PHYSICS

Sound Waves Prevent Smoke Belching From Chimneys

New Process Developed by Bureau of Mines Scientist Is Inexpensive Enough to Apply to Small Factories

UNFORTUNATELY the smoke-belching chimneys of industry denote the return of prosperity. Not that anyone believes prosperity as evidenced by renewed industrial activity is unfortunate; only the fuming chimneys. All too little realized still is the fact that smokeless chimneys can also be a mark of business and that it is not necessary to pollute the air man breathes to earn dollars by manufacturing.

Ever since soft, or bituminous, coal was discovered on the English seashores where the waves laid bare deposits—and the coal was called sea cole—the smoke nuisance has been literally on top of every busy community. Back in 1257 Henry III, the then King of England, had a moving day. His wife Eleanore removed from Nottingham to Tutbury Castle owing to the "unendurable smoke of the sea-cole."

Then as now commissions were appointed to study the problem but over 400 years later in 1661 John Evelyn wrote about the "hellish cloud of sea-borne coal which maketh the city of London resemble the suburbs of Hades."

Dr. E. R. Weidlein, president of the American Chemical Society and director of Mellon Institute for Industrial Research in Pittsburgh, Pa., has said:

"One of the biggest problems we are facing is the smoke nuisance. Smoke does not have a single saving grace. It is injurious to health. It is expensive in that it means fuel waste, high laundry bills, defacement of expensive buildings and lessened working capacity. Experts declare that throughout the United States smoke costs each inhabitant $16 annually.

Air Hygiene

Dr. Weidlein ought to know, for his laboratory was the source from which has sprung the newly organized Air Hygiene Foundation which is now in the forefront of smoke fighting in America.

It is a long way from Henry III's Queen Eleanore in both time and distance to Washington, D. C., in the year 1937, but recently the U.S. Bureau of Mines demonstrated a method of ridding chimneys of dust and smoke particles by the use of sound waves. The development because of its cheapness strikes at one of the most potent sources of industrial smoke—the small factory.

Developed by H. W. St. Clair, scientist from the Bureau's laboratories in Minneapolis, Minn., the precipitation of chimney smoke by sound truly works a seeming miracle. In his recent demonstration Mr. St. Clair filled a five-inch diameter glass tube with thick white smoke. Then he turned into the tube the sound waves of a high-pitched note of 7,000 vibrations a second. And at once the smoke particles began to cluster in striated levels down the length of the tube and wandered off to the walls and fell to the bottom.

Given to Public

The idea behind the method, for which patents have been applied (to be turned over free for the benefit of the public), is the simple experiment which everyone who has ever taken a course in physics must have performed.

Remember the long glass tube on the inside of which you sprinkled that yellowish, brown powder. How you put a stopper at one end and inserted a plunger device at the other. Then you applied rosin to the metal rod of the plunger and pulled a rag over it and created a shrilling sound of high pitch.

Immediately the brown powder—it was probably cork dust—danced up and down in the tube and gradually settled into certain spots just the length of the sound wave apart. The intervening spaces cleared up and became rid of the dust.

In that experiment, whether you remember it or not, you generated standing waves of sound that bounced back and forth in the tube from one end to the other and created regions where there was a maximum amplitude of sound wave vibration called anti nodes and then, alternately, regions where there was a minimum of vibration, called nodes. The experiment showed that the dust was kicked out of the anti node areas and deposited in the nodal region.

The St. Clair experiment with smoke precipitation uses this long known phenomenon except that the standing sound waves run vertically up and down the smoke stack, instead of horizontally. In actual practice the smoke and flue gases would be run in at the bottom on the side of the chimney and come out at the top, also on the side. And all the while the sound waves bounce up and down in the stack to precipitate out the particles.

Tried Out

Mr. St. Clair's method of smoke particle precipitation is completely in the experimental stage in America, but small pilot plant operations have been tried out in Germany in the past year or two. What success it will have, if and when it goes into real commercial operation is something which cannot be answered at the present time.

The first question which any one acquainted with the field of smoke stack flue particle recovery is, "How does it compare in effectiveness with the Cottrell electric method and also in cost of installation and maintenance?"

BATTLING SMOKE

In this experimental tube, H. W. St. Clair, U. S. Bureau of Mines scientist, demonstrated his new method for precipitation of smoke.

This well-known and widely used technique, developed by Dr. Frederick G. Cottrell of Washington, D. C., uses a powerful electrostatic field to attract the particles in the smoke which it is desired to remove. But its sizable cost of installation (getting proper electrical insulation and protection runs into money) has limited the number of Cottrell units throughout the world to hundreds only. For an effective reduction of the smoke nuisance thousands of installations would be required in the small industrial plants which now feel they cannot afford the costlier equipment.

Not for Fog

The answer to the question on the relative merits of the Cottrell and St. Clair methods is that one has to know something about the cheapness of a real installation and not merely a laboratory demonstration model. It seems as if the St. Clair method might be cheaper but no one yet really knows.

At the recent demonstration of St. Clair's device in Washington, Dr. Cottrell was asked what the possibility might be of using the system of sound waves to clear fog from an airport and the idea that enemy smoke screens in time of war might effectively be dispelled by the method. He smiled and shook his head. No.

The system, he indicated, relies on the use of standing waves to bring about the clearing phenomenon. It works nicely inside a tube or chimney but to try it on an airport would be most difficult in that the sound waves would spread in all directions, including upward, and so much of their energy would be lost. As for using the device in wartime, Dr. Cottrell merely pointed out that if the enemy would let you set up a large reflecting surface behind their lines you might have hope of creating some standing waves and dispelling their smoke screens.

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DOWN IT GOES

As a high-pitched sound is originated when the bulb is pressed, the dust collects in layers and then falls to the bottom of the chamber.

PHYSICS

Sticks to Old Viewpoint to Interpret Transmutation

Professor Bohr Surprises Physicists With Idea That Nucleus Has Temperature and Use of Thermodynamics

INTERPRETING the transmutation of the elements, by the changing of their atomic nuclei, must be considered from the old statistical point of view of thermodynamics rather than exclusively by the newer quantum theory, said Prof. Niels Bohr of the Institute of Theoretical Physics at Copenhagen, speaking at the meeting of the American Physical Society.

Prof. Bohr, one of the world's great physicists, is a past winner of the Nobel Prize and best known for his atomic model called the Bohr atom. This model and the relatively simple theory which produced it are no longer used in the front rank of thinking on atomic problems, but at the time of its inception more than 24 years ago it was a major forward step in science.

Prof. Bohr believes that modern atomic theories which treat the behavior of individual atoms, particles and nuclei are bound to fail when used on heavy atoms like lead which contain over 200 protons and neutrons in the nucleus. One must, he indicated, revert to the well-known laws of thermodynamics which have been used for 100 years to treat physical phenomena where a large number of particles are involved.

In barest outline Prof. Bohr examines, mathematically, a heavy atom like lead, forgets its individual internal particles and treats it as though it were a tiny drop of water or mercury with a myriad of particles in it. Such a theoretical droplet of nucleus would have such an enormous density that if it were as large as one cubic centimeter, its weight would be over 100,000,000 tons.

Under normal conditions, Prof. Bohr shows, the tiny droplet may be thought of being at a fairly low temperature.

During experiments in which such a nucleus is bombarded with neutrons, however, the first effect of the impact is to raise the effective temperature to the inconceivably high level of some 50,000,000,000 degrees Centigrade.

At such temperatures the particles within the nucleus, suggests Prof. Bohr, go into a state of violent thermal agitation. Some of the nuclear particles will "evaporate" and be hurled off with energies amounting to several million volts.

As soon as excess energy is liberated in this fashion the nucleus will "cool" down to lower temperatures and the evaporation will cease. Any residual energy will be radiated in the form of gamma rays until the nucleus has cooled to its normal temperature.

The main point of Prof. Bohr's new thinking on atomic physics which interests and even shocks some physicists is the idea that a nucleus can be thought of as having a temperature and that the evaporation of particles can be treated by thermodynamics.

By making detailed calculations based upon this idea Prof. Bohr was able to explain a number of phenomena which have been observed to take place when atoms undergo transmutation from one kind to another. In carrying out his calculations Prof. Bohr finds it necessary to use some of the ideas inherent in the more modern quantum mechanics. There is little doubt that the new Bohr theory, if proved successful, will be quickly accepted and welcomed by all physicists.

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