

AN ELECTRICALLY-OPERATED GYROSCOPE.

A NEWLY-DISCOVERED MOTION.

BY EDWARD DURANT.

This specially-constructed gyroscope for use in the College of the City of New York, made by Charles Dressler, from suggestions by Prof. Alfred Compton, is quite new, in that it produces its own motion through the medium of electricity. Within the stationary ring mounted on the stand are carried the conducting wires, which convey the current from the binding posts to mercury cups located at the gimbal pivots of the two movable rings, and thence to the magnetic field ring and the armature brushes. One movable ring is pivoted to rotate in a vertical plane. The magnetic wire-wound field ring is gimballed to rotate in a horizontal plane, while the armature, composed of a large disk encasing within the armature wires, is pivoted vertically in the field ring, and is in line with the vertical axis of the outer movable ring. In the illustration the brushes will be seen above the armature disk. Below is a special swinging weight, made to move to and from the armature disk by a crank-pin wheel operated by a worm screw on the armature shaft meshing with teeth on the crank wheel. The shaft of the motor is in the nature of a pendulum having the movable weight at the bottom. When set in motion electrically it has the function of a gyroscope, and if it is placed by hand in a position at right angles to the normal, or, in other words, in a horizontal position, while spinning, it will describe an orbital circuit like a planet or satellite, and revolve in a plane parallel with, or tangential to, the earth's surface.

The armature shaft supporting the pendulum weight then becomes a rotating radius vector, and the pendulum weight or armature disk becomes a miniature spinning, planetary mass, revolving in orbit with mutual affection between itself, the earth, and other planets.

The gyroscope has a constant angular velocity, and a constant orbital time. The separate nutation device attached, consisting of a relatively light weight, oscillated radially by means of the worm gear on the radial shaft, through a small space above the theoretic supporting pivot, brings about the most marvelous mechanical movement yet discovered. The pendulum begins to rise to a horizontal position, as before, but by Nature's influence only; and after it reaches the horizontal position or planetary plane it performs the astronomical nutation phenomenon by gradually stopping and slowly starting again.

What we conceive of as weight or gravitational influence, passes out of the spinning mass to the imaginary supporting point or center of orbit.

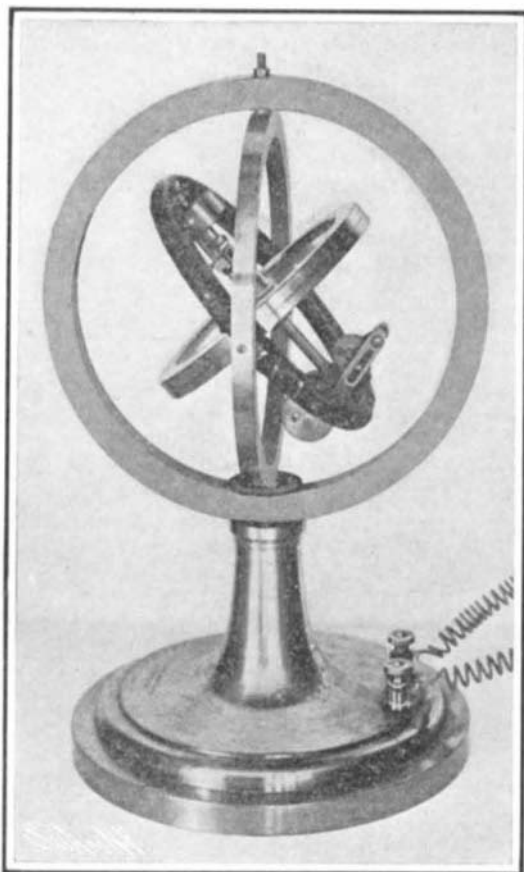
When both the supporting rings or gimbals are in the same vertical plane, and the gyroscope wheel is rotating on axis at maximum speed, it will be observed that the gimbals cannot be moved freely by hand, except in the direction of rotation, and a very appreciable resistance is offered when an attempt is made to move the gimbals by hand in the reverse direction.

If the outer gimbal is forced by hand to move in the direction of this phenomenal resistance, the inner gimbal immediately inverts before permitting the outer gimbal to move freely in this same direction it was at first forced.

When the model is at rest the heavy pendulum weight is by no means balanced by the very light oscillating weight.

Up to about 1860 the jet condenser was the one usually employed on board ship, which meant, of course, that the boilers were constantly fed with salt water; and this, in turn, meant the deposition of great quantities of sulphate of lime scale on the heating surface. With the low pressure then

prevalent this did not greatly affect the economy of the boilers, except that, as "blowing off" to keep the density of the water down was a continuous practice, there was a certain loss of heat, and of course there was the necessity for frequent scaling of the heating surfaces. However, they were effectually protected against corrosion. About 1860 the use of surface con-



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densation became general, and as this greatly reduced the amount of scale formed, it was practicable and safe to increase steam pressures, which accordingly resulted with a consequent reduction in the weight of machinery per unit of power.

THE "WHIRLPOOL" ILLUSION.

We illustrate herewith "The Great Whirlpool," the invention of Mr. Joseph A. Bruce, of Brooklyn, N. Y. This appears to be the latest thriller in the amusement line, and its novelty should appeal to the amusement-loving public.

A building over fifty feet high and one hundred feet square is built inside to simulate a monster whirlpool. The passengers who are seeking the sensation ascend

in boats by an endless chain from a lobby to the upper interior. As the boats come up, the passengers are confronted by a tremendous waterfall, the water falling from a great height, while the whirlpool proper is at their feet, ninety feet in diameter, the depth being fifty feet. By optical illusions the depth is made apparently much deeper, the waters dashing, jumping, and gyrating to the vortex below, from which the spray ascends. The roar of the mad waters is heard, and the boat starts down an inclined plane or spiral road, going by gravity on tracks at ever-increasing speed until through an opening it disappears at the bottom, apparently sucked into the insatiable depths below. Passing through dark tunnels over many bumps, the boat dashes into the foyer to sunlight and safety.

The building is inclosed, and with the liberal use of electric effects an artistic, realistic, and ingenious exhibition is given.

Our sketch from model shows the interior as the passenger views it when he reaches the top in the boat car; the lower cut gives an idea of the mechanical construction. As shown in the illustration, the interior of the whirlpool, being built as an inverted cone, shelves down with considerable pitch from the top toward the lower center. The shelves contain tracks upon which the boat cars run. From the base of the waterfall there runs all around the building a trough, which carries the water from the falls, and overflowing, it runs down the whirlpool and around the roadway.

The interior is covered with canvas to represent water, and with the electrical effects the whirlpool seems indeed to be a live, mad body of water, restless, hungry, and pitiless. The water descends to a tank at the bottom of the whirlpool, over which is built a bridge upon which the boats pass to make their exit, and from this tank the water is pumped to the top of the building to feed the jumping, spurting, wild, and troubled waterfall. The boats having sails set on the rear side, the passengers are protected from the spray.

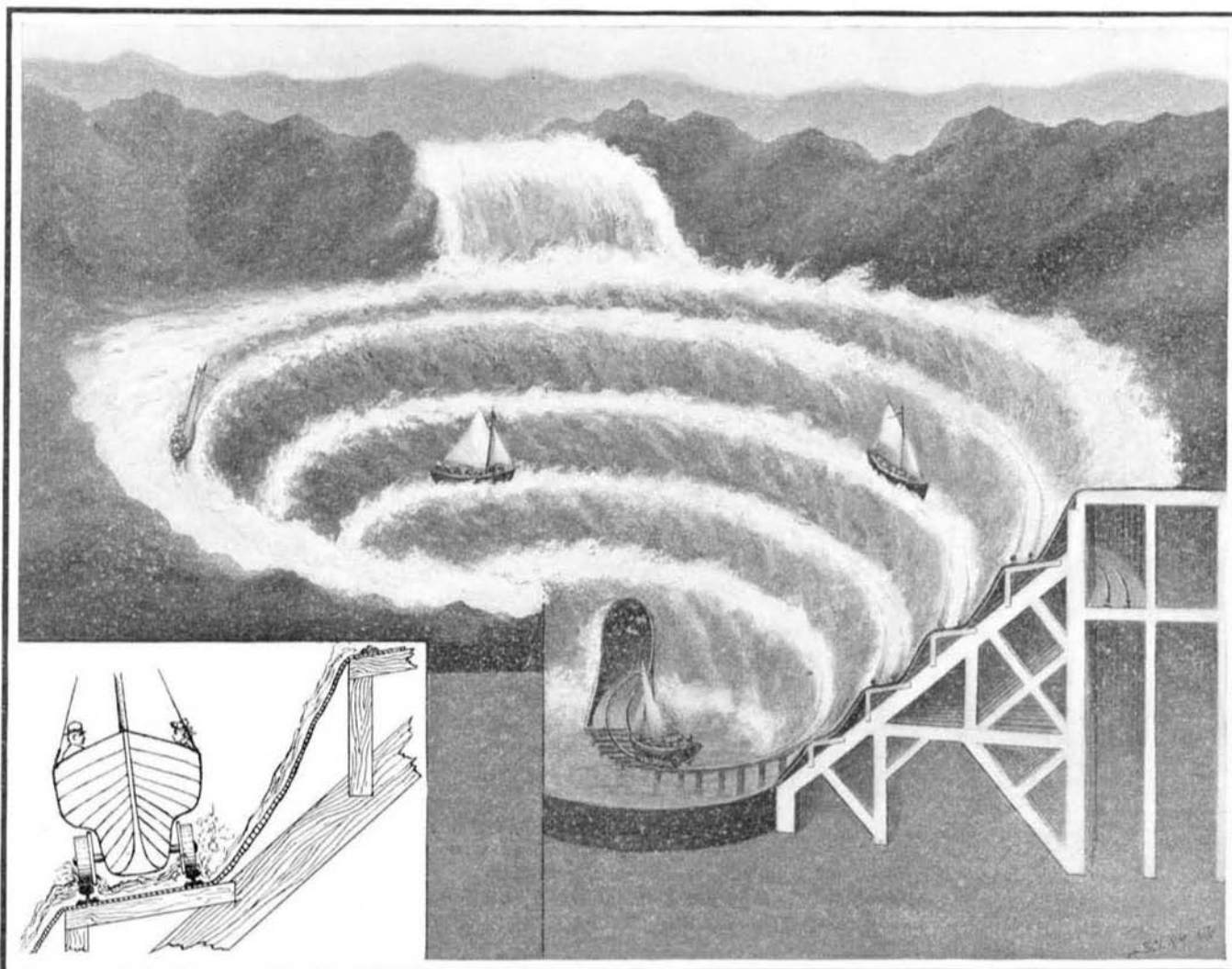
Each car is in charge of a man, and as the cars are equipped with safety brakes and are run on signal, all danger of accident is eliminated.

IMPROVED METHODS IN HIGH-SPEED CHRONOPHOTOGRAPHY.

BY DR. ALFRED GRADENWITZ.

Instantaneous photography, and especially the chronophotography of a moving object, have enabled us to recognize the true nature of some animal motions of which we have had but very hazy conceptions. The operation of the cinematographic camera consists essentially in moving a sensitized film behind a photographic objective, and stopping it for a moment at regular intervals while an exposure is made. For ordinary purposes a rate of ten to twenty views per second is quite sufficient to photograph the different phases of motion. On viewing in a similar intermittently working outfit the series of photographs taken, the impression of a continuous motion is produced. For more rapid movements, however,

the rate mentioned proves insufficient, and the late Prof. Marey, of Paris, who paid especial attention to the phenomena of motion, designed some ingenious means of abridging the time of exposure, and thus increasing the number of photographs taken in a second. By intercepting the beam of light with an interlocking disk fitted with narrow slits and rotating at a high speed, he was able to obtain photographs of flying insects in 1-25,000 second. The same process was subsequently made use of by Lendenfeld, who succeeded in reducing the time of exposure to 1-42,000 sec. He was the first who succeeded in employing a continuously moving instead of an intermittently moving film for the dissol-



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ciation of the images by means of his high frequencies. By employing a rapidly oscillating mirror he produced on a fixed plate images which were separated by intervals of 1-2,150 of a second.

The series of images obtained by this method are

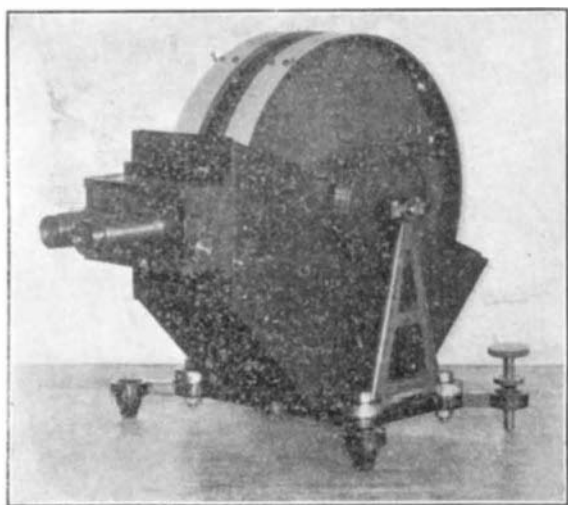


Fig. 1.—Bull Chronophotographic Camera with Cover Removed.

rather short and hardly adapted for a synthetic reproduction of motion. Moreover, they are somewhat blurred owing to the time of illumination, which despite the rapidity of exposure, is still too great as compared with the speed of displacement of the image.

Now, Mr. Lucien Bull, of Paris, the collaborator of Prof. Marey, further developed Marey's ideas. By using the electric spark as a source of light he was

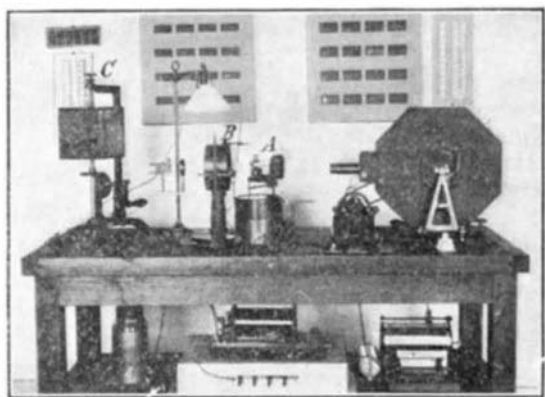


Fig. 2.—The Bull Chronophotographic Apparatus.

able to effect dissociation of extraordinary rapidity without losing definition.

In order to obtain a series of images at constant distances, which is a necessary condition for effecting the synthesis of the analyzed motion, Mr. Bull produces the electric sparks at intervals corresponding to equal displacements of a film.

The outfit used by him is represented diagrammatically in Fig. 4. In a camera box, A, a cylinder, B, is mounted on a horizontal shaft. To the same shaft is fitted outside of the camera a rotary current interrupter, which is connected with the primary winding of an induction coil, D. The induced current is allowed to flow to a Leyden jar condenser, F, the spark passing at E between two magnesium electrodes in front of the lens, G, which concentrates the rays on to the objective, O, in the focus of which the cylinder rotates. This cylinder carries a sensitized film and is rapidly turned. At each revolution a number of sparks corresponding with the number of contacts on the interrupter passes at E. The shutter is thereupon opened during one rotation to obtain a series of images at constant distances apart of an object placed between the lens, G, and the objective. The shutter is a double shutter and is opened at the given moment by a cam on the edge of the cylinder. The closing of the shutter is effected automatically at the next revolution by the same cam.

Fig. 1 is a photograph of the apparatus, with the cover removed. There are two objectives and two films, so that the apparatus is adapted for taking stereoscopic views.

The cylinder is 35 centimeters in diameter and 10½ centimeters in breadth. There are 54 contacts on the interrupter, thus breaking the current fifty-four times for each revolution of the cylinders. Consequently fifty-four photographs are taken

in one revolution. The images are focused by means of a finder comprising a mirror inclined at an angle of 45 degrees, and located immediately behind the objective. Before making an exposure this mirror is lowered by means of a button seen to the right of the finder in Fig. 1.

In Fig. 2 one entire outfit is shown ready for use. Below the objective is placed the electric motor driving the cylinder of the apparatus. At A a tuning fork is mounted, producing fifty vibrations per second, register the time sure. For this of the prongs are while in vibration with the objects. The different positions of the prongs indicate shown in Fig. 2a. From a' to b', coincidence of to the other, a performed, corresponding to the number of two such frequency at are taken is observed. At B (Fig. 2)

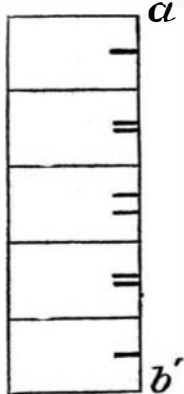


Fig. 2a.—Marks Made by Tuning Fork and Indicating Time of Exposure.

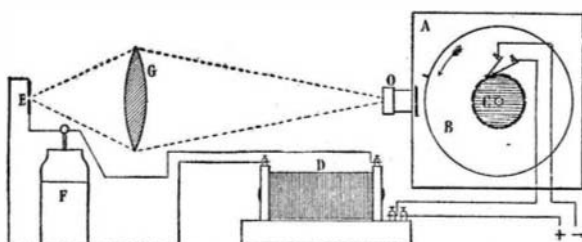


Fig. 4.

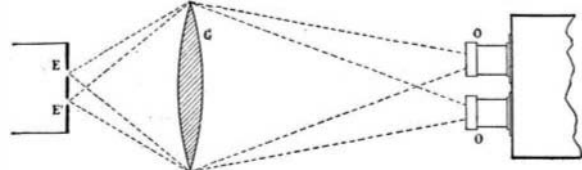


Fig. 5.—Apparatus Arranged for Stereoscopic Photography.

is seen an optical condenser, which is shown separately in Fig. 3. This condenser constitutes the luminous field on which the object comes out clearly. In the same figure are shown the two magnesium spark gaps.

At C (Fig. 2) is a rotating mirror, which, though not indispensable, proves useful for ascertaining whether the sparks succeed one another at regular intervals. On the table are further represented the induction coil, placed on a condenser of great surface, a

Leyden jar, and the electrical resistances. In Fig. 5 is a diagram showing the apparatus as used for stereoscopic views. Two sparks are produced in the same circuit, giving two distinct beams of light directed toward the corresponding objective. E E' are the spark-

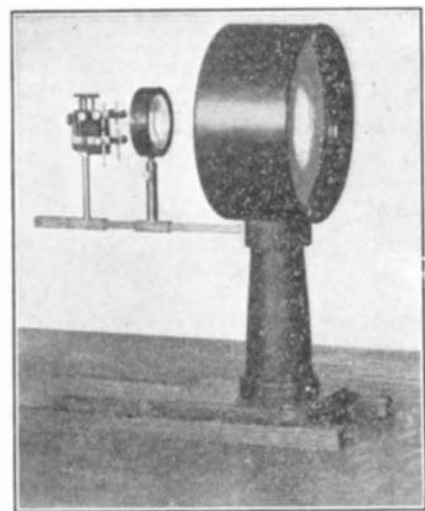


Fig. 3.—Optical Condenser Used with the Bull Chronophotographic Camera.

gaps, G the optical condenser, and O O' the objective of the apparatus.

Fig. 6 shows a series of images of a soap bubble which is traversed by a paper projectile thrown by a spring. In Fig. 7 is seen an ordinary fly in stereoscopic

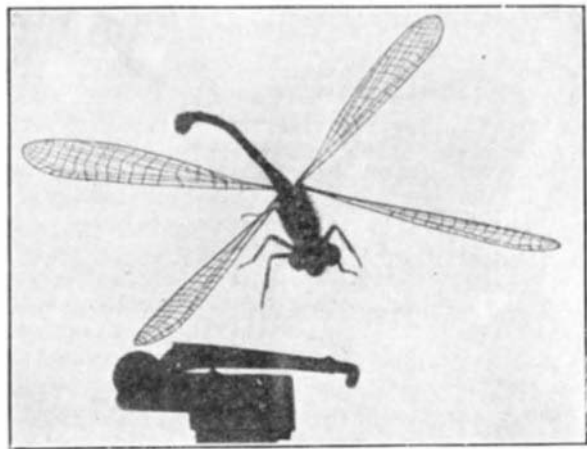


Fig. 10.—An Enlarged Picture Taken by the Bull Apparatus.

views (a and a'). To the right is shown a millimetric scale, by means of which the displacement of the object is measured, and the tuning fork prongs giving the speed at which the images are obtained. These views were taken at the rate of 1,100 per second, whereas the bee represented in Fig. 8 in horizontal flight was photographed at the rate of 1,200 images per second. In Fig. 9 is seen a libellule (*Agria puella*) on starting. These images were obtained at the relatively moderate speed of 600 images per second. One of the images composing this series is magnified in Fig. 10. The highest speeds so far obtained are more than 2,000 views per second, but Mr. Bull is of opinion that with specially constructed induction coils far greater frequencies can be obtained.

It should be remembered that the aggregate time of exposure is quite inappreciable as compared with the intermediate intervals of darkness. In fact, the duration of each spark has been calculated to be only about the 2,000,000th part of a second. As the distance traversed by the film during this minimum interval is quite inappreciable, the image is as sharp as may be desired.

A London dentist named Whitehouse is the inventor of a scheme for overcoming the motion of a vessel on the sea, which was recently given a trial on one of the boats making regular trips across the English Channel. Many of the world's most distinguished scientists and inventors have taken a trial at this problem without success, but the present inventor says that it was never possible until electricity became available for the purpose. The berth designed by him is swinging, and supported by four cords. By means of electric motors these cords are automatically operated to counteract the motion of the boat, in which it is said to be very successful.

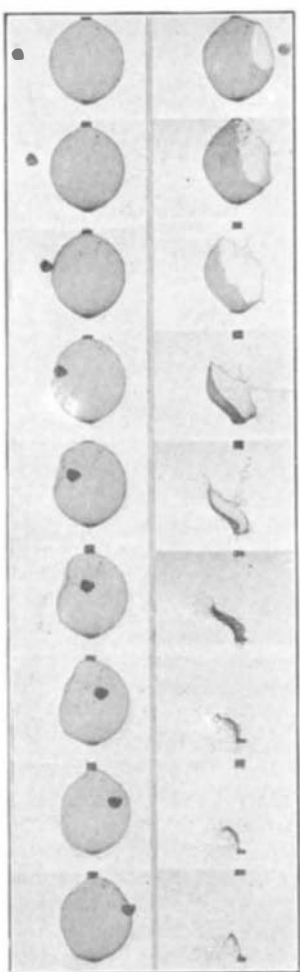


Fig. 6.

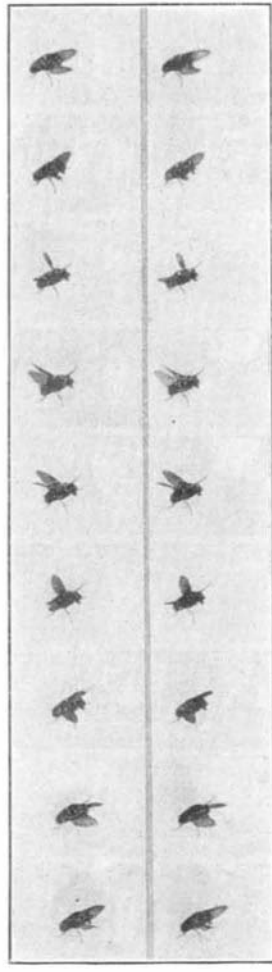


Fig. 7.



Fig. 8.



Fig. 9.