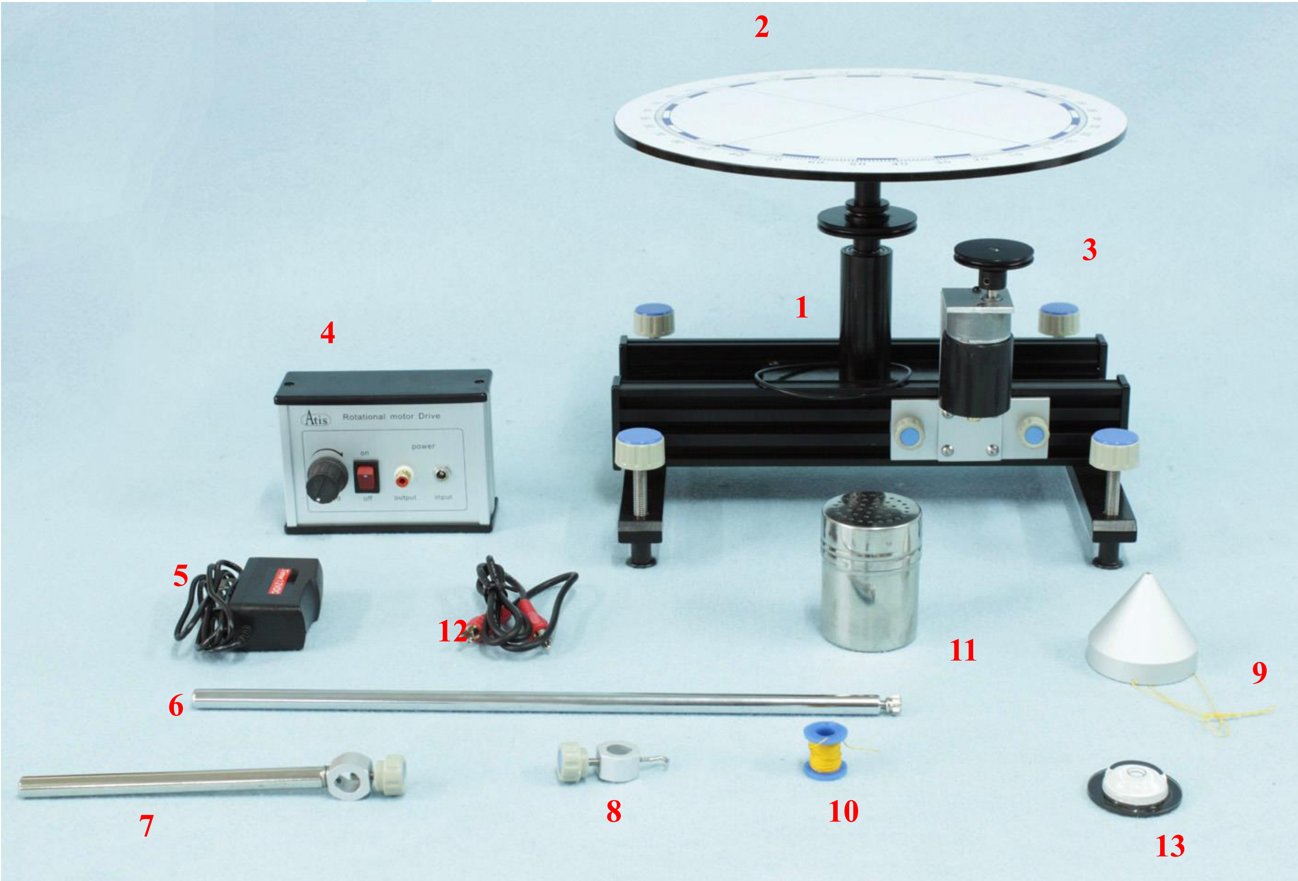
$$\omega = 7.292\times10\text{-}5\,\text{rad/s} \cdot \sin \phi$$

$$\omega = 15.04^{\circ} \cdot \sin \phi /\text{h}$$

1. Experimental accessories:

No.	Item	QTY	No.	Item	QTY
1	Test bench (with moving belt)	1	2	angle disc	1
3	Variable speed motor	1	4	Motor speed controller	1
5	DC power supply	1	6	pillar	1
7	With strut joint	1	8	With hook connector	1
9	Funnel (including S-shaped hook)	1	10	thin line	1
11	fine sand	1	12	connecting line	1
13	spirit level	1			

Experimental accessories comparison chart:



1. Experimental assembly operation

Pic 4-1

1. Please put the driving belt on the axle with the lowest speed ratio. As shown in Figure 4-1 above.

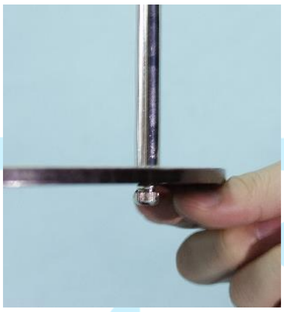


Figure 4-2

2. The struts are screwed onto the angle disc and secured with nuts.

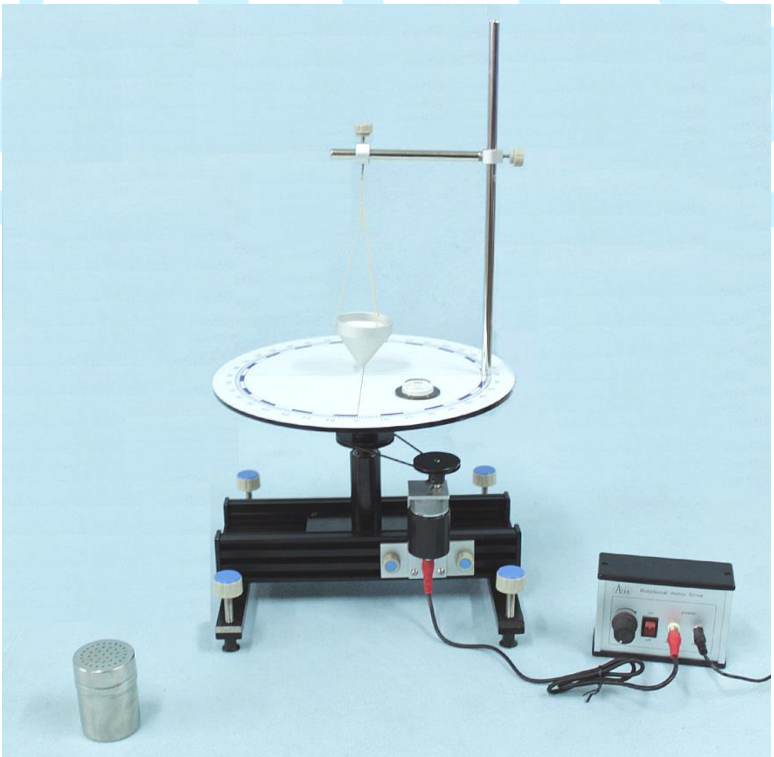


Figure 4-3

3. The variable speed motor is connected to the controller as shown in Figure 4-3. And adjust the speed to slow. Then turn off the power.

4.Assemble the "joint with pillar" and "street with hook" in sequence, and adjust the position of the funnel on the center of the angle disc, pour in fine sand, before turning, please block the outlet of the funnel, release it gently at an appropriate angle, and start the speed change motor.

Note: The variable speed motor cannot be too fast.

5. Observe the experimental results, as shown in Figure 4-4 below, and try to discuss in groups. Suppose the angle turntable is the earth, and describe the situation of standing on the earth and floating in outer space to observe the swing of the funnel.

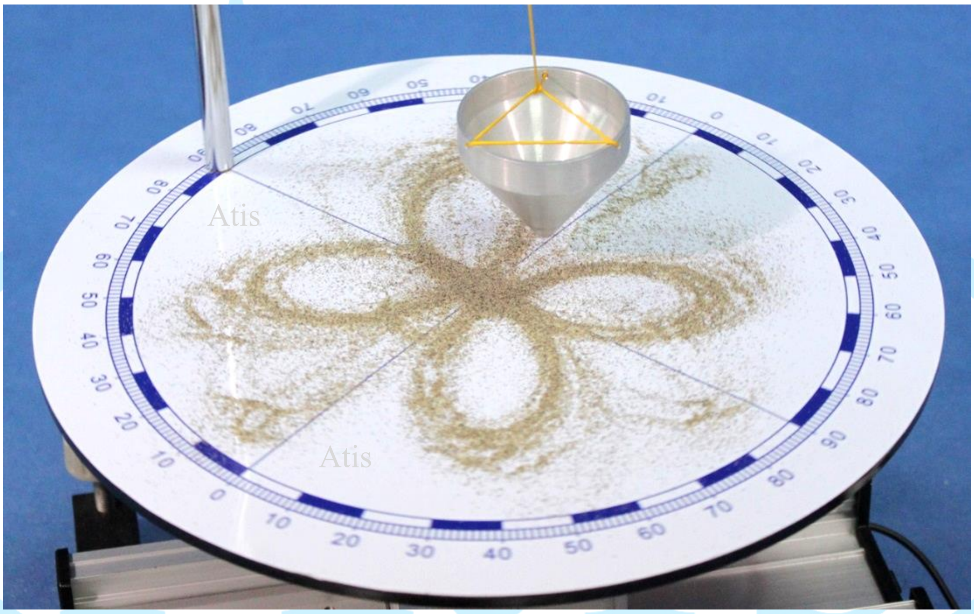


Figure 4-4 Use fine sand to draw the trajectory of the Foucault pendulum on the turntable.

1. Discussion of experimental problems:

1. What is the difference between a Foucault pendulum and a simple pendulum?

2. What are the directions of motion of the wobble observed from the field of vision in outer space and the field of vision on Earth?

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