

## A BEAUTIFUL EXPERIMENT.

BY H. B. DAILEY.

To the many amateur experimenters in static electricity who have been lured into this fascinating pastime by the excellent chapters in "Experimental Science" devoted to this branch of physics the following beautiful experiment would, in the opinion of the writer, prove of more than ordinary interest:

A piece of slender glass rod or tubing is bent in an alcohol flame into the shape shown in Fig. 1. By means of the arrangement in Fig. 2, the glass is supported so as to revolve freely in an upright position, its lower end resting loosely in a shallow hole in the wooden base of the instrument, while its upper end is held in like manner by the horizontal wooden arm at the top of the insulating standard, S. A small wooden pulley, P, cemented to the lower extremity of the glass and belted by means of a thread on to the hand wheel, W, furnishes a means of rapid rotation. Along the whole length of the glass is cemented by means of shellac a very narrow strip of tinfoil, which is divided at short intervals with the point of a penknife; the foil on the two straight extremities being left intact.

The glass is set revolving and a current from an induction coil or influence machine is passed through the tinfoil, illuminating all the cut spaces. If the glass has been skillfully bent and the discharge is sufficiently rapid, the effect is one of startling beauty.

Persistence of vision transforms the revolving luminous glass into a perfectly symmetrical vase, glimmering, phantomlike, out of the darkness, and bedecked with thousands of jewels and flashes of shimmering light, having the appearance of the most delicately fashioned wire work, wrought in curves of sparkling fire. To insure the proper shape of the glass, a sketch of a vase of the desired form may be drawn upon a piece of smooth board and the glass made to conform with the outlines of one of its sides. The vase may be made 8 or 9 inches in height.

The ordinary spiral tube familiar to experimenters gives an exceedingly beautiful effect when revolved as above, the spiral being multiplied many times by persistence of vision.

## THE BOILERS AND BULKHEAD DOORS OF THE "CHICAGO."

The unarmored cruiser "Chicago" of the United States navy was one of the original vessels of the famous "white squadron." She was launched in 1884, and on her trial trip she made 15 knots with 5,083 horse power. It was decided about three years ago to make many changes in the "Chicago," and these changes, which are almost completed, will convert her into a fast cruiser of 18½ knots, developing about 9,000 indicated horse power. New engines, of course, were required, and they were built at the Brooklyn Navy Yard, as well as the boilers shown in our engraving. The Bureau of Steam Engineering adopted a combination of the cylindrical Scotch boilers and the sectional type. The engine room is next the four Scotch boilers, then comes the blower room, then the six Babcock & Wilcox boilers. The "Chicago" will be worked under forced draught on the closed stokehold system when running at high speed. Our engraving shows a pair of the Scotch boilers, which are about 1,000 horse power each. They are placed athwartships, and our illustration

supposes the visitor to be in the stokehold looking at one pair of boilers, while the other pair is at his back. The Scotch boilers all make use of a common stack, and at the level of the protective deck the stack is crossed by heavy armor bars which preserve the integrity of the protective deck.

The Scotch boilers were built at the Brooklyn Navy Yard and are made of nickel steel, the sheets being 1½ inches thick and the heads ¾ inch thick. The mean diameter is 13 feet 8½ inches and the length 10½ feet. The three corrugated furnaces are 3 feet 5 inches in dia-

expansion type. The cylinders are 33½ inches, 50½ inches and 76 inches, the stroke is 40 inches and the engines make 120 revolutions per minute.

We now come to another interesting feature of the reconstructed vessel—the bulkhead doors. Lord Charles Beresford says: "It is a fact that upon the loyalty of the watertight doors, when closed, and upon the assurance that they are properly closed, depends the power of a battleship to float when wounded by ram, torpedo or a gun. It has been authoritatively stated that the cause of the loss of the 'Victoria' was that

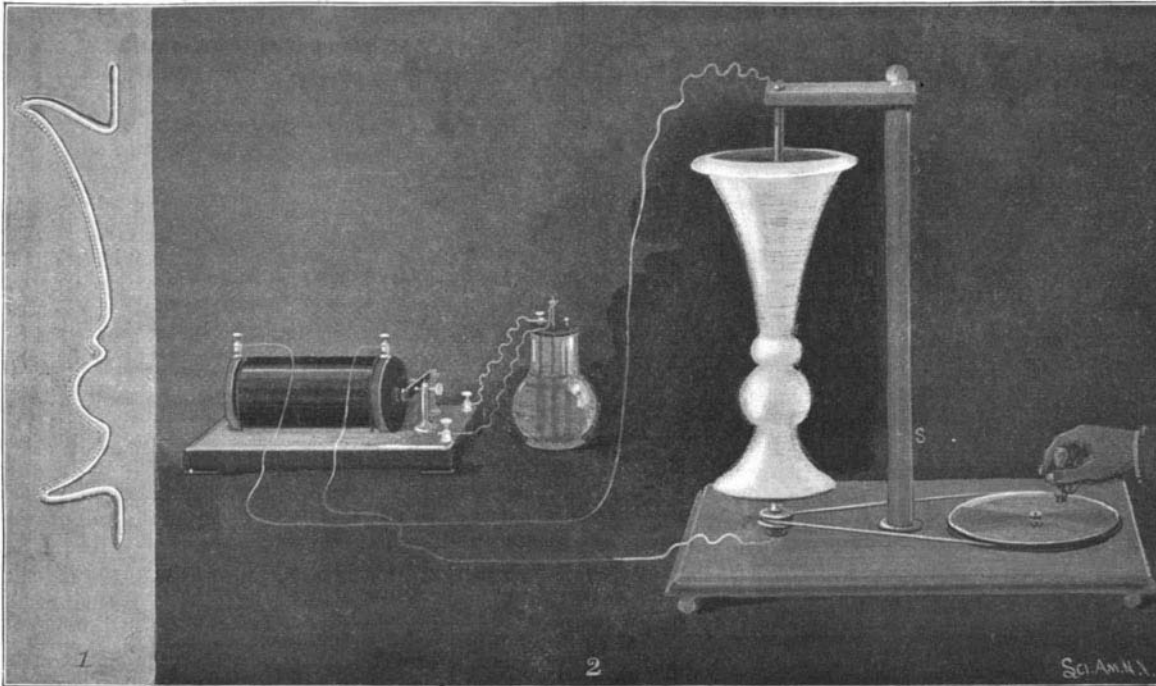
the watertight doors were not closed, and it has been constantly proved to be impossible to close watertight doors in an emergency, no matter how well disciplined and how gallant the ship's company may be. The system of closing the doors by evolution as to time invites an accident." Some very able experts contend that there should be no doors at all and that the main bulkheads should be intact to the main deck.

To the layman the number of bulkheads, doors, hatches and valves is extraordinary. Take the battleships "Indiana," "Massachusetts" or "Oregon," for instance; they have 272 watertight compartments, and the total number of watertight doors and hatches is 354. The number of valves for ventilating, draining and flooding hulls, including

sea valves and pump suction, and excluding all valves for motive power and auxiliaries, numbers 294, making a grand total of watertight doors, hatches and valves of 648. Valves are less important than doors and hatches, but when they guard a sluiceway, the passage of a ventilating pipe from one compartment to another, or a magazine flood cock, they involve the integrity of the ship in an emergency. It is hardly possible to exaggerate the sudden turmoil and shock of a collision in a seaway accompanied by fog and blackness, perhaps within as well as without the ship, the wild upheaval and stampede of being torpedoed, or the strain and jar of modern battle; and it requires about 110 men, excluding officers, to bring the cellular structure of the ship into operation when needed in the type of ship to which we have referred, so there is no wonder that ships go down when they have their skin punctured below the lower line, as for instance the "Vanguard," "Victoria," "Blanco Encalada," and "Elbe."

Many experiments have been tried and systems introduced for the instantaneous closing of all the bulk-

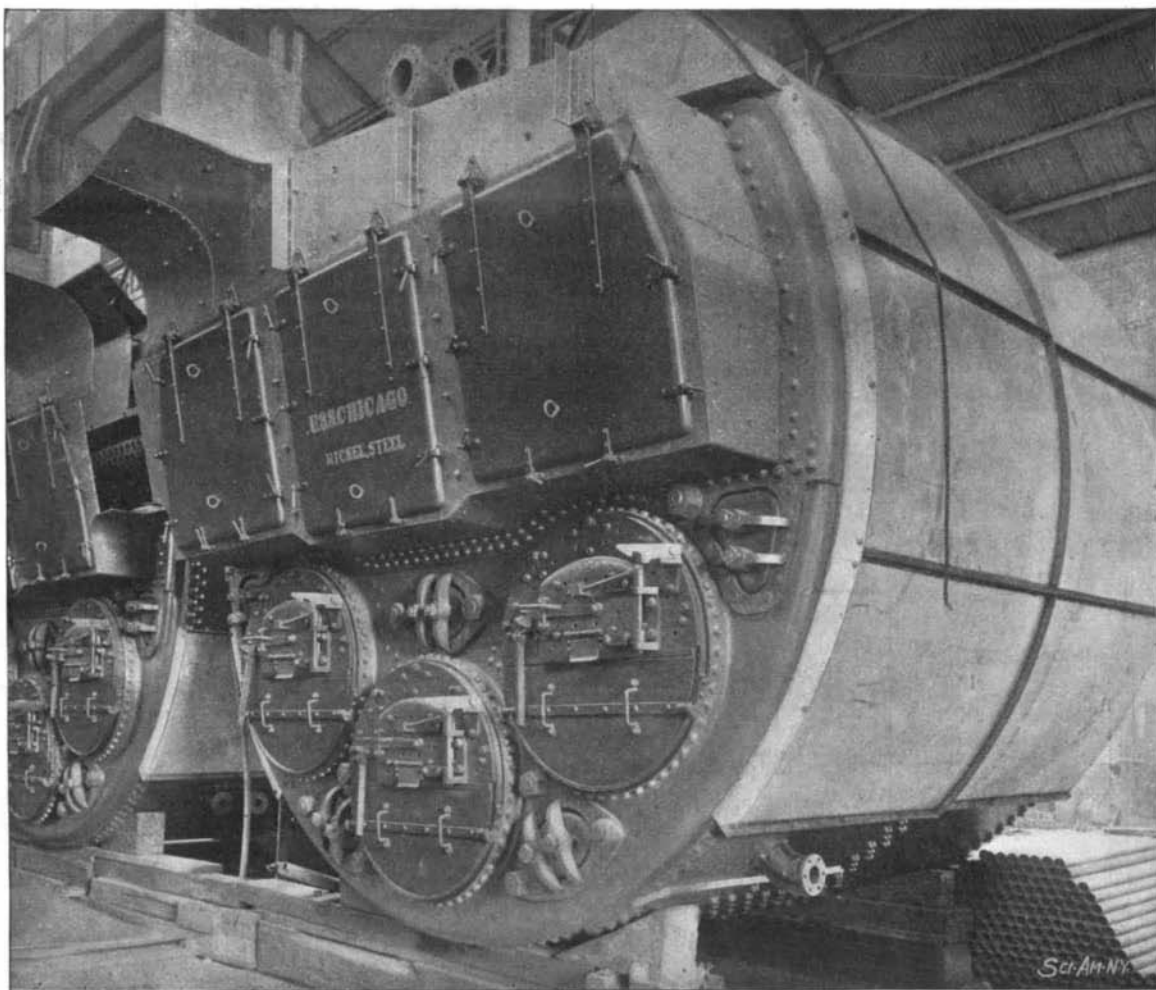
head doors in an emergency. We present some engravings of one of the most successful solutions of this problem—the "long arm" system of Mr. W. B. Cowles of the construction department of the United States navy. The cruiser "Chicago" as reconstructed is provided with an installation of this system. Mr. Cowles considered that a practically perfect system would be to tie together in assorted bunches the widely distributed devices in a ship, by bringing the connecting strings from each device to a switchboard for each bunch and then assemble the switchboards into one or more central stations, from which each device can be controlled by an operator, independently, and to arrange the devices as they are needed to be operated in case of an emergency, so that this can be done with precision and full knowledge, from a point where the emergency can first be discovered. Arrangements should also be provided so that neither the emergency operation nor any other can harm the attendant or take control



NOVEL ELECTRICAL EXPERIMENT.

meter and are all fired from the same stokehold. The length of the grate is 6 feet 8 inches. The outside measurement of the 417 tubes is 2¼ inches, and they are of a thickness of No. 10 Birmingham wire gage. The heating surface of the tubes is 1,770 square feet; the heating surface of the furnace is 134 square feet, of the combustion chamber 166 square feet, and of the tube sheets 66 square feet. The total heating surface is 2,138½ square feet. The grate surface is 68.33 square feet. The boilers are covered with magnesia covering. It is expected that the Scotch boilers will drive the ship at a speed of 13 nautical miles an hour, and with the water tube boilers it is expected that 18½ nautical miles an hour will be made. The six Babcock & Wilcox boilers have a total heating surface of 18,000 square feet and 360 square feet of grate surface, making the total heating surfaces foot up 26,550 square feet and the grate surfaces 633 square feet. The bunker capacity is 920 tons. The steam pressure is 180 pounds per square inch.

The twin screw engines are of the horizontal triple



A PAIR OF NICKEL STEEL SCOTCH BOILERS FOR THE RECONSTRUCTED CRUISER "CHICAGO."