AN IMPROVED OZONE GENERATOR.

BY CHARLES H. COAR.

In 1875 Van Marum, a noted chemist, discovered that the passage of electric sparks through the air produced a peculiar odor, but neither Van Marum nor his fellow collaborators were able to define the gas which emitted this odor, nor could they analytically reduce it to its constituent elements. In 1840, however, Schonbein, an eminent scholar who occupied the chair of chemistry at the University of Basel, Switzerland, in prosecuting his inquiry into the nature of the gas generated by the application of electric sparks to the air, discovered that the oxygen of the air when exposed to the action of electricity of the proper potential underwent a great change; the volume was contracted and it acquired properties that were remarkably different. For instance, its weight was increased and its chemical activity greatly enhanced. This change, it has been proven, consists of a conversion of the oxygen into an allotropic modification which has received the name "ozone" (from the Greek *ozo*—I smell), an allusion to its peculiar odor. Ozone is an allotropic form of oxygen which is absolutely decomposed at 270 degrees, and partially decomposed by any lesser degree of heat, so that it at once follows that it is impossible to convert oxygen into pure ozone by the direct application of electric sparks, for while they form ozone they also decompose it. This may make the ozone dangerous, as there is no certainty as to how far it may go. Supposing the ozonization to have reached a certain proportion, each additional spark, besides producing ozone, will decompose part of that originally produced, as the sparks oxidize nitrogen of atmospheric air more rapidly than does the silent discharge, and the product of this is largely composed of oxides and other poisonous gases.

Ozone, even at ordinary temperatures, will gradually relapse into its original state of plain oxygen, and ozone once decomposed by heat or otherwise becomes oxygen and must be subjected to the action of the electric current again, so that obviously the lower the temperature of oxygen or air electrically treated, the greater the chance of the ozone to remain active. The ozone of nature is generated without heat and is delivered without oxides or obnoxious gases as is the case when it is chemically prepared or generated by the means heretofore known to science by electrolysis of water solutions, etc. The ozone of nature is a colorless gas that is always especially plentiful in high altitudes, and is ever present in the atmosphere to a more or less degree owing to conditions and circumstances. In converting oxygen into ozone, the action of the electric current is to compress the oxygen into a less number of molecules, being three molecules into two.

In the course of experimentation to which, for nearly three quarters of a century, ozone has been subjected, it has been fully demonstrated that pure, or relatively pure, ozone exerts a powerful therapeutic influence upon the respiratory organs, through its action upon them, destroying all germ life in these organs. It is penetrating and leaves a chemically metallic taste in the mouth of one using it which is not easily dissipated or forgotten. Pure ozone properly applied tends to purify and also increase by this means the blood stream, and all the weakened tissues. It is especially valuable in the treatment of diseased respiratory organs and should prove one of the most important factors in the treatment of tuberculosis. The ozone of nature has always been found of great value medicinally, it not being uncommon for physicians to send patients for treatment to such parts or portions of the country as are well supplied with the ozone of nature. The ozone of nature has insufficient strength to be of any value commercially, and consequently scientists have endeavored to devise some means to generate it mechanically and still keep it pure as the product of nature. Heretofore the manufactured ozone has had too many foreign gases mingled with it to be of any value therapeutically or commercially.

The ozone generator illustrated in this article is a recently invented apparatus for generating pure ozone, in which the oxygen is electrically ozonized without contact with heat or flame, which in consequence means no increased temperature. These are not desirable in the production of pure ozone, as any contact with them tends to produce nitrous fumes and oxides from nitrogen only, which, when inhaled and subjected to the moisture of the breath, produce nitric acid from the fumes and chemical changes in the oxides, either of which is undesirable. The generator, as will be described, is extremely simple and generates an unusually large percentage of relatively pure ozone from a given quantity of oxygen of the air or pure oxygen if desirable. The generation of ozone in this apparatus is effected directly from the air by means of an interposition of dielectrics between the terminals of the converting device or generator proper, which have points in contact with the dielectric throughout their entire surface, thus doing away with the unfortunate air gap of former methods, over which the current must leap of necessity, thus creating heat or sparks which act, as heretofore stated, directly upon the nitrogen of the air, decomposing it into injurious gases as well as creating oxides. In this instance the method of placing the dielectrics in the converter has obviated the necessity of employing extremely high voltages such as were heretofore used.

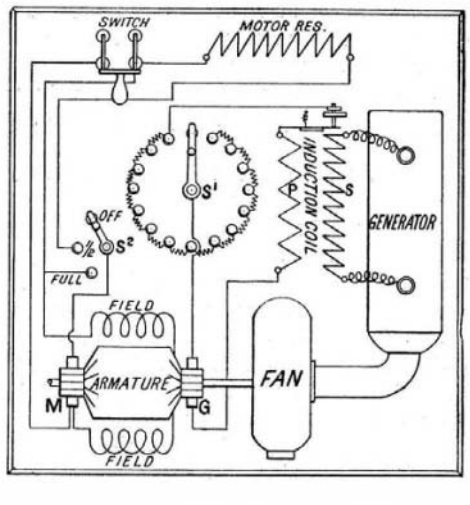

Fig. 3.—The Circuits of the Ozone Generator.

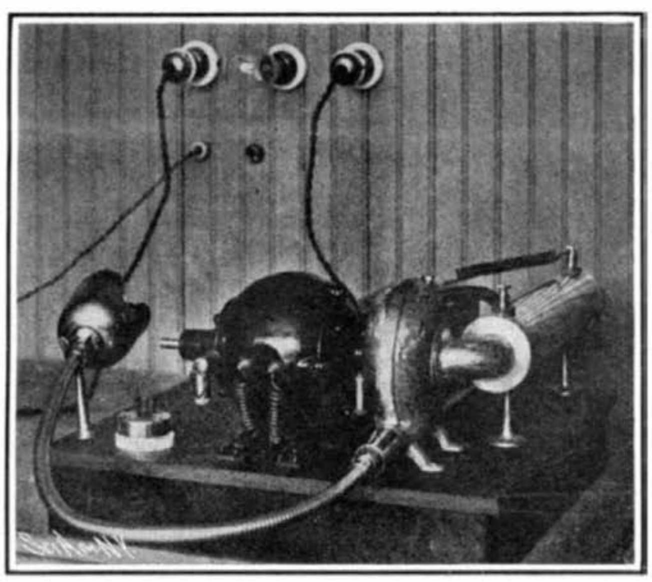

Fig. 1.—General View of the Apparatus.

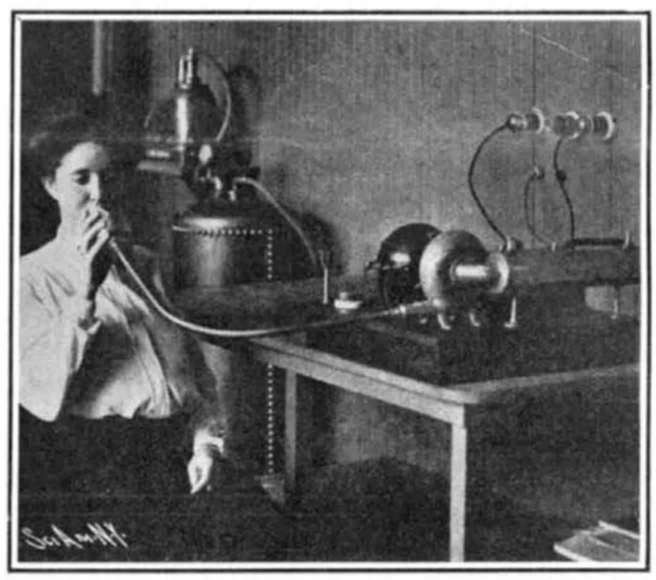

Fig. 2.—The Apparatus in Use.

The complete generating outfit as shown in Fig. 1 is very compact, being mounted on a base 17 inches square. Fig. 2 illustrates the method of applying the set during medical treatments. Fig. 3 shows the assembly and circuit arrangement of a set designed to be used where direct current is available for propelling the motor. The sets are also designed for use where alternating current is available, but in this case the motor equipment is dispensed with, a small step-down transformer being used to transform the current down to approximately five volts, at which pressure it is delivered to the induction coil. The direct-current set is supplied with a small 1/40-horse-power motor generator set, running at about 1,800 revolutions per minute. The generator end, *G*, of the motor set has about 10 watts capacity and delivers current at five volts pressure through a regulating rheostat, *S*¹, to the primary winding, *P*, of a ¾-inch spark coil. The motor end of the set is connected to the outside source of current by means of an ordinary lamp plug and socket, the current consumption being approximately the same as is required for a 16-candle-power lamp, and thence through the double pole switch and motor rheostat to the armature and field windings. The motor also propels a 4½-inch fan which creates a suction of air through the converter and causes the generated ozone to be delivered by means of a flexible tube connected thereto to the point of usage. During operation the generator delivers current to the primary winding of the induction coil, which is equipped with a make-and-break contact causing a potential of approximately 6,000 volts to be generated in the secondary winding, which is connected to the converter as shown. The converter shown in Fig. 4 is composed of a plated tube 2½ inches in diameter by 9 inches long, one end of which is open for the admittance of air while the other end is connected to the suction fan and flexible tubing as mentioned. Inside this tube are placed five conducting plates alternately connected to common terminals but insulated from each other by dielectrics composed of French glass plates, *G'*. The conducting plates are 5 inches long and 1¼ inches wide and are composed of two narrow fiber strips, *F*, each being provided with a narrow slot for the admittance of crimped narrow aluminium ribbons which are fastened therein between the two fiber strips in such manner that a screen is formed which will have many points in contact with the plate glass dielectrics. The small aluminium ribbons are bonded together by an aluminium wire extending through in contact with each individual ribbon in the one strip or conducting plate in such manner that they become as one conductor. This aluminium wire is brought out and connected to its proper terminal as shown. Such a plate is placed between two glass dielectrics, so that it forms what may be termed a ventilated condenser, each glass dielectric having contact with different aluminium conducting plates on opposite sides. Three of these aluminium plates are connected to a common terminal which in turn is connected to an insulated binding post mounted upon the containing tube. The two remaining aluminium plates are connected in common with two small tin-foil strips, *T*, which are placed in contact with the outside surfaces of the two outer glass dielectrics, and the common terminal thus formed is connected to the remaining insulated binding post. This arrangement is shown in Fig. 4. The different plates and dielectrics are bound together in a square form by mica, *M*, and the whole snugly fits into two fiber washers, *W*, which fit inside the containing tube. In this mounting the form is slipped into the tube and the electrical connections made, after which melted paraffin, *P'*, is poured about the ends and allowed to set, thus preventing the passage of air through the tube excepting through the openings provided in the aluminium plates as shown in the end view.

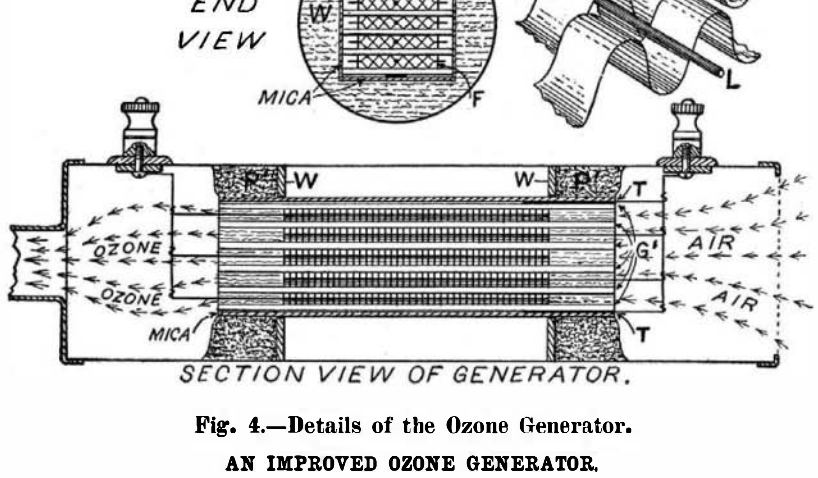

Fig. 4.—Details of the Ozone Generator.

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During operation the voltage delivered from the secondary winding of the induction coil to the aluminium plates causes a Brush discharge to occur between the various plates and dielectrics, thus converting the oxygen sucked in by the fan into ozone. There is in this arrangement a perfect effluvium of electricity between the aluminium plates and dielectrics, because of their nearness to each other and the many contacts present, which is comparatively silent and cold, a condition necessary and ideal for the generating of the purest ozone. A generator similarly constructed but of much larger proportions, is being extensively employed of late in flour mills, the arrangement being to subject the grain to drafts of ozone, which tends to destroy fungous growth, insect eggs or any form of bacteria as well as accomplishing other desired results in the finished and by-products.

New Applications of Compressed Air.

Apart from its extensive employment in tunneling and foundation work, compressed air is being applied in rapidly increasing measure to various branches of engineering work with much advantage, says the Engineering Review. Pneumatic tools such as hammers, riveters, calkers, drills, and the like are fairly universal, but in addition to these, various new appliances of quite different character are now finding extensive use. The adaptation of compressed air for raising water is a natural and logical application. Various devices have been employed and are constantly being developed for this purpose. Some of these, such for instance as the air lift and forms of the direct displacement pump, fully hold their own by reason of convenience or compliance with conditions prohibiting other apparatus. But all appliances of the kind suffer from the drawback that they are not economical in operation. The chief objection to the direct displacement compressed air pump is that it does not utilize the potential energy of expansion and allows the air to escape at full pressure. This disadvantage is obviated by the return-air pumping system which embodies a most important invention. While the familiar direct displacement pump receives for each charge all the compressed air it will hold and rejects all of it, the return-air pump, working in a similar way, only uses the power actually necessary, and returns the balance to the intake side of the compressor. The return impulse of the air during expansion converts the displacement pump into an economical machine, and opens up great possibilities of additional uses for compressed air in permanent pumping plants in connection with water supply installations, and, in fact, for raising any liquids that can be dealt with by other pumps. Another new invention related to the return-air pump, although employed in quite a different direction, is the electro-pneumatic rock drill. This machine is of revolutionary character in design. The drill has no valve or valve motion. A small air compressor is fitted near the drill to be operated; two pieces of hose each connect one end of the compressor with one end of the drill cylinder, and there are no valves or obstructions to prevent the free flow of the air through the hose or into or out from either cylinder. The compressor is driven by a small electric motor mounted upon the same frame. As the compressor piston moves to and fro, the pressure rises in front of it and falls behind it, causing alternations of pressure at the two ends of the drill cylinder, and thereby operating the drill piston. After the first charge no additional air is taken in, except to compensate for leakage, and none is discharged. The drill piston is checked at each end by the elasticity of the air so that the force is not lost, but is transmitted to help the next stroke. Thus the important economy of the return-air pump is reproduced in another way. The new form of drill has been worked under exacting conditions for several years in this country.

Volcanic Dust Fog.

M. Stanislas Meunier, the well-known authority upon meteorological effects, gives an account of a phenomenon which occurred at Paris and which was no doubt caused by the eruption of Vesuvius. On the morning of the 11th of April a dry and yellowish fog extended over the city. It was strong enough to interfere with the navigation on the Seine, and the sun appeared under a peculiar aspect. Supposing that this phenomenon might be caused by the eruption of Vesuvius, M. Meunier placed upon the roof of his dwelling a series of plates covered with glycerine so as to retain the floating dust. These plates when treated with water gave a rather abundant deposit in which soot and organic matter were visible to the naked eye. The fine portion of the deposit, which was separated by the Thoulet heavy liquid, gave an extremely fine sand, and a microscopic examination of this confirmed M. Meunier's idea.

Comparison of this sand with the ash sent up by Vesuvius in 1822, of which he had a sample, showed a complete identity with the latter. The main difference consists in the presence of some perfectly spherical globules of oxidized iron in the Paris dust. We may, therefore, admit that the fog seen in Paris was caused by the very fine dust sent up from Vesuvius.

A HOME-MADE EQUATORIAL MOUNTING FOR TELESCOPES.

BY CARL L. GRUPPEN.

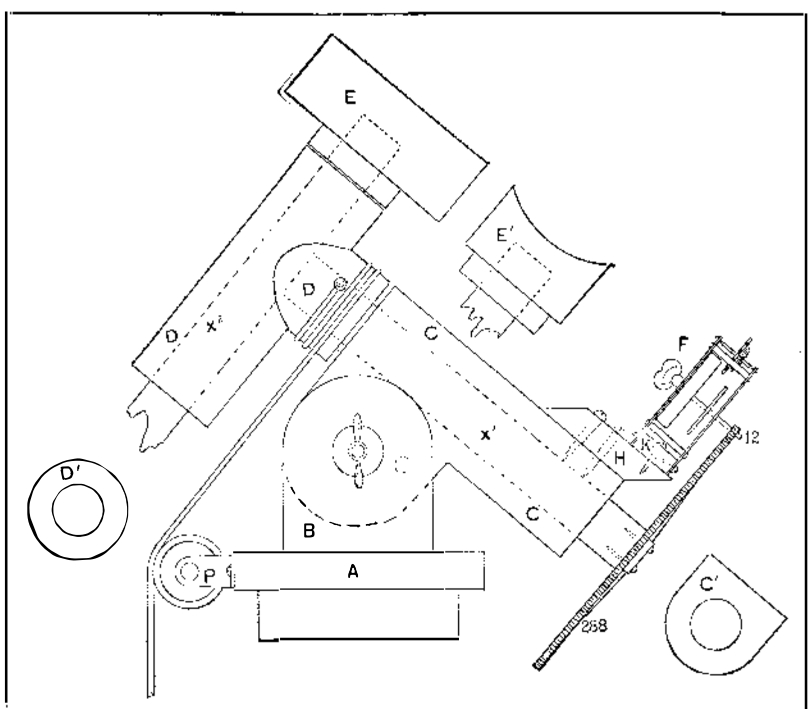
The accompanying illustration shows an equatorial stand for a small telescope, which may be made entirely of wood. An equatorial stand is not a novelty by any means, but one made from wood is certainly a rarity.

The illustration shows only the head of the stand, the tripod being fastened to the piece *A*. Maple is as good a wood as any on account of its close grain. The piece *A* is made of two disks, the upper 5 inches in diameter and ¾ inch thick, and the lower 4 inches in diameter and 1 inch thick.

The pieces are glued together with furniture glue and when dry two pieces, the shape of *B*, 3 inches wide, 3½ inches high and 1 inch thick, are screwed tightly onto it, with a space of two inches between them.

The member marked *C* is 2 inches thick and the section of one end is shown at *C*. The whole piece is 6 inches long. At the upper end it has an arm, marked with a dotted *C*, which fits in between the two pieces of *B*. From its upper face to the end of the arm is 4½ inches, and the arm is the same width as the pieces of *B*, 3 inches. The arm is rounded off to the same circle as *B* and at the center of each curve a ¼-inch hole is bored to take a bolt passing through the arm and the two pieces *B*. By means of a thumb-screw it is possible to clamp the piece *C* in any position. A 1-inch hole is bored all the way through *C*, and this forms the bearing for the polar axis.

The piece *D* is formed of two intersecting cylinders each 2 inches in diameter. The longer piece is about 5½ inches and the shorter extends only 1 inch to one side of the longer and is joined onto it 1 inch from the upper end. After the pieces *D* are glued firmly together, a 1-inch hole is bored through the center of the smaller piece till it intersects the longer boring.



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The axes of the stand are made of 1-inch dowels and a piece 8½ inches long serves for the polar axis. One end of this piece is glued tightly into *D* but not far enough to interfere with the passing of a similar dowel through the longer cylinder.

The free end of the dowel marked x^1 is rubbed with graphite such as that used on bicycle chains, to make it turn easily, and is pushed into the hole in the piece *P*.

The member *E* serves as the bed of the telescope. A shoulder ½ inch thick and of the same diameter and section as the longer cylinder *D*, is glued to the piece *E* which is made of any convenient size, according to the size and curvature of the telescope. *E* is the section of such a piece. Into the bottom of this is bored another 1-inch hole and another dowel is glued into it. The dowel may be left about 2½ feet long. It is pushed through the long cylinder x^2, and thus forms the declination axis.

The telescope is attached to *E* by means of strips of brass passing over its barrel and is fastened with screws on each side of *E*. When the telescope is mounted, a sliding weight, about half as heavy as the telescope, is adjusted on the free end of x^2 which was left 2½ feet, and when the telescope is balanced by it, the dowel projecting beyond the weight is cut off.

By means of the bolt passed through *B* and *C* the polar axis can be adjusted to the pole of the celestial sphere, no matter in what latitude the stand is used.

The stand thus made answers nearly all the purposes of the instrument purchased at a much greater cost, and if the builder wishes to attach a clockwork to make the telescope follow the object that is being viewed, it is as easy as the building of the stand. Get the movement of an ordinary alarm clock and procure a small gear wheel with 12 teeth, and mount it on the end of the shaft in the clock which carries the minute hand. Next get a larger wheel of the same pitch having 288 teeth, which can be procured at any hardware store. Drill holes through the hub of this and fasten it by means of four or five wood screws to the end of x^1, which projects through *C*. Mount the clock by means of the block *H* on *C* so that the wheel 12 engages the larger one 288.

Next procure some woven shade cord, and making one end fast by means of a screw and washer, pass it a few times around the smaller cylinder in such a direction that in unwinding it will turn the polar axis in the direction necessary to follow the stars from east to west. Pass the cord over the pulley *P* and hang a weight on the other end.

The shaft of the minute hand of the clock turns twenty-four times in one day, and as the larger wheel has twenty-four times as many teeth as the smaller, it will only turn once in a day.

The clock is not powerful enough to turn the telescope, but it will regulate the speed of the telescope which the weight is trying to turn by means of the cord unwinding from *D*. The shaft of the clock can be turned without turning the movement in order to set the clock, so that the telescope can be turned on the polar axis without disengaging the clock from it.

The weight on the end of the cord must be as heavy as possible, without being heavy enough to make the shaft of the clock slip in the movement. The alarm apparatus may be removed from the clock, as it is unnecessary. The description of the stand makes its construction appear really much more difficult than it really is, but it is worth the trouble taken by anyone scientifically inclined and with enough mechanical ability. The writer has made one, and this illustration is taken from his instrument. It works as perfectly as necessary for mere viewing purposes, but for photographic work the bearing of the polar axis should be lined with a brass tube and the axis itself made from iron or brass rod.

Hay Fever.

It is now known that hay fever is due to the invasion of the mucous membrane of the nose by the pollen of certain plants. This membrane is not equally sensitive in all persons; there are many who are quite immune from hay fever. Different pollens have not the same activity either; that of certain plants is innocuous, whereas that of other species is very active. The irritating action is really exerted by the pollen itself, and not by a bacterium of any kind. This has been well established by Dunbar. At present a hundred and fourteen plants are known to have toxic pollen; wheat, rye, and quite a number of gramina form a part of them. The active principle of the pollen consists of a granular amylaceous material, and lasts a long while. It is possible by snuffing up dry toxic pollen, to produce hay fever during the middle of winter. The toxin of this granular material has been separated, and it has been used in manufacturing an antitoxin. But the toxins of the different pollens vary; their antitoxins correspondingly. We can scarcely hope to find an antitoxin that will permit of treating hay fevers due to different pollens. It will be sufficient indeed to prepare antitoxins corresponding to the principal toxic pollens. The antitoxin should be administered by preference in a powder—a mixture of sugar and antitoxic serum. It generally cures and confers a certain immunity. Out of 222 cases treated, these results were obtained:

127	successes	say 57 per cent.
71	improvements	say 32 per cent.
24	failures	say 11 per cent.

The proportion is very encouraging.—From L'Illustration.

An intermittent filter will shortly be completed for the temporary treatment of the Ludlow reservoir supply of the Springfield, Mass., waterworks. Its object is to remove tastes and odors from the water during the summer season, and it is not for winter use or for removing a large proportion of bacteria. It was designed by Mr. Allen Hazen, and is being constructed by leveling off an area of about four acres on a point projecting into the reservoir, and covering it with coarse sand. Water will be pumped from the reservoir through a 24-inch pipe to an aerating fountain and thence distributed over the filters. The effluent will be collected in 8-inch drains 12½ feet apart, leading to a collector which terminates in a chamber where aeration will take place.