

AN ELECTRIC POWDERLESS, SMOKELESS, FLASHLESS, AND SOUNDLESS GUN.

BY OBED C. BILLMAN.

While but two patents have been issued by the United States Patent Office for electro-magnetic guns, and these within the past two years, yet it appears that scientific men gave this problem their attention a number of years ago.

In 1845, Charles G. Page, of the Columbian (now George Washington) University, Washington, D. C., wrote an article, which was published in the American Journal of Science and Art, vol. 49, page 132, in which he stated:

"Another curious instrument is the galvanic or magnetic gun. Four or more helices arranged successively constitute the barrel of the gun, which is mounted with a stock and breech. The bar slides freely through the helices, and by means of a wire attached to the ends toward the breech of the gun, it makes and breaks the connection with the several helices in succession, and acquires such velocity from the action of the four helices, as to be projected to the distance of forty or fifty feet."

The primary principle involved in the construction of these guns consists in impelling the projectile by the magnetic action of a solenoid, the sectional coils or helices of which are supplied with current through devices actuated by the projectile itself. In other words, the sections or helices of the solenoid produce an accelerated motion of the projectile by acting successively upon it.

A principle somewhat similar is involved in the construction of electro-magnetic rock drills and dispatch tubes. Patents granted to Marvin, Nos. 361,829 and 368,405, are instances of the former, and patent No. 259,817, granted to Cheever, is an instance of the latter.

In the electro-magnetic rock drills, the plunger is moved by the action of a sectional solenoid, through the coils of which current is supplied through contacts closed by the plunger itself.

The electro-magnetic dispatch tube consists of a carrier or dispatch tube surrounded by a series of coils or helices, a galvanic battery having one pole permanently connected with one end of the coils or helices by a series of branch wires, the other end of the coils or helices being left open circuited, a traveling carrier provided with circuit-closing devices for completing the circuit between the open ends of the helices, and a conductor connected directly to the other pole of the stationary battery.

An advance sheet of Consular Reports, dated February 27, 1902, contains an account of an electro-magnetic cannon in Sweden, as given in a report by Consul-General Bordewich, under date of "Christiania, January 25, 1902."

"Prof. Birkeland (who two years ago was sent by the government to northern Norway to study magnetism, the aurora borealis, and cloud formations) is engaged in the construction of a cannon with electro-magnetism as the motive power in place of explosives. A small model of the invention throws projectiles weighing a pound with great force."

A patent was issued to Kristen Birkeland, of Christiania, Norway, for the invention above referred to, March 15, 1904, No. 754,637, and this was the first patent issued by the United States Patent Office for an invention of this class.

The application of Birkeland was filed January 2, 1902, and Samuel T. Foster, Jr., a native of this country, residing at Victoria, Tamaulipas, Mexico, having read the account of the Birkeland invention, as referred to in the Consular Report, filed an application for Letters Patent December 10, 1902, but owing to the difference in the construction of the guns disclosed in the two co-pending applications, no interference was declared.

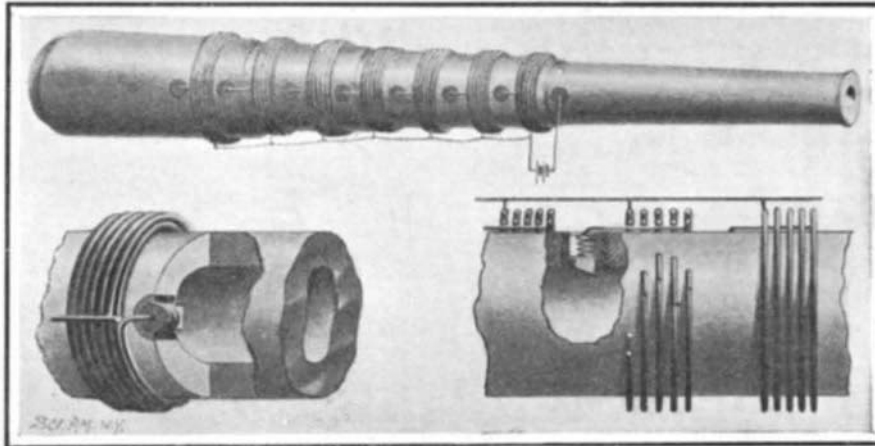
The broad claims originally filed by Mr. Foster were held to be anticipated by the Journal article above referred to, but a patent was finally allowed and issued to him February 6, 1906, for an electric gun, No. 811,913, the second patent issued in the United States for an invention of this class. One of the practical difficulties encountered in the construction of a practical electro-magnetic gun arises from the fact that the modern methods of electrical calculation would indicate that in order to obtain service velocities with service projectiles an enormous number of windings would be required, thus involving the use of a barrel whose length would be prohibitory.

Another difficulty arises from the fact that in order to give the projectile a service velocity, without an enormous number of windings, an abnormally heavy current—that is to say, a current beyond the safe car-

rying capacity of the solenoid—is required, and hence the temperature of the solenoid will be raised to a point sufficient to destroy it.

Prof. Birkeland attempts to overcome these difficulties by supplying an abnormally heavy current to a coil and then cutting off the current from the coil before the temperature of the coil has reached such a point as to injure or destroy it, claiming that the rate of increase of the temperature depends upon a number of factors other than the current.

Mr. Foster says, in the specification of his patent:



THE FOSTER ELECTRO-MAGNETIC GUN.

The projectile is impelled by the magnetic action of a solenoid, the sectional coils of which are supplied with current through devices actuated by the projectile itself.

"All projectiles used in this gun must have magnetic properties, and projectiles of iron or containing large portions of iron are preferable. That projectile having the greatest magnetic permeability is most suitable for this gun." The Foster gun is very simple and comprises a barrel surrounded by a series of coils or helices, a series of openings arranged along the barrel and provided with insulated walls, a series of connector-plugs mounted in said openings and normally adapted to be engaged by the projectile, a series of springs mounted in said openings and adapted normally to hold the connector-plugs in contact with the insulated walls, and an electric generator connected with said helices and barrel.

In this way means are provided for energizing and de-energizing the coils or helices in regular sequential order by the projectile completing and breaking their circuits and for automatically keeping the center of their electro-magnetic field just ahead of the projectile until it has reached the center of the last electro-magnetic field. When the projectile has reached the last electro-magnetic field, means are also provided for opening the battery circuit and releasing the projectile of all further electro-magnetic action of the gun.

PHOTOGRAPHING A DEVIL FISH—THE CHAMELEON OF THE SEA.

BY CHARLES FREDERICK HOLDER.

The strange spiderlike creature known as the octopus or devil fish comes of an ancient lineage. Its family tree includes shelled animals which held sway in the Silurian sea millions of years ago. The late



A Sixty-pound Devil Fish so Powerful That One Man Could Not Tear Its Arms from the Boat.

PHOTOGRAPHING A DEVIL FISH—THE CHAMELEON OF THE SEA.

Prof. Newberry, of Columbia University, referred to a certain *Orthosceros titan* which may have weighed a ton—a torpedo-shaped creature with a shell twenty feet in length, which doubtless played havoc among the denizens of the abysmal regions of ancient seas. Again, there were others, with nautilus-like shells, as large as a cart wheel; and the most forbidding living animal to-day, the one shrouded by the greatest mystery, is the giant squid, a cousin of the octopus, which lives in deep water, only occasionally being found, as was one recently, off the Southern Californian coast,

floating, a great white mass, so bulky that the boatman who saw it told me that not only could he not take it aboard, but it was so huge that he could not tow it in. The arms of this specimen he described as being as large as a man's leg, and doubtless this ten-armed devil fish attains a length of one hundred feet and a weight of several tons.

The keeper of the Avalon zoological station, who had an uncanny experience with a large devil fish, or octopus, related the incident to the writer. He said:

"I was fishing at the time with several partners out of San Francisco. It was our custom to go out to the banks around the Farallones and try for deep-sea fish. It was a rough place, nearly always blowing half a gale, foggy and dangerous, and often we had to let lines go and run in to lie in the lee of the rocks. One morning I was hauling in the trawl when it stopped coming. I thought I was foul of a rock, so pulled hard, and after a while felt it give and begin to come up, but very heavy. It's slow work hauling in a trawl, taking off a fish and killing sharks that get hooked, and it was some time before I got what I supposed was a rock. I had just taken a turn about a rowlock with the line, to rest, when it sagged, and looking over I saw a great mottled ball out of which shot a long arm that took hold of the gunwale and held on. We often caught devil fish, and there was a demand for them in the market, so I tried

to pull it up; but another arm came up, as big as my own, while another crept over the side near my partner, who started up, shouting that it was coming aboard. I looked over and saw a great red mottled mass hanging to the bottom of the boat; then I reached for a knife—a kind of cleaver—my partner doing the same. The devil fish was caught by several of the trawl hooks, and tried to fasten to the boat to get rid of them. Its arms shot out of the water like fingers, and when I saw one the size of my arm and growing bigger near the base, I didn't wait, but slashed at them right and left, cutting them on the rail. Some of the tentacles near the body looked as big around as my leg, and the whole arm or feeler was nearly twice as long as a man. The arms were probably twelve feet long, and the body two or three times the size of a man's head. The whole mass was so big that we were glad to chop it to pieces as it came aboard, and then to punch it away from the boat with oars and get rid of it; it was too heavy to take aboard, especially in a seaway."

A number of large devil fishes have been taken near Tacoma, and when spread upon the grass are seen to be formidable creatures, with their enormous button-like suckers, which combined constitute a power sufficient to drown men in the open water. Monterey has produced a number of large specimens which would terrify strollers along the weed-covered rocks at low tide.

It was my good fortune to have under examination at Avalon, Santa Catalina, at various times, several large living devil fishes and a squid, the latter eight feet in length. The devil fishes were first noticed on a point of rocks at the north end of Avalon Bay. I was lying on a rock watching the movements of some land crabs which kept retreating from the water as the tide rose, when suddenly a crab dashed frantically from the water, and out after it "galloped"—there is no other word for it—a devil fish nearly two feet across. The animal continued the chase a short distance, lifting its tentacles in the air in a sort of overhead motion, then finding the pursuit hopeless it withdrew, with the peculiarly unpleasant writhing, gliding motion characteristic of these animals, and upon reaching the water stationed itself just at the edge, so mimicking the color of the bottom that when I glanced away and looked suddenly back, I could not at once distinguish it. This devil fish had the appearance of a cat watching for mice, and when a crab was seen it would shoot out a long, attenuated tentacle and attempt to seize it. By carefully insinuating my way to the water's edge I quickly grasped the specimen, and after a short struggle tore it from the rocks

and secured it. At various times I had from three to five devil fishes in an inclosure, where I could watch them change color and test their strength. In confinement, if the tank bottom was dark, they assumed various tints, generally a dark reddish brown; but the largest one was a tiger-like creature, about three feet across, with a ground of livid white covered with black or dark gray blotches, giving it a truly fiendish appearance, especially as the eyes were conspicuous and appeared to emit lambent gleams. The change of color was marvelous in its rapidity. In a special tank