THE OZONE WATERWORKS AT WIESBADEN AND PADERBORN.

The city of Wiesbaden has for years been drawing its supply of drinking water from the Taunus springs, which yield excellent water. But the continued growth of the town has forced the municipal authorities to provide for some means of supply beyond the limited source of the Taunus springs, and with this end in view the surface water from wells sunk in the plane of the Rhine has been subjected to a special purification, which turns it from a water of inferior value, fit only for general economical purposes, into an excellent drinking water. The method of purification is a novel one, which has never before been applied on a technical scale. Instead of the water being filtered, as usual, it is treated with ozonized air prepared in ozonizers of the Siemens pattern. The whole plant has been put up by Siemens & Halske, of Berlin. Its maximum output is 66,000 gallons per hour, but normally only 33,000 gallons are consumed, so that there is a surplus of 100 per cent available.

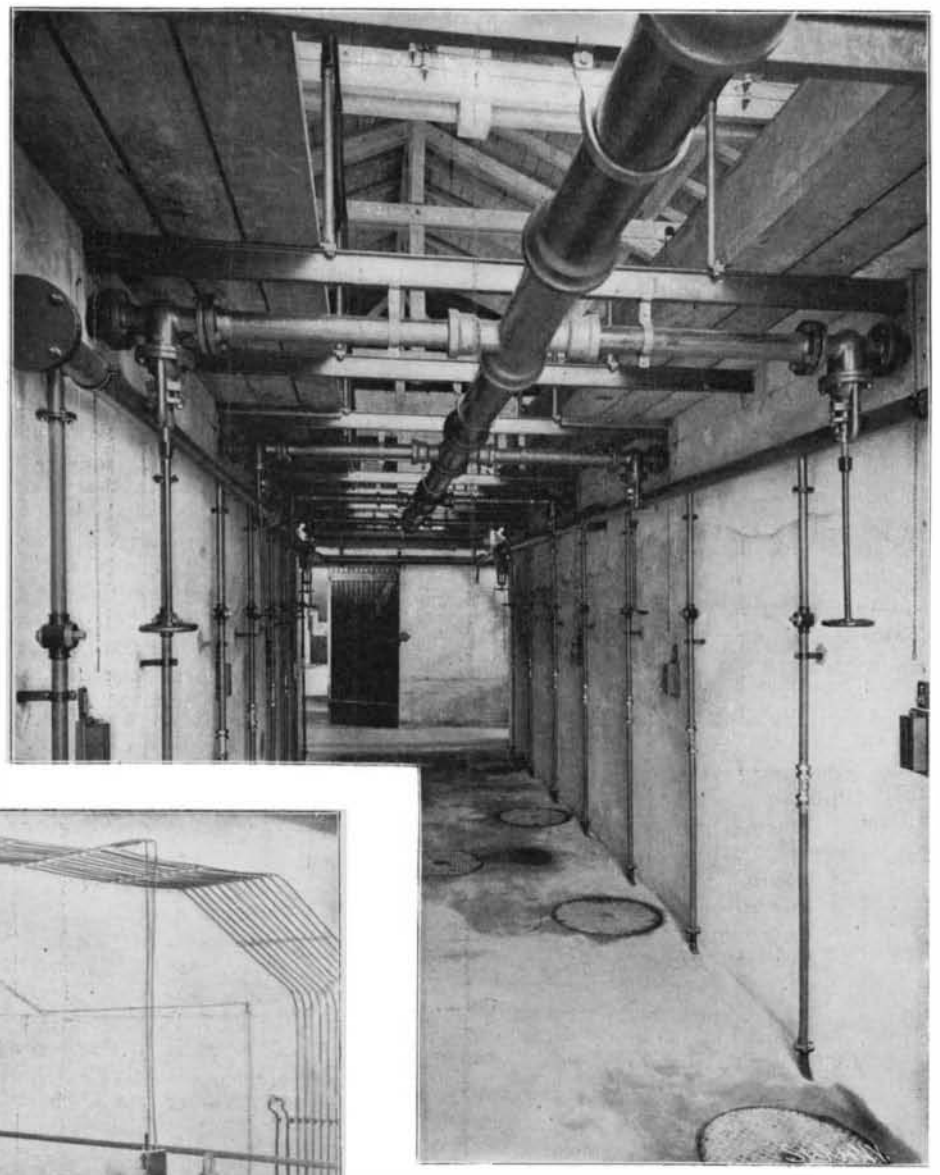
THE OZONIZERS AT THE WIESBADEN PLANT.

Every part of the installation is duplicated, so that it can be worked in two absolutely independent halves, and moreover, if any particular part becomes unfit, the connections are so arranged that it can always be replaced by the corresponding duplicate part.

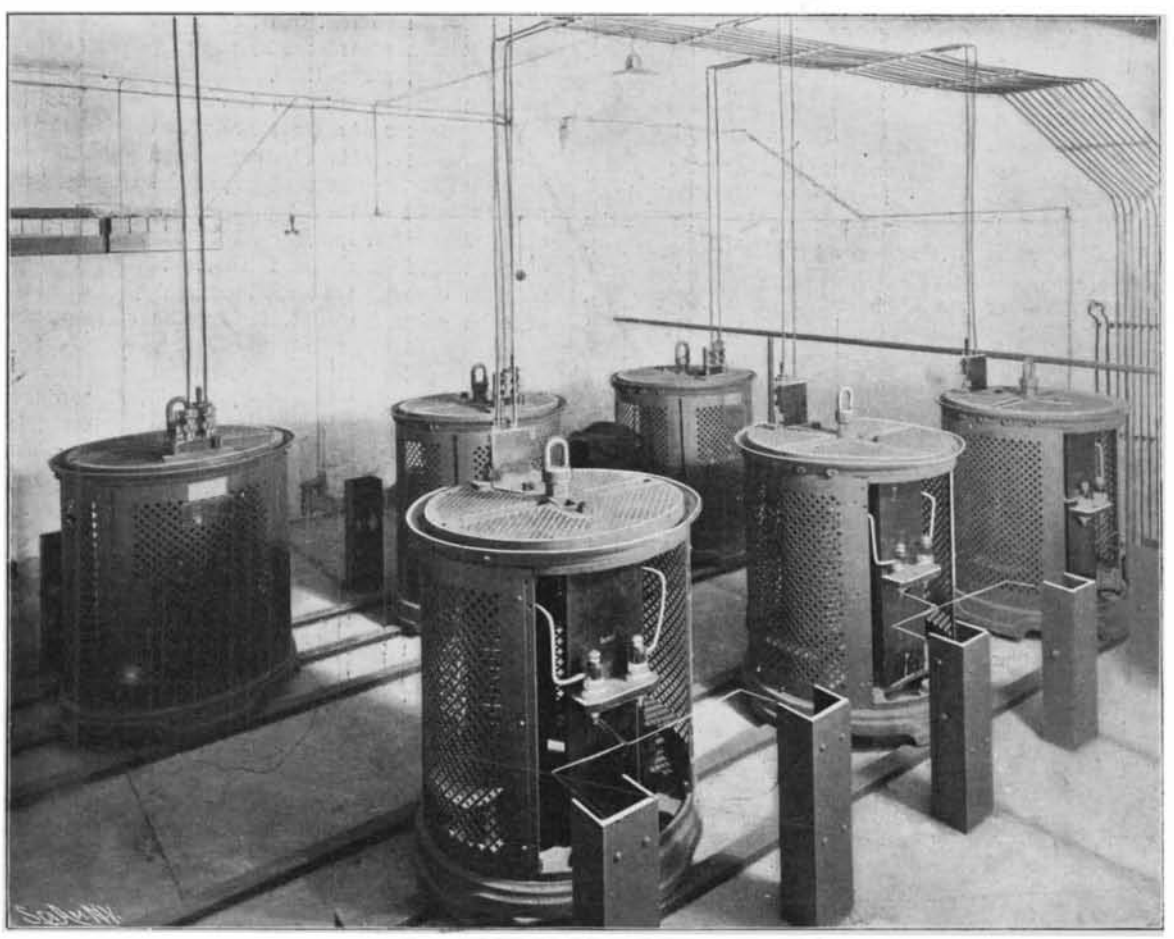
The equipment is as follows: A pair of engines drive a direct and an alternating current dynamo each, which in their turn furnish the power for the motors of the pumps and the current for the ozonizers, this current being transformed up to the requisite 8,000 volts by six step-up transformers (see figure). The building containing the plant is divided into three rooms: 1, the engine room; 2, the room for the ozonizers and transformers; and 3, the room for the sterilizing towers.

In the engine room are placed two 60 horse power Wolf's engines, two direct and two alternating current dynamos, two centrifugal pumps, and two fans to supply the air current for the ozonizers. The portion of the building containing the ozonizers is two stories high. On the ground floor it accommodates forty-eight ozonizers placed in two groups separated by a gangway (see figure). Each of these groups forms part of one of the two independent plants. It has twenty-four ozonizers arranged in four rows, one above the other, of which every eight are connected to one of the six transformers. Such a series of eight ozonizers furnishes the quantity of ozonized air required for one sterilizing tower. The ozonizers are of the Siemens type; the one pole consists of the cooling water of the glass tube, and is earthed, while the other pole, connected to the transformers, is placed in an inaccessible position and therefore causes no danger to the attendant. The ozonizing tubes are inclosed in a cast-iron case consisting of three parts: a completely closed central portion, into which are firmly screwed the eight ozone tubes; an upper part, functioning as reservoir and distributer of the air; and a lower part forming the ozone-collecting chamber. In the upper chamber, removed from all possible touch of the attendant, are fixed the terminals from the transformers. On the floor of the lower compartment are placed the high potential cylinders with their insulating glass rods, and in addition an automatic device to prevent a short circuit through any leakage of the cooling water. This consists simply of a strip of filter paper stretched across a metal spring. If the filter paper gets moist it tears, the spring opens out and automatically places the particular ozonizer out of work.

The cover, bottom, and front wall of cast-iron case are made of thick plate glass, so that the blue shimmer of the silent charge, a certain sign of the proper working of the apparatus, can be watched by the man in charge of the room, which is kept dark. Owing to the careful protection of the high potential terminal, the apparatus can be fearlessly and safely handled by the workmen. The air supply is fed by means of a main pipe running along the row of ozonizers and sending branches to them severally.



THE STERILIZING TOWERS.



THE HIGH POTENTIAL TRANSFORMERS.

The brickwork sterilized towers are divided into four sections, and are placed in two rows, of which one forms the reserve plant. These towers receive from a common feed pipe the unpurified water above. They are about thirteen feet high, and are filled to a height of some six feet with coarse gravel. The water trickles in a fine stream down this gravel, meeting a slow current of ozonized air ascending under a slight excess of pressure. The feed pipe is provided with a conical valve which automatically stops the supply of water, if at any time any part of the ozonizers is out of order. The quantity of water passing down through each tower is 11,000 gallons per hour, and the volume of air passing up in the same time is 21,000 gallons. At the bottom of each tower there is a collecting tank for the sterilized water, from which the latter is pumped to the high-level reservoir.

Due provisions are made against accidents interfer-

ing with the working of any particular portion of the ozonizing plant. The disturbances which are liable to occur are two:

1. The current in the electrical apparatus may fail.

2. The current of air through the plant may fail.

In either case an automatic device leads to the closing of the valve through which water is admitted to the sterilizing towers, and at the same time a bell informs the attendant of the mishap. In this way the supply of unsterilized water to the consumers is effectually prevented by means of apparatus which is of the simplest construction and easily controlled.

Each half of the plant, yielding a supply of 33,000 gallons, expends 50 horse power, of which 27 go to the ozonizers and about 22 to the pumping plant, the remainder being used up for the air blast, for feeding the boiler, etc.

The cost of the plant figures out to one and one-third cents per 1,000 gallons of sterilized water, of which about one-third of a cent falls to the coal consumed in effecting the ozonization. (The price of one ton of coal yielding 7.7 times its weight of steam being reckoned at $5.) To this must be added about two-thirds of a cent in payment of interest and for keeping in repair. But it must be remarked that the Wiesbaden plant is not typical, as there were no pre-existing water works, and pumping has to be done, which does not properly form part of the work of an ozonizing plant.

Prof. Proskauer and Dr. Schüder, of the Koch Institute for Infectious Diseases at Berlin, have carefully investigated the efficiency of the ozone sterilizing process, with results which are highly satisfactory. They worked with water which was grossly infected with virulent bacilli (of the cholera and typhus kind). Their result only confirmed the conclusion previously arrived at in the preliminary experiments at Martinikenfelde by the same investigators, namely, that ozone, in the concentration in which it issues from the Siemens apparatus will destroy all pathogenic bacteria and nearly all harmless microbes, excepting just a few highly resistant and innocent forms, provided a suitable gravel filling is used in the sterilizing towers.

A month after the opening of the Wiesbaden water works, there was also inaugurated a similar plant, on a smaller scale, however, at Paderborn. The sterilizing apparatus of this is a precise copy of that at Wiesbaden, the only difference being that the water delivered from the sterilizing towers is allowed to flow down in a series of cascades, so as to work out the last traces of ozone.

The Paderborn waterworks have to supply 13,000 to 15,000 gallons of sterilized water daily. The plant has nine ozonizers of the Siemens type (of which three are for reserve) and two sterilizing towers with four sections each. The power for the electric plant is supplied from a gas engine. The former consists of direct and alternating current dynamos, two blowers and three transformers, and has arrangements preventing the supply of unsterilized water similar to those at Wiesbaden. The cost of power is a little higher at Paderborn, but on the other hand there is less ozone used per gallon of water, so that the total expenses are much the same as at Wiesbaden.

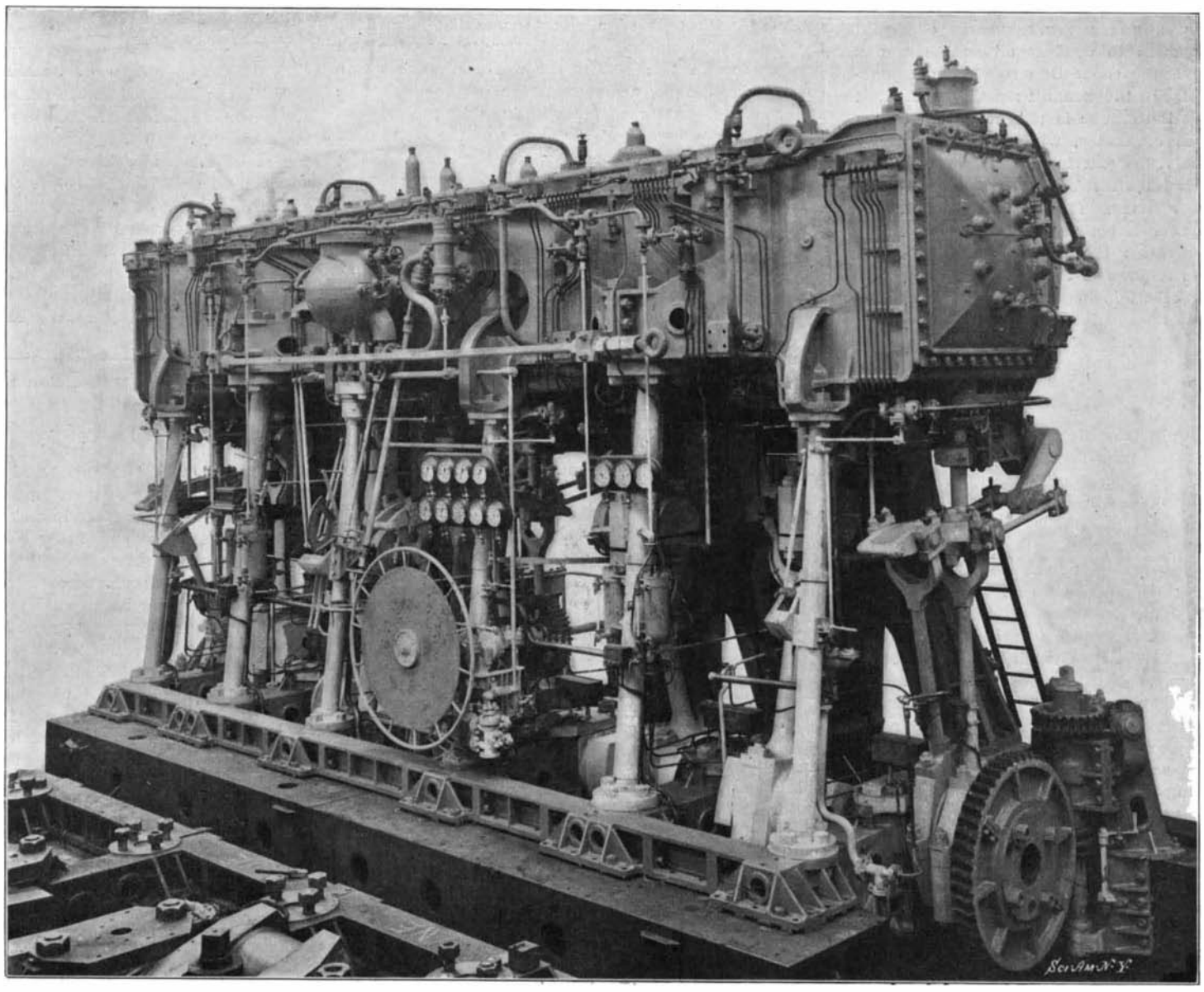
The establishment of the plants at Wiesbaden and Paderborn marks the début from the laboratory into the technical world of a process which is likely to prove a serious rival to older methods of purifying drinking waters, which have been in vogue hitherto.

THE NEW CHILIAN BATTLESHIP "LIBERTAD."

The striking illustration on our front page is reproduced from a photograph taken from the launching ways, just as the new Chilian battleship "Libertad" had taken the water. The heavy chains which are seen hanging from the sides of the ship were dropped to assist by their friction upon the bottom in checking the vessel's way through the water, while a part of her launching cradle will be noticed still in position under her starboard bow. We have seen many handsome photographs of a launch, but never one that approached this in dramatic interest.

The "Libertad" was launched on January 6 at the yards of Messrs. Vickers, Sons & Maxim, Barrow-in-Furness, England. She is a sister ship to the "Constitucion," which was recently launched for the Chilian government by Armstrong, Whitworth & Co. from the Elswick shipyard, Newcastle.

It is claimed for the "Libertad," and we think with much show of truth, that she is, for her size—11,800 tons—the most powerful fighting ship afloat. The European-built Chilian vessels, probably because they have come chiefly from the Armstrong yards, are all remarkable for their powerful offensive qualities, the armament of these vessels being, in proportion to their displacement, more powerful than that of any ships in the world; unless indeed we make an exception in the case of the United States navy.



THE QUADRUPLE-EXPANSION ENGINES OF THE "LIBERTAD."

The "Libertad" is 436 feet long and 71 feet broad, and her mean draft is 24 feet 7½ inches. Her motive power consists of Yarrow boilers of the large-tube type, and twin-screw, triple-expansion engines of 12,500 horse power, and her estimated sea speed is 19 knots an hour. The normal coal capacity is 800 tons, but the full bunker capacity is 2,000 tons. The vessel will carry a complement of 700 officers and men.

The armament consists of four 10-inch breech-loading rifles with quick-action breech mechanism; fourteen 7.5-inch rapid-fire guns, fourteen 3-inch rapid-firers; four 6-pounders; four Maxims, and three submerged torpedo tubes; and from this heavy battery it is estimated that with all the guns firing at their maximum speed, this vessel could deliver in one minute 13½ tons of metal whose combined energy would amount to 1,700,000 foot-tons. In explanation of this great total, it is sufficient to mention that the guns are all of the modern, long-caliber, high-velocity type, with the latest pattern of breech mechanism designed to facilitate rapid loading. Thus, the 10-inch guns will fire a 500-pound shell with a muzzle velocity of 2,850 feet per second and a muzzle energy of 28,160 foot-tons. At the muzzle these guns will be capable of penetrating 31 inches of steel armor. The 7.5-inch gun of the broadside battery is a 50-caliber piece, which fires a 200-pound shell with a muzzle velocity of 3,018 feet per second, and a muzzle energy of 12,638 foot-tons. This piece, which can fire eight rounds per minute and has, therefore, about equal rapidity of fire with the 6-inch piece, can penetrate at the muzzle nearly the same thickness of steel plate as the 10-inch gun, or 29.4 inches. The adoption of such a heavy gun for the secondary battery is in accordance with the best modern practice, which recognizes that the 6-inch piece is not sufficiently powerful to penetrate the modern Krupp armor with which the secondary batteries of modern warships are protected. This 7.5-inch gun, however, is capable of effecting penetration at ordinary battle ranges, and therefore marks a great advance on the secondary batteries carried by most existing warships and cruisers.

While the defensive features of the "Libertad" are, perhaps, not quite equal to her tremendous powers of offense, they are fully up to the average of the latest ships. She carries a practically complete belt at the water line which has a maximum thickness of 7 inches amidships and is associated with athwartship screen bulkheads 10 inches in thickness. This belt is 8 feet in depth. Side armor of the same thickness extends to the upper deck over the whole side of the ship lying between the two main barbettes, and by its association with transverse bulkheads of 6-inch armor, it forms a complete armored central citadel. The upper deck is formed of 1-inch steel plating, while the protective deck, which is 1½ inches in thickness within the citadel and 3 inches in thickness at the ends outside the citadel, extends completely from stem to stern at the level of the top of the waterline belt. The barbettes for the 10-inch guns are 10 inches in thickness in the front where they project beyond the central citadel armor and 8 inches in the rear. The 7.5-inch guns are carried, four of them in casemates on the upper deck at the four corners of the central citadel, and the other ten are within the citadel on the gun deck, five on either side. This battery of ten guns is further protected by 1-inch screens of steel plating placed transversely between each pair of guns. These two battleships will be considerably the most powerful war vessels in the Chilian fleet, which possesses some of the most notable armored cruisers in existence.

Not the least remarkable feature about the "Libertad" is the great speed at which she has been built. The first keel plate was laid March 13, 1902, and the launch took place on January 6, 1903, the vessel being therefore, completed in the remarkably short space of ten months. We commend this record to the consideration of our private shipbuilding firms, who are largely responsible for the backward condition of our navy. The contract for the construction of the "Missouri" (which is a vessel only 400 tons larger than the "Libertad") was signed December 30, 1898. Last December, after the expiration of four years, the vessel was no less than twenty months behind contract, and she is not yet completed.