MAGNETIC BRAKE FOR SMALL ELECTRIC MOTORS.

BY THE BELGIAN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

When a metal disk is revolved between the two poles of a powerful magnet, there are developed on it intense currents that have the effect of interfering with the motion. The greater the velocity of the disk, the more intense are the currents and the stronger the reaction. If, therefore, such a disk be fixed upon the shaft of a motor, and be so arranged as to run between the poles of an electro-magnet, the currents that develop therein will counteract the motion of the motor; and, since the reaction increases with the velocity, the motor will meet with a greater resistance in proportion to its increase in speed. It will therefore be subjected to braking and releasing automatically, and always with the power that is proper to its velocity. Experiment has shown that, in small motors, this kind of braking is more efficacious and convenient than mechanical braking.

The Siemens & Halske establishment, of Berlin, not long ago devised two types of such a brake, which are represented in the accompanying figures. In the smaller model (Fig. 1) a horseshoe magnet is so arranged that the axis of rotation of the disk corresponds to the geometrical axis of the motor. The closing of the magnetic lines of force is effected by an arc that is connected with the magnet by a brass ring. The distance between the magnet and the arc may be modified at will.

The electro-magnet is excited by two coils which are secured thereto and the extremities of the winding of which enter two mercury cups, whence fixed connections extend to terminals. Owing to this arrangement, the mobility of the magnet is in nowise interfered with by stationary supply conductors.

The horizontal magnet frame has on one end a graduated copper tube on which is a movable weight. On the other end a threaded bolt carries a counterpoise for establishing the equilibrium.

Between the magnet and the arc already mentioned revolves a copper disk mounted on the shaft of the motor. This disk is secured to the hub by steel spokes. The heat that develops in the disk is consequently not transmitted to the shaft of the motor. The hub is secured to the shaft by means of an arrangement which makes it possible to employ the same disk for motors whose shafts have different diameters. This fastening arrangement consists of a sleeve in three parts, which, by means of a hexagonal nut, is secured to the conical hub, and, in this manner, to the shaft of the motor.

In order to limit the movement of the magnet frame and to determine the zero position, an upright carrying two stops and an indicating pointer is placed at the extremity of the copper tube or beam, which is pointed at its end as shown. The rod and the bearings for the brake are mounted on a common base plate. In the large model (Fig. 2) the electro-magnet is movable upon the beam, so as to permit of compensating for the action of terrestrial magnetism. Such an arrangement was not deemed necessary for the small model, because the influence of terrestrial magnetism is of no consequence.

The important point in mounting is that the axis of oscillation of the electro-magnet shall coincide very exactly with the prolongation of the geometrical axis of the motor. After the brake has been mounted, the movable weight is placed at the zero point of the beam and the counterpoise is regulated until the beam is directly opposite the index. After the magnet has been set in action, the beam is brought back to the zero position in consequence of the action of terrestrial magnetism. The error that results is of no consequence in the small model, and is corrected in the large one by the arrangement just described.

In Fig. 2 the counterpoise of the brake, placed in a north-south position, points north. The magnet makes an angle of about sixty-five degrees with the horizontal. Should circumstances require that the brake be mounted in the opposite direction, the magnet must be placed in such a way as to make the same angle, but on the other side, that is to say, to the right instead of to the left. For this purpose, the brake is removed from its bearing, the nut that fixes the magnet to the frame of the beam is unscrewed, the position desired is given the magnet, and the brake is replaced upon its bearing.

The boxes seen in the figures contain the special sleeves necessary for shafts of 6, 7, 8, 9, 10, and 12 millimeters in diameter for the brake of the second model, and also the various weights, counterpoises, and tools for the mounting of the apparatus.

If, after the starting of the motor, the magnets be excited, currents will be produced in the disk that will tend to cause the magnet to revolve around its axis. The beam by that very fact will leave its position of equilibrium, and, if the movable weight be displaced the equilibrium will be re-established. The work of the motor can then be calculated according to the following formula:

$$L = \frac{2\pi.\ b.\ n\ Q}{60.75} = \text{H. P.}$$

in which Q is the movable weight in kilogrammes, b the displacement of the latter starting from the zero point, and n the number of revolutions of the motor per minute. The value $\frac{2\pi\ Q}{60.75}$ is constant, and may be displaced by C. Then $L = C,\ n,\ b$. In order to simplify the calculation, the movable weight, Q, is so selected that C shall be a whole number.

The applications of these brakes have given excellent results, and it is to be anticipated that all those who employ small electric motors will find it to their advantage to make use of them. The arrangement described, in fact, serves not only for the determination of the power of a motor, but also, and especially, for the regulating of the velocity of it.

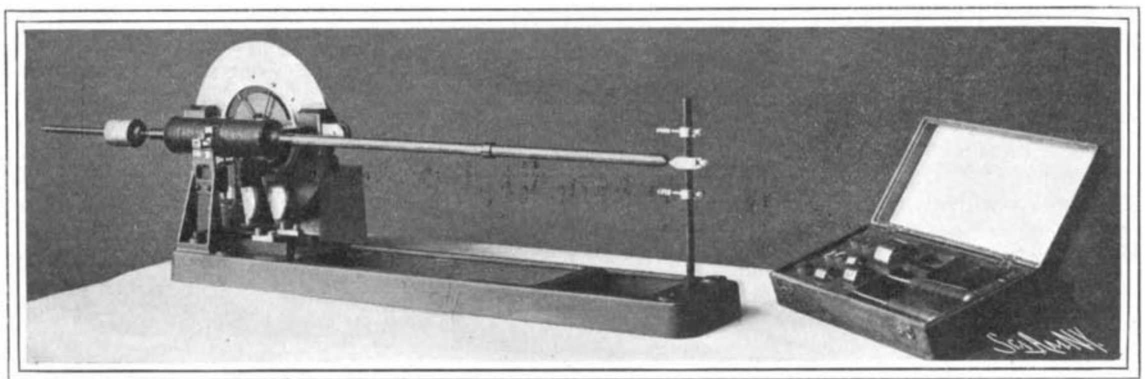


Fig. 1.—SMALL MODEL MAGNETIC BRAKE.

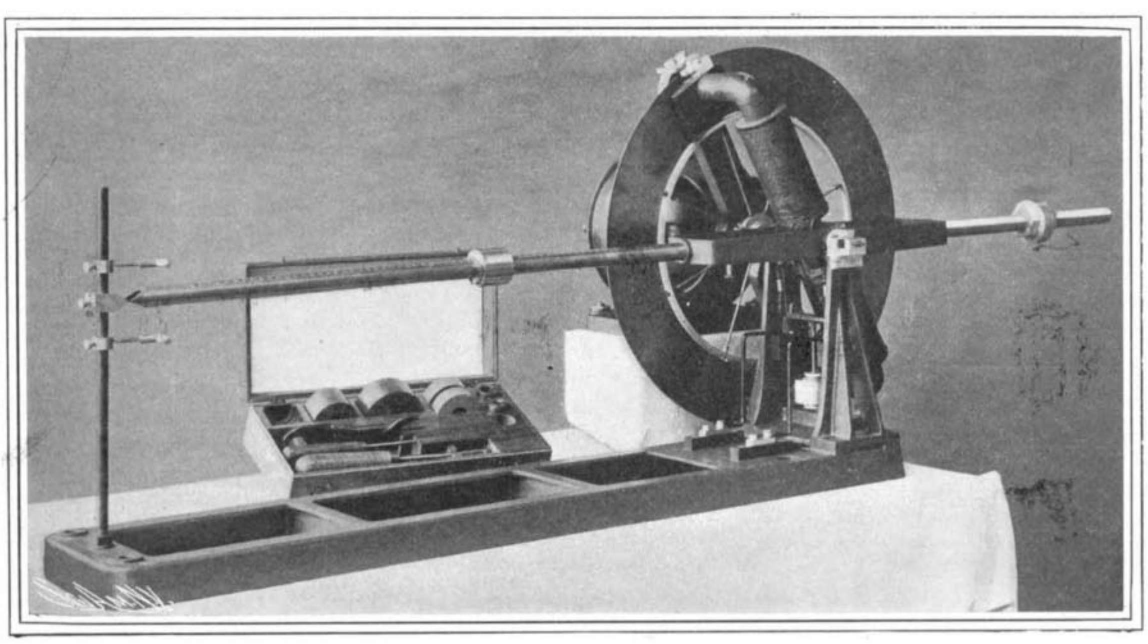


Fig. 2.—MAGNETIC BRAKE FOR SMALL MOTORS (LARGE MODEL).

PHOTOGRAPHY OF STAR SHADOWS.

BY EMILE GUARINI.

In the majority of scientific questions, the least fact is, as well known, capable of giving rise to interesting researches and offering material for important philosophical deductions.

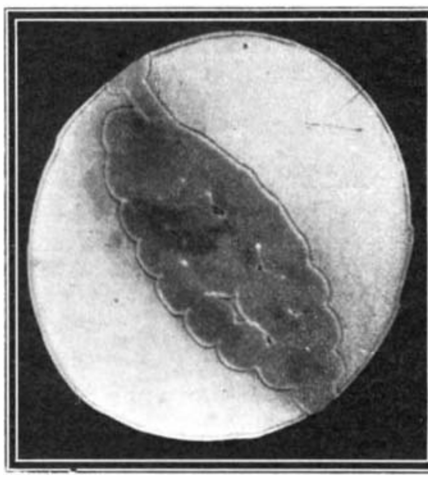
The study of the shadow projected by the stars is a case in point. It would appear so much the less interesting, at first sight, in that we do not usually think that there are any stars except the sun or moon that project a shadow. Now, a more minute examination of the subject shows that such is not the case and that, although few stars produce a *visible* shadow, there is nevertheless a large number of which the shadow can be photographed. The very interesting researches that have just been made by M. E. Touchet, assistant secretary of the Astronomical Society of France, prove this. There is, in the first place, reason for examining the most brilliant stars and planets, and, among others, the planet Venus, the Shepherd's Star. Venus, in fact, is, with the sun, the moon, and Jupiter, the only star that projects an appreciable visible shadow, and, in astronomical treatises and reviews, we may find numerous references to observations of this phenomenon. M. Camille Flammarion, in his magnificent work entitled "The Lands of the Heavens" expresses himself upon this subject as follows: "The light of Venus is so powerful that it occasionally produces a shadow. I noticed this fact unexpectedly one evening and without having in any wise previously thought of it. Returning from a trip to Italy, in the spring of 1873, I stopped at Vintinille, through which the train from Italy passed at about nine o'clock at night. It was on the 23d of March. Led by a guide through the dark city, I perceived that three shadows were following to our left along a garden wall near which we were walking. Very much surprised at such a shadow produced without moonshine and without reflections, I spoke of it to my two companions, who recognized it as well as I. It was very strongly and sharply defined. The sky was studded with brilliant stars; but, to our right, there was only Venus as a star of the first magnitude and so exceedingly brilliant that its light appeared alone more brilliant than all the others of the firmament combined.

"The wall was of a dirty, almost grayish-white. Had it been white, our shadows would have been still more marked.

"During the following weeks, at Nice, I renewed the experiment upon paper. The shadow of my fingers, of a lead pencil, or of any object whatever was depicted upon this with the greatest sharpness. Since then, I have often remarked the same phenomenon, which is one that anybody can easily observe, especially if his attention has been previously called to it."

Sir J. Herschel, in his "Outlines of Astronomy," describes the phenomenon as follows: "Under favorable circumstances, Venus projects quite a strong shadow. This should be received upon a white ground. The open window in a room with white walls is the best arrangement. In such a situation I have observed not only the shadow, but the diffraction fringes that border its contour."

We now come to M. Touchet's experiments. Upon an ordinary astronomical telescope, not mounted equatorially, M. Touchet arranged a light camera from which the objective had been removed. In the place of this he put an object that presented details fine enough to give an idea of



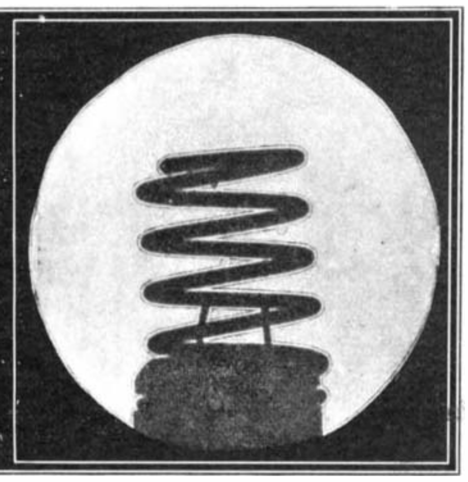


Fig. 1.—Shadow of a Brooch Cast by Sirius. Fig. 2.—Shadow of a Spring Cast by Venus.

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