

5,000,000 Volt Artificial Lightning

Physics

How man is learning to out-Jove Jove by controlling the lightning, how radio is giving eyes to aviation in all kinds of weather, and how new Robots are permitting power stations to be controlled without any human attendance, were among the interesting subjects presented at the recent New York meeting of the American Institute of Electrical Engineers and here described.

Artificial lightning of 5,000,000 volts is now produced in the experimental lightning laboratory of the General Electric Company at Pittsfield, Mass., F. W. Peek, consulting engineer, told the American Institute of Electrical Engineers..

The previous record was 3,600,000 volts, but higher voltages are now obtained by the use of a radically new method which, in effect, throws into series four or more of the smaller lightning generators.

Full-size test sections of transmission lines, poles and electrical machinery are attacked by the artificial lightning to determine how apparatus in service can be protected from real lightning.

Mr. Peek and his fellow-engineers go hunting for actual lightning striking transmission lines and buildings during storms. By photographing the New York skyline during storms he discovered that a tall structure like the Woolworth Building will protect from lightning smaller buildings within a cone of which it is the center. This fact was first suggested by allowing lightning to play over model villages.

Even 5,000,000 volts is a mere fraction of the potential of the actual electrical discharges from clouds. The voltage of the usual lightning flash is about 100,000,000 volts at 100,000 amperes. This represents a thousand billion horsepower and an energy of four thousand watt-hours. And the whole performance is complete in a few millionths of a second.

Although most of us consider lightning an accompaniment of summer storms, thousands of electrical storms are in progress in various parts of the world continuously. Mr. Peek estimates that the total energy dissipated in the world by lightning is continuously 1,200,000 kilowatts.

Radio to Make Airways Safe

Radio beacons, marking the air routes of the nation, will soon make it possible for airplanes to fly safely in fog and passengers to rely on the timetables of the airways, Dr. J. H. Dellinger, chief of the radio section of the U. S. Bureau of Standards, predicted.

Dr. Dellinger told of a practical test of the radio beacon developed in his laboratory. The day was misty and the weather charts read "low visibility." The pilot who had never flown the route was relieved of all his maps. His only instructions were to fly from Philadelphia to Washington, using as his guide the radio beacon. The beacon-indicator led him accurately to the College Park Field outside of Washington, the sudden deflection of his indicator told him his journey was ended and he landed safely on a field he had never seen.

How Beacon Works

"The directive radio beacon is a special kind of radio station, usually located at an airport, just off the landing field," said Dr. Dellinger. "Instead of having a single antenna like an ordinary station, it has two loop antennas at an angle with each other. Each of these emits a set of waves which is directive; that is, it is stronger in one direction than others. When an airplane flies along the line exactly equidistant from the two beams of radio waves, it receives signals of equal intensity from the two. If the airplane gets off the line it receives a stronger signal from one than the other.

"The indicator on the instrument board of the airplane shows when the signals from the two beams are received with equal intensity, by means of two small vibrating reeds. When the beacon signal is received, the two sets vibrate. The tips of these reeds are white in a dark background, so that when vibrating they appear as a vertical white line. The reed on the pilot's right is tuned to a frequency of 65 cycles and the one on the left to 85 cycles. It is only necessary for the pilot to watch the two white lines produced by the vibrating reeds. If they are equal in length, he is on his correct course. If the one on his right becomes longer than the other, the airplane has drifted off the course to the right. If he drifts off the course to the left, the white line on the left becomes longer. Thus if the pilot leaves the regular course either accidentally or to avoid stormy area, the radio beacon will show him the way back.

"The whole receiving system comprises a small indicator unit on the instrument board weighing one pound, a receiving set weighing less

than 10 pounds, and a 10-pound battery. The same receiving set can be used to receive radiotelephone messages, by plugging in a pair of headphones. The receiving system is very little affected by interference, including static, other radio stations, and airplane ignition interference, which has hitherto been the bar to satisfactory use of radio on airplanes.

"The beacon stations will probably be placed at airports in general averaging about 200 miles apart. The Airways Division of the Department of Commerce Aeronautics Branch has begun a program of installing them on the various airways. The directive beacons, with a straight airway between them, will be supplemented by small marker beacons at intervals (perhaps 20 miles) along the route. These are simply very low-power radio transmitting stations serving as mileposts. A characteristic signal from a marker beacon will show on the visual indicator aboard the airplanes when that point is being flown over."

Cable Could Guide Ship

The traditions and principles of water navigation were criticized by Robert H. Marriott, consulting engineer of the Federal Radio Commission, who pointed out that although an electrical cable could be laid in New York harbor that would allow a blindfolded helmsman to follow the channel, such a device is not used.

"Such a device has been proposed time and time again and our Navy spent a great deal of money in demonstrating its practicability," Mr. Marriott declared before the institute.

The channel marking device is comparatively simple, Mr. Marriott said. The transmitter includes a single conductor cable laid in the bottom of the channel, through which alternating current of say one thousand cycles is conducted to its outer end which is grounded. The receiver on a steel vessel includes two flat coils of wire hung on the port and starboard sides of the ship, parallel to the ship's sides and connected to two head phones or other indicators. When the keel of the ship is steered directly over the cable the responses from the two coils will be equal. When the ship gets off on the starboard side the greatest response (*Turn to next page*)

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will come from the port-side coil and vice versa. until the ship is brought back to where it should be.

He also urged that submarine sound beacons and radio beacons be utilized to a greater extent in navigation. Using an echo to tell the depth of the ocean is another navigational method that should be more widely used.

Aviation is using modern navigational methods more widely than sea navigation. Mr. Marriott described the radio compass, the earth inductor compass, the radio beacon, and the newer methods of finding the altitude of an airplane above the ground.

New Switching Device

A new type of circuit breaker for use in switching the large amounts of electricity on transmission lines was described by engineers of the Westinghouse Electric and Manufacturing Company.

Large circuit breakers now in use usually require oil tanks for insulation and gradually reducing the flow of the current during the switching operation. The new deion breaker is oil-less and, as its name indicates, it operates by deionizing the arc. The current is allowed to arc and is then drawn over metal plates sufficiently fast to prevent burning them. The one large arc is broken up into a large number of short arcs and finally the arc streams between the two conductors are deionized and turned into a barrier to the current.

In 82 tests there were only two failures of the new circuit breaker to function properly, B. G. Jamieson of the Commonwealth Edison Company of Chicago reported. Dr. Joseph Slepian, research engineer, and R. C. Dickinson and B. P. Baker, Westinghouse engineers who participated in the development, described the theory and possibilities of the deion circuit breaker, at present applicable to currents up to 15,000 volts and 2,000 amperes.

Manless Power Plants

Power stations that run themselves and are watched by electric eyes that record their impulses miles away were described by a group of General Electric Company engineers to the meeting.

"Automatic performance has been applied extensively during the recent years to the generation, transmission and distribution of electrical energy," said the report. "Auto-

matic devices and equipments are very satisfactorily performing duties that were performed only a few years ago by operators. A large number of men heretofore performing important but minor duties have been released for more active and responsible positions."

To control the automatic machinery from a central point it is necessary to transmit to that point the readings of instruments.

In the future television may come to the aid of the electrical dispatcher by allowing him to look at the dials of instruments far distant from his post. But at present watching remote electrical stations by television is too costly and not practical.

A new technic of "telemetering" has developed as a result of the need of remote control. Over the transmission lines themselves, special cables or telephone lines, signals are sent to a central point and duplicate on dials and in records the reading on the instruments in the manless power plants.

Noise in Household Machinery

Noise in vacuum cleaners, electric refrigerators, motors and other household equipment is being attacked by research engineers of the Westinghouse Electric and Manufacturing Company. Thomas Spooner and J. P. Foltz explained some of the causes of annoying sounds from street railway motors and other electrical apparatus that sometimes disturb the peace of communities.

In their tests the engineers cannot rely on human ears to diagnose the noisy ills of machinery. A sound analyzer picks up sound of a given frequency, amplifies it, "listens" to it, and records its share in the "noise" on an electrical instrument.

Most of the noises in small electric motors are caused by gears, the sound of the rotating parts in air, and the vibration of the frames.

Magnetism Tests Metals

Magnetism, working silently without injuring metal, is a testing tool coming more and more into industrial and research use, Raymond L. Sanford, chief of the magnetic section of the U. S. Bureau of Standards, told the American Institute.

Case-hardened chain, heat-treated forgings and steam turbine bucket wheels are among the products now given a routine magnetic analysis to detect flaws and insure quality.

In exploring the qualities produced by new steel treatments, in determining the changes that take place during the cooling or heating of a ferrous alloy, magnetic analysis is used by scientists investigating the properties of materials.

Inspection of welds is facilitated by magnetic methods. Since welding is coming into larger industrial use, the magnetic test will facilitate the control of this modern method of joining metals together.

Edison Medal Presented

Dr. Frank B. Jewett, who as president of the Bell Telephone Laboratories has directed important research in telephony, was presented the Edison medal by the American Institute of Electrical Engineers.

The Edison medal is awarded annually and was established by associates and friends of Thomas A. Edison. Previous awards have been to such electrical leaders as Elihu Thomson, George Westinghouse, Alexander Graham Bell, Nikola Tesla, John J. Carty, W. L. R. Emmet, Robert A. Millikan, Michael I. Pupin, and William D. Coolidge.

Dr. Jewett is also vice-president of the American Telephone and Telegraph Company in charge of development and research.

Science News-Letter, February 2, 1929

Publicity or Secrecy

Psychology

G. K. CHESTERTON, in *The Illustrated London News*:

Essential secrecy has rather increased than decreased in the last few centuries. I know there is a general impression to the contrary, because of the wide space occupied by things like advertisement and publicity. But this is to misunderstand the very nature of these things. Publicity is not the opposite of secrecy. Publicity often means only the public praise for a secret process. It means the enlargement of trade marks, but not the diminishment of trade secrets.

Science News-Letter, February 2, 1929

The United States had more cases of smallpox this year than any other country reporting this disease, except India.

A goiter survey in Oregon shows that 36 per cent. of the girls have enlarged thyroids as compared with 22 per cent. of the boys.