

in case of any accident. This cutting out is to prevent any injurious effects from short-circuiting, in the case of fire in the building, when the switch board, being wet by water from the fire engines, might give occasion to this trouble were the current turned on.

The general operations of the office are facilitated by the use of the cash carrier railroad and by pneumatic tubes. An elevated gallery occupies approximately the center of the main operating room. An extensive system of cable cash carriers, embracing 16 radiating lines, with four to six stations on each line, connects with all parts of the room. By this the messages are distributed from and returned to the central gallery. The cash carrier runs at the rate of about 750 feet a minute, enabling the most distant part of the room to be reached in 10 seconds. Twenty-four pneumatic house tubes terminate in this gallery; and four street pneumatic tubes running north to 23d Street, and intermediate offices, and four running south to exchanges below Wall Street, are also operated from this gallery. All messages coming in or going out from the main operating room must go through this central gallery.

Fig. 2 of the drawings shows the time repeater. At noon, every week day, the time is transmitted from the United States Naval Observatory at Washington. This signal has to be sent out over many lines in all directions; at present 60 different lines transmit it. The time repeater includes 92 repeating magnets. These are operated on a local circuit, which in its turn is governed by a relay connected to the Washington circuit. The repeating points of the 92 magnets are connected by loops to the main line switches. This apparatus represents a multiplication of relays, and can be used for sending 92 repetitions of one message over 92 different lines by a single operator, and it is contemplated on election nights and similar occasions to thus use it.

The average business done in this office is over 100,000 messages per day. The longest circuit is that extending from New York to San Francisco, about 3,400 miles long. Of the 750 lines leaving the building, the greater part are operated by the Morse system, the majority of the operators' desks seen in the engraving being devoted to this system. Besides this there are four Wheatstone, 42 duplex and 92 quadruplex lines, and two lines occupied by combination printing instruments. The office accommodates about 800 operators. Our thanks are due to Mr. Alfred S. Brown, Electrical Engineer of the Western Union Telegraph Co., for courtesies received.

Improvement in Stokehold Ventilation.

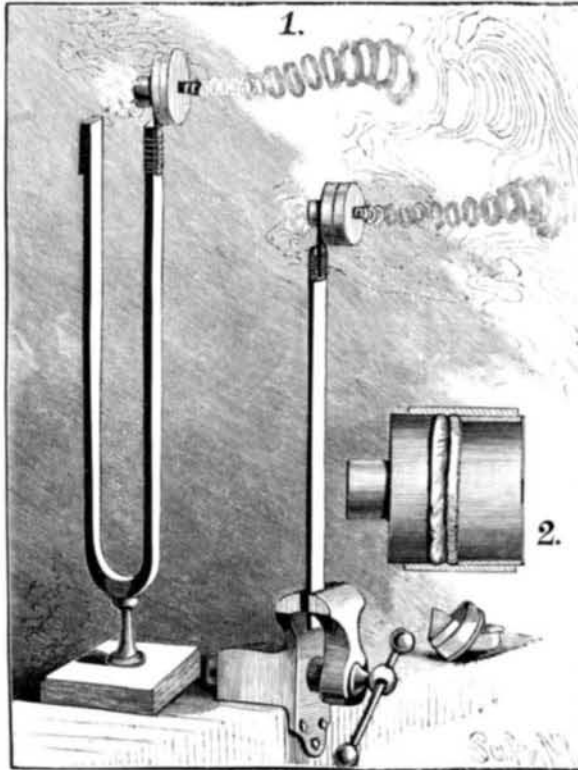
By the system of Mr. W. H. Martin the usual unsightly ventilating cowls on deck are done away with, the necessary down draught being obtained by the utilization of the heat radiated from the main boilers and uptakes. This lighter air is allowed to rise up through an enormous space between an inner and outer funnel, causing a powerful down current of fresh air through the stokehold combing, at the same time thoroughly preventing the rising of any smoke or dust to the deck, as is usual when cleaning fires and quenching ashes. To insure the fresh air reaching the stokehold floor, there is a light air-tight screen or bulkhead built in front of each end of the boilers, reaching from the deck right down to within 6 feet from the stokers' floor, the lower part being on hinges to allow access to the smoke box doors. As the whole of the air drawn off by the annular funnel space, to which is to be added that needed for combustion in the furnaces, has to pass down in front of these air screens, the result is a powerful draught of fresh air at all times, independent of the direction or force of the wind on deck, keeping the stokehold at a temperature considerably lower than in the sunshine on deck, and but from 5° to 15° Fah. above that in the shade. This system, which is much more economical than the fan, is in use on most Dutch steamers trading to the East Indies, and has proved to be of great value.

Four electric fans have been placed by the Crocker Wheeler Company in the turrets of the powerful iron vessel Miantonomoh, the intention being that they shall blow away the smoke from the guns.

AN EXPERIMENT IN ACOUSTICS.

BY GEO. M. HOPKINS.

In the annexed engraving is shown a very simple and effective method of indicating visibly the vibrations of a reed, tuning fork or diaphragm. It is not assumed that it can replace any of the existing methods of rendering visible indications of sonorous



VIBRATIONS SHOWN BY SMOKE RINGS.

vibrations, but it adds another very pretty acoustic experiment to the list of those already known.

In Fig. 1 are shown two forms of apparatus which yield practically the same results. In one a reed is clamped in a vise at one end and provided at the other end with slip of wood attached firmly by a wrapping of thread. To the wooden slip is glued an ordinary paper pill box, having a diameter of about two inches and a depth of $\frac{3}{4}$ inch to 1 inch. In the bottom of the box is made a 1 inch hole in which is secured the

end of a paper tube 1 inch in diameter and about 1 inch long. The cover of the box is perforated with a $\frac{1}{4}$ inch round hole. If the material of the cover is coarse and thick, a larger hole is made and over it is glued a piece of fine thin Bristol board, which is perforated with a $\frac{1}{4}$ inch round hole.

In the box thus mounted is placed a strip of blotting paper bent into V-shape and rendered non-absorbent at the bend by means of melted wax paraffin or something of a similar nature. One end of the blotting paper is moistened with hydrochloric acid and the other with aqua ammonia. The particles of ammonium chloride which form by the combination of the vapors of ammonia and hydrochloric acid are so minute as to float in the air like particles of smoke.

When the reed is vibrated, a minute vortex ring is formed at each excursion of the box and thrown off in the manner illustrated. A reed having a low rate of vibration (say 32 or less per second) is required, and the amplitude of vibration must be small.

When the box is attached to a tuning fork, the action is prolonged. It is, of course, necessary to compensate for the box on one limb of the fork by a weight on the other.

In Fig. 2 is shown a cylindrical box considerably larger than those already described. It is divided into two compartments by a thin rubber diaphragm, and closed at the front, with the exception of a $\frac{1}{4}$ inch round aperture. Blotting paper, charged with hydrochloric acid and ammonia, is placed between the diaphragm and the apertured front, and sounds are uttered in the short tubes projecting from the box. The vibration of the diaphragm causes puffs of air to issue from the small aperture at the front of the box, carrying the fumes of ammonium chloride, which render the vortex rings visible. The sounds uttered are necessarily of very low pitch. If the vibrations are too frequent in any of the forms of this experiment, the rings merge into each other and the effect is lost. In the apparatus shown in Fig. 2, a mere flutter of the tongue or lips gives good results.

It is obvious that a burning substance capable of yielding a good volume of smoke will answer quite as well as the ammonium chloride.

DISTINGUISHED ELECTRICIANS.

The portraits here presented represent men who, while they have achieved notability in the electric world, have, in so doing, shown that they possessed the requisites for success in any branch of work. Untiring industry, great ingenuity, and a belief in themselves would have made them great in any of the executive departments of life. Thomas Alva Edison's story has been told so often that it cannot but be a trite one. He was born on the 11th of February, 1847, at Milan, Ohio. He began life at the age of twelve as a train boy, soon advancing to be a news dealer with four young assistants. He then began practicing telegraphy, and at last obtained a position in Port Huron. He soon began to invent, and in 1864 he moved to Memphis and had one of his inventions, an automatic repeater, put into service. He struggled along, inventing, working at his profession, and experimenting, until he went to Boston in 1868, where he was able to open a workshop for developing his inventions. Shortly afterward he was retained by the Western Union Telegraph Company, and started an electrical laboratory at Newark, where he employed 300 men. In 1876 he moved to Menlo Park, New Jersey, and in 1887 left Menlo Park and erected in Orange, New Jersey, what is supposed to be the largest experimental laboratory of its kind in the world. His inventions, which are numbered by hundreds, center largely on electricity, although one of the most wonderful of his achievements, the phonograph, is not an electrical invention at all.

Alexander Graham Bell was born in Edinburgh, Scotland, March 3, 1847, being therefore almost exactly the same age as Edison. His father and grandfather were both language teachers, and the young Bell's attention was directed to language by the course of studies prescribed by his father. The synthesis of artificial speech, by Helmholtz's method, is said to have early engaged his attention, and he resolved to pursue one of the outcomes of his studies, multiple telegraphy,



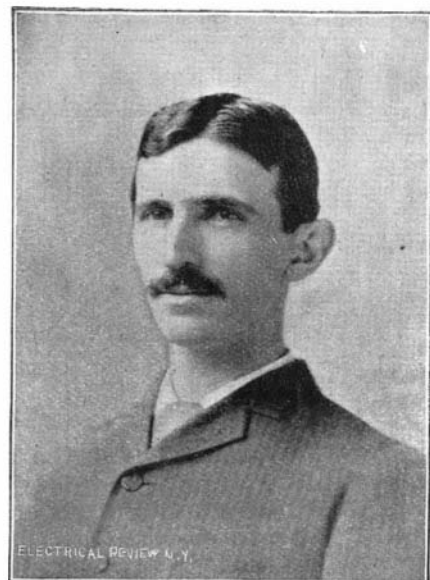
THOMAS A. EDISON, ORANGE, N. J.



PROF. ALEXANDER GRAHAM BELL, WASHINGTON.



PROF. ELIHU THOMSON, LYNN, MASS.



NIKOLA TESLA, NEW YORK.

DISTINGUISHED ELECTRICIANS.