SCIENTIFIC APPARATUS AND LABORATORY METHODS

GYROSCOPES AND TOPS WITH BALL BEARINGS

IN the usual form of gyroscope, the spinning member is attached to one end of a rod and a counter weight to the other. The rod is supported at its center by a stand in such a way that it can rotate about one horizontal axis and the vertical axis. The gyroscope is thus free to move up and down in nutation and also to rotate about the vertical axis in precession. If, however, the rod is placed in a bearing at the point of support (Fig. 1) it can also rotate about its own axis.

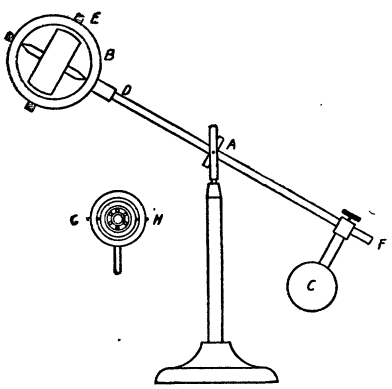

FIG. 1. The rod FD turns in the bearing at A; the bearing turns about a horizontal and vertical axis; the counterweight C is adjustable. The frame of the rotating member B is screwed to the rod at either D or E. GH shows the mounting of the bearing at A.

This gives another degree of freedom to the top and if the counter weight is placed on a second rod as shown in the diagram, it is possible to give two couples to the gyroscope. In this way the different types of precession and nutation can be shown as desired. The frame which contains the spinning wheel of the gyroscope may be screwed into the rod in three different ways so that the plane of the rotating wheel may be (a) parallel to the rod, (b) perpendicular to the rod in a horizontal plane, (c) perpendicular to the rod. In all three positions, the gyroscope, on account of the bearing, will give many new combinations of nutation and precession.

The mathematical theory of tops shows that it is extremely difficult to make a tall thin top (such as a lead pencil) stand up while spinning. The reason for this is that a tall top must be rotating at a very high speed. We have designed a special type of tall top which we spin by means of a rotating magnetic field. This field is produced by a spinner (Fig. 2) consisting of a laminated iron core with a two-phase winding

[1] Preliminary note.

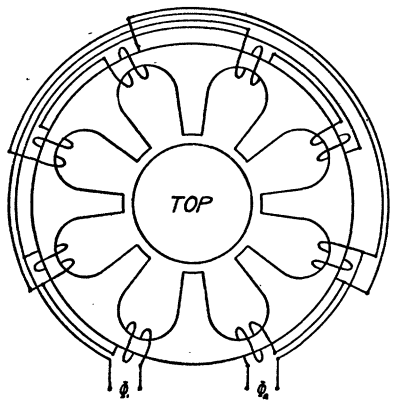

FIG. 2. Laminated iron spinner with two-phase windings for producing the rotating magnetic field.

on it. An Alexanderson alternator supplies the high frequency alternating current for the spinner. When the top is placed in the rotating magnetic field, it is caused to rotate as an induction motor. Thus with an input frequency of 600 cycles, the speed of the top is nearly 600 revolutions per second (36,000 revolutions per minute). The top itself consists of a solid copper disk (Fig. 3, A) two inches in diameter and one inch thick, attached to a five-inch spindle (C) by means of a high-speed ball bearing, B. The spindle of the top is held in the hand and the copper disk is placed in the rotating magnetic field of the spinner. This top will stand upright at first, but as air friction reduces its speed, it will gradually lean over and will finally precess in an almost horizontal position. In this position, centrifugal force (which is usually neglected in theory) will cause the point of the spindle to describe a spiral. This particular top spins best on a fairly rough surface.

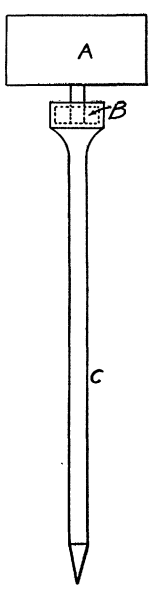

FIG. 3. The Top.

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MOUNTING MEDIUM FOR CLEARED SPECIMENS

THE interest shown at the St. Louis meeting in our cleared specimens of frog tissue mounted in Petri dishes and the requests for further information about