tion to the clamp. This can be avoided (for instance) in a single contact by arranging to clamp a single, bent copper strip so as to join two stationary strips, which are insulated from each other by celluloid.

The clothespin contact has been used to give a simple arrangement for inserting one ammeter successively into several different circuits without interrupting current. At the point where the insertion is to be made, two copper strips run down into the clamp, insulated from each other by celluloid except at the end, where they are usually in contact, closing the circuit. The ammeter leads terminate in two copper strips, which run on the opposite sides of a wooden wedge. When this wedge is forced into the jaws of any one of the clamps, the original contact there is broken, but not till after the ammeter is connected to both sides of the break, so that the current is not interrupted.

A Magnetic Snake

By Chancy W. Nieman

A VERY interesting and beautiful experiment for the home laboratory, and one which shows in a very striking way the relation between electricity and magnetism, is the magnetic snake. All the preparation necessary for this experiment is a bar magnet, a few batteries of any form, and a small amount of very simple construction.

It is made as follows: A few strands of tinsel, such as is so much in evidence at Christmas time, are braided together to a very flexible electric conductor, as shown clearly in the accompanying illustration. The ends are attached to two screw eyes, which are screwed into the wooden support. A bar magnet is fixed by its middle as shown. Wires from a few dry cells are connected to the two screw eyes. It is best to have a reversing switch, so that the direction of the current through the tinsel can be changed. When the current is turned on, the "snake" will act like a live boa constrictor, coiling itself with great suddenness and velocity around the unsuspecting bar magnet. Upon reversing the current it will quickly uncoil itself, and writhe around until it

A magnetic snake.

is tightly wrapped up in the opposite direction. If the magnet is not painted about the middle, a layer of paper should be put around it to keep it from short-circuiting the tinsel.

The direction in which the snake wraps itself is the same as that in which a piece of wire would have to be wrapped to make an electro-magnet with the poles at the same ends as the poles of the bar magnet.

How to Make an Insulated Thumbscrew

TAKE a small pill-box, the size of the required head. Fill it with hot sealing wax (black preferred), then while still soft, place the head of the bolt or screw in it, and allow it to cool. A piece of bent tin may first be soldered to the head of the bolt to give the wax a good grip. When cool, the paper box may be washed off and the wax touched up with a hot knife blade. Milling may be put around the edge in the same way.

A Sensitive Relay for Wireless Telegraphy

By E. H. Williamson, Jr.

IT is probable that the majority of amateur wireless telegraphers are in the habit of sitting by their receiving apparatus with the telephone receivers over their ears waiting for the buzz which indicates that "something" is coming in from the aerial. It is also probable that many of them have gotten very tired of sitting there listening for long periods and have removed the silent 'phones just as a message has started to come in. Being in this class myself, I started experimenting to see if there was not some method by which the incoming Hertzian wave would either register itself, or at least give a signal which would be audible without the necessity of keeping the 'phones to the ears. Several devices were tried without success, and finally the one described in this article was built, which gave a reasonable degree of satisfaction when carefully adjusted. The principle involved was very simple, namely, to increase the minute motion of the telephone receiver diaphragm by a system of levers, so that a local circuit

could be closed and broken simultaneously with the movement of the diaphragm.

The relay was made as follows: A hard wood base, eight inches long by three inches wide, was made, these dimensions being convenient but not necessarily to be adhered to. Across the ends two strips were screwed to raise it one-fourth of an inch. An ordinary "watch case" double pole telephone receiver was wound to about 250 ohms resistance with No. 38 S.S.C. copper wire. This was set at the right-hand side of the base one inch from the end, the ring projecting from the receiver being clamped between two strips of wood through which a screw was driven into the base, holding the receiver immovable. A strip of one-sixteenth of an inch brass one-half of an inch wide and three and one-half inches long was bent over for one inch, at right angles and a U-shaped strip of thinner brass soldered to the bent arm so as to project downward. A notch was then filed centrally at the bottom of each leg of the U, and the standard was screwed vertically at the end of the base board. The photograph shows the idea clearly. A lever arm was made from a piece of three-sixteenths of an inch square brass bar three inches long, a long thin brass pin being soldered across one end, so as to rest in the notches of the U, to form a pivot for the lever. This bar was drilled and tapped for a 4-32 machine screw at a point one and one-half inches from the pivot, so that the screw would be over the center of the diaphragm. A one-inch machine screw was then driven through the square bar until it rested on the diaphragm, and held the lever parallel with the base. A piece of No. 1 copper wire eight inches long was then soldered to the left-hand end of the bar, making the total length eleven inches. The motion of the diaphragm was of course multiplied at the end of this lever, but not sufficiently, nor steadily enough to depend on for a make and break of contacts, so a second lever, also of copper wire, No. 41, six inches long, was pivoted on a U-shaped support, of brass, screwed to the base. The left end of this lever was bent at right angles and so adjusted as to rest with a slight weight against the lower surface of the first lever, the cross arm pivot being set two-thirds of the way toward the left end for this purpose, and also to multiply the movement further. At the right end of the second lever, a short brass strip was soldered, provided with a machine screw and washer under which was clamped a piece of No. 22 platinum wire pointing upward. A brass block with a similar strip and screw projecting from the left side was screwed to the base in such a manner that the left side could be raised and lowered a trifle. A bit of platinum foil was clamped to this support by the screw and washer and the right end of the second lever bent up until the platinum wire was about one-sixteenth of an inch below the foil. This distance was again reduced by unscrewing the machine screw in the bar about one turn, thus dropping the first lever and raising the opposite end of the second. The final adjustment was made

by lowering one side of the contact block until the two contacts were almost touching. The terminals of the telephone receiver were connected with two binding posts at the right. The posts at the left connected the contact block and the U support of the second lever. The receiver was put in circuit with a home-made silicon detector, shown at the right, the aerial and ground wires being connected as usual. From the relay posts a local circuit was run to a battery and home-made telegraph relay of 200 ohms resistance. When the armature of this relay was finely adjusted close to the magnets, it would vibrate with a sound quite audible in any part of the room when the telephone receiver diaphragm moved under the influence of a wave from the aerial.

I tried connecting a single stroke electric bell to the terminals of the second relay and got a sound out of it, but it was no better than that of the relay alone, so I abandoned this plan.

The first contacts in the relay were made with mercury and platinum, but did not work, as the capillary attraction of the mercury prevented a break when a contact was once made. The wiring chart gives a clear idea of the various circuits and their connections.

Concrete Cathedral

THE cathedral of Poti on the Black Sea in Russia is built entirely of reinforced concrete. It is of the Byzantine type, designed somewhat after the St. Sophia structure of Constantinople. As the loose sandy soil near the Rion River, upon which the build-

ing is located, will admit of but little weight on the pile foundation, reinforced concrete answered the purpose very well, and it took less than a year to build, against ten years for the Batoum and other Russian cathedrals, besides costing much less. It has a main dome surrounded by half-domes covered with sheet iron. A pressure of but twenty pounds per square inch was permitted upon the foundations.

Colored Shadows

By Prof. Gustave Michaud, Costa Rica State College

NOT many people are ready to admit that a dead black, opaque, object may cast, in special circumstances, a beautifully colored shadow upon a white surface, yet the fact can be shown in less than five

Fig. 1.—Plan view of box for producing colored shadows.

Fig. 2.—Front view of butterfly frame.

minutes wherever two candles, a sheet of black pasteboard, and two pieces of colored glass (red and green) are at hand.

With these implements a parallelepipedic box is erected upon a sheet of white paper, the top of the box being left open. Fig. 1 is a top view of box show-

A sensitive relay for wireless telegraphy.

ing the arrangement of the four pieces of glass and pasteboard.

A piece of black paper is then cut to about the shape shown on Fig. 2, and glued across a small piece of pasteboard. Fig. 2 is a front view of the whole. A top view is seen in the center of Fig. 1. The candles are placed as shown in Fig. 1, and every light but two candles being extinguished, it becomes evident that the paper bottom of the box remains as white as before in spite of the fact that colored light only now falls upon it. The vertical piece of black paper is now laid on the center of the box in the position in Fig. 1.

The result is a beautiful butterfly which appears on the white paper. Its posterior pair of wings is intensely red; the anterior pair is of a pure green color. White disks are seen on the corner of each wing.

These wings are but the shadows of the vertical piece of black paper, deposited in the middle of the box, and the reason why an opaque object may, in such circumstances, cast a colored shadow on a white surface lies in the fact that red and green lights are complementary and give white light wherever they fall together. On the other hand, wherever the opaque object intercepts the green light only, the paper remains red, and, similarly, wherever a shadow is cast for the red light only, the paper will be green.

If, instead of being placed so as to cast a shadow for one color only, the black paper intercepted both of them together, the result would of course be the ordinary dark and colorless shadow.