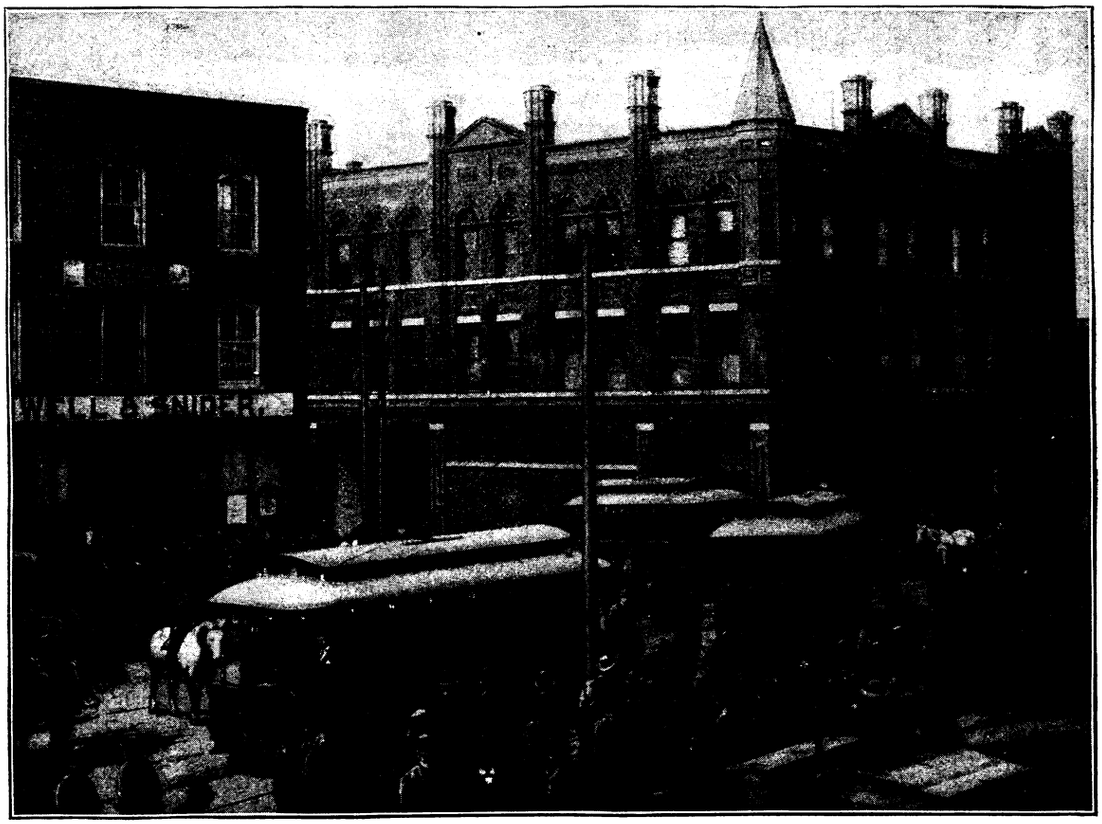
grees. When the inner tube is pushed right out, and the boat is floating near the surface, only the top of the telescope tube need be above the water; and the captain, standing within the boat, by glancing upward, can see in the mirror what is going on in front of him, or, for the matter of that, all around him, if the inner tube be revolved. By means of this ingenious application of a telescopic conning-tower with a mirror, the size of that part of the vessel which must project above the water-level to permit of an observation being taken, has been much reduced, as compared with the old plan of making the conning-tower large enough for the captain's head and shoulders to enter. In the stem of the vessel is fixed the torpedo-launching tube, and in the stern the electric motor by which the propeller is driven. There are various water-ballast tanks by which the vessel is trimmed, and access to the interior is afforded by a man-hole a little forward of the conning-tower. The power for working this vessel is derived from a battery of 564 Commelin & Demazures alkaline accumulators, weighing, in working order, close upon 10 tons. A compound switch is provided by means of which the battery can be differently grouped; the combinations being 12 cells parallel and 47 in series for very slow speed, 6 in parallel and 94 in series for slow speed, 4 parallel and 141 in series for ordinary travelling speed, and 2 parallel and 282 in series for fast speed. The weight of the battery per horse-power is 83 pounds. The electric motor works the propeller direct without the intervention of any speed-reducing gear, and has been specially designed for this purpose by Capt. Krebs. It is a sixteen-pole disk machine, weighing 2 tons, and developing 52 horse-power at a speed of only 280 revolutions a minute. The armature is 40 inches in diameter, and the winding is such as to require only four brushes. The resistance of the machine is .16 of an ohm. At full speed, the motor is sufficiently powerful to propel the boat at a speed of 9 to 10 knots per hour; the capacity of the battery being said to correspond, under this condition, to about four and a half hours of work, which would take the boat over a total distance of 40 to 45 knots. At a speed of 6 knots an hour, the total distance that the boat could travel with one charge would be about 120 knots.

While the "Gymnote" is a boat mainly intended for the discharge of torpedoes against the enemy's ships, a second and much smaller submarine boat is now being built, the mission of which will be to render the enemy's submarine mines harmless by cutting their cables. This boat is also spindle-shaped, but only 15 feet long by 5 feet 3 inches in diameter, and will have a crew of two men only, whereas the crew of the "Gymnote" is from six to eight men. As the cubic capacity of this boat is comparatively small, compressed oxygen is to be carried as part of the equipment. The boat is to be provided with powerful scissors, working from inside, by means of which it is intended to cut the electric cables of the submarine mines. The screw is mounted on a swivel-shaft to facilitate the manœuvring, and is worked by an electric motor driven by a battery of Schanscheiff primary cells. The boat is lighted by five small glow-lamps; and a small arc-lamp with a projector is also provided, the beams of light from which can be thrown forward through glass lenses fixed in the hull, so as to illuminate the water for a certain distance ahead, and thus make the work possible for which this boat is especially intended.

If this country is going to rely to a great extent on torpedoes as a coast defence, the recent improvements in submarine boats cannot but be of great interest to Americans. Congress recently appropriated a considerable sum for the construction of such a vessel, and, although nothing definite is known about the plans that will be adopted, yet it is understood that electricity will not be the motive power.



VIEW OF ELECTRIC ROAD AT ASHEVILLE, N.C.

NATURAL GAS IN OHIO IN 1888.

A LATE number of the *American Manufacturer* has a careful review of the natural-gas situation in Ohio, by Professor Edward Orton, the State geologist, who says in effect that no important discoveries have been made in Ohio during the year 1888, though a

great deal of drilling has been going forward, and the productive districts remain as at the end of 1887, four in number; viz., the Berea grit, the Ohio shale, the Clinton limestone, and the Trenton limestone. The last-named stratum, which is both a gas and oil bearing rock in northern Ohio and central Indiana, is, excepting possibly the Bradford sand, the most important single source of petroleum and gas on this continent. The oil is still ranked as inferior, on account of the present difficulty of refining it; but there is no drawback to the gas, as is apparent from the following analyses, made for the United States Geological Survey: —

	Findlay.	Fostoria.	St. Mary's.
Hydrogen	1.64	1.89	1.74
Marsh-gas	93.35	92.84	93.85
Olefiant gas	.35	.20	.20
Carbonic oxide	.41	.55	.44
Carbonic acid	.25	.20	.23
Oxygen	.39	.35	.35
Nitrogen	3.41	3.82	2.98
Sulphuretted hydrogen	.20	.15	.21
Total	100.00	100.00	100.00

The small fraction, one-fifth of one per cent, of sulphuretted hydrogen is held to be decidedly advantageous, as it affords a certain means of detecting leaks.

No place within the natural-gas belt has derived greater advantages from this fuel-supply than Findlay, where in November, 1884, it was first found that the Trenton limestone, at some places at least, contained stores of high-pressure gas. Since January, 1886, the population of the town has increased from 6,000 to 30,000. Although there are rolling-mills, chain-works, machine and edge-tool shops, etc., the principal industry is glass, 155 pots being used by the ten firms engaged in making window-glass, fine flint ware, and bottles.

This growth has been built up in Findlay, as in other towns, by giving free, or nearly free, gas to manufacturers, — a gift which in some instances has been supplemented by land and contributions to capital, either from the town or parties interested in real estate. Under these circumstances, the question of the continuance of the supply is a vital one. Professor Orton has contended that the supply is a stored one, and notwithstanding the reasonableness of the theory, in view of the exhaustion of all deposits of liquid hydrocarbons, the gas has been used most profusely for the rough work of founderies, rolling-mills, brick and tile works, lime-burning, and the like, until, a short time since, Findlay found itself short of gas. A new well was drilled in, and, on being shot, responded with a pressure in the open casing of from 38 to 40 pounds, equivalent to a yield of about 30,000,000 cubic feet per day. The famous Karg well, which has been the main reliance of the town for the past two years, was estimated to discharge 12,000,000 cubic feet.

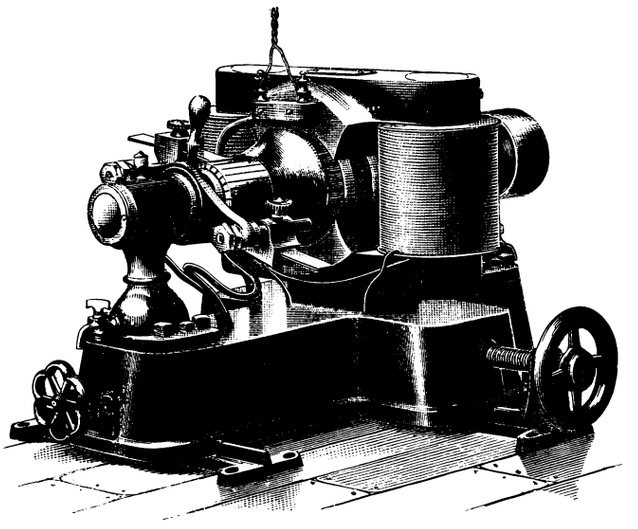
This shortage of gas has led to an investigation, from which the professor concludes that none of the large wells in the field have flowed three years, practically unrestrained, without giving unmistakable signs of nearing their limit. In some cases oil invades them; in others, salt water. The smaller wells appear in some instances to have a longer lease of life than the great wells. In some of the town wells the original rock pressure has been reduced by about three-eighths, but in others it is claimed it is fully maintained, only more time is required for gathering. The area exhausted by a vigorous well is not yet determined, but it is thought that the central portion of Findlay is partially drained of its original supply. As the city has pledged itself to furnish many million feet of gas each day, great energy and sagacity will be required to maintain in full vigor the splendid industries now established, and insure the continued prosperity of the town.

What is predicted of the Ohio Trenton limestone gas-field may probably be asserted as to the 2,000 square miles of the field in Indiana, though, if wells yielding 30,000,000 cubic feet of gas per day, equivalent to nearly 1,000 tons of coal, are to be found whenever a shortage occurs, there may be a longer lease of the industrial life of that region than a cursory reading of Professor Orton's article might lead one to infer.

THE DENISON MOTOR AND DYNAMO.

THE accompanying illustration shows the form of dynamo and motor now manufactured by Mr. J. F. Denison of New Haven, Conn. These machines do not differ in their construction much from that which experience has shown to be desirable, but the motors have some points worthy of special consideration.

An arrangement known as the Denison interlocking starting attachment is contained in the base of the machine, and is said to prevent any mistake in operating the motors. This attachment is



THE DENISON MOTOR AND DYNAMO.

so arranged that the current cannot be thrown on unless the resistance in the rheostat in the base is in the proper position. This is manipulated by a hand-wheel. In case of accidental breaking of the circuit, an automatic lock makes it impossible to turn the current on until the resistance is again in normal condition. The absence of attachments external to the machine, which are usually placed on the wall, the machine being entirely self-contained, does away with the expense of sending out special attendants to set it up. Further, as there are but two binding-posts, it is impossible to make a mistake in wiring.

HEALTH MATTERS.

Analysis of Foods.

THE commissioner of internal revenue of the United States has published the regulations concerning the analysis of foods and drugs in the District of Columbia. These regulations are based on the Act of Congress passed in 1888, entitled "An Act to prevent the Manufacture or Sale of Adulterated Food or Drugs in the District of Columbia." Section 12 of this Act provides that any health-officer, inspector of nuisances, or any food-inspector, may procure any sample of food or drug, and, if he suspects the same to have been sold to him contrary to any provision of the Act, he shall submit it to the commissioner of internal revenue to be analyzed. An offence shall be deemed to be committed in the case of drugs, if it differs from the standard of strength, quality, or purity laid down in the pharmacopœia, or falls below the professed standard under which it is sold. In the case of foods, the regulation gives a standard for butter, cheese, cocoa, chocolate, coffee, honey, lard, malt liquors, milk, mustard, olive-oil, oysters, pepper, tea, vinegar, wheaten flour, bread, and wine.

A large number of coloring-matters are prohibited for use in foods. Among these are aniline, gamboge, fuchsine, naphthol yel-