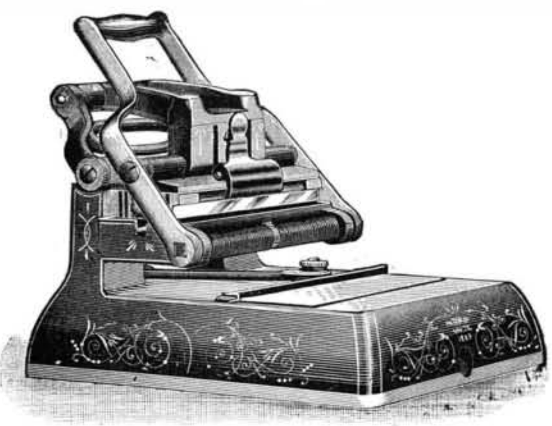
ENVELOPE ADDRESSING MACHINE.

One of the most important requisites of business correspondence is that the envelopes should be addressed in a manner not only providing every possible safeguard against misdirection, but also against being missent by the rapidly working postal clerks who have not time to carefully decipher obscure superscriptions, but must throw each letter to its respective pouch by the impression formed on the first glance.

The R. H. Smith Mfg. Co., of Springfield, Mass., who make a specialty of everything in the rubber stamp



ENVELOPE ADDRESSING MACHINE.

line, have recently put on the market a new device, as shown in above engraving. It is called Smith's Patent Lever Self-inker No. 3, and is, in fact, a miniature printing press of simple but effective construction, especially designed for printing the addresses on envelopes, postal cards, and shipping tags, which it does rapidly and in a most perfect manner, using their well known metal-bodied rubber-faced type, a font of which is furnished with each press, and the office boy can in his leisure moments set up the addresses and print a complement of envelopes for each of the firm's regular correspondents, returning them to the envelope boxes in which they came, simply taking an imprint on a slip of paper and folding in with imprint exposed to index them, leaving in convenient form to use from and enabling the boy to see and replenish any kinds running low.

CARLYLE described his indigestion "like a rat gnawing at the pit of his stomach," and said his best physician was a horse. Some one has jocosely remarked the outside of a horse was the best thing for the inside of a man. Calvin was a sufferer from indigestion, so was Emerson, so was Cowper, so was Darwin, so indeed were many of the great men of modern times. An old physician used to say: "Tell me how a man digests, and I will tell you how he thinks."

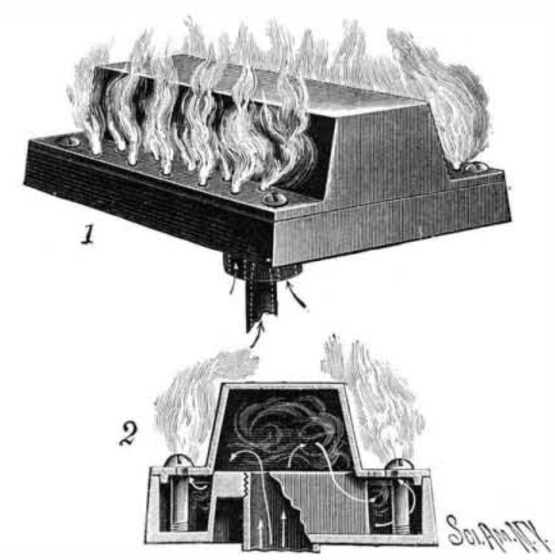
A GAS BURNER FOR HEATING PURPOSES.

The illustration herewith represents a gas burner which has been patented by Mr. Phillip Lesser, of Ridgway, Pa., Fig. 1 giving a general view of its appearance, and Fig. 2 showing a broken sectional view. The base casting is made with a central elevated platform and a narrow channel or chamber surrounding the whole interior of the burner. Upon the upper edges of the outer walls of the base casting is bolted a cap plate, the bolts being passed through longitudinal flanges covering the exterior channel of the base, while the central portion of the cap plate consists of a longitudinal elevated chamber, the side flanges having numerous perforations for the escape and burning of the gas at the sides of the central elevated chamber. The gas is admitted to this central chamber above the top of the elevated portion of the base through an opening in which a gas pipe may be fitted, the gas becoming then heated, and expanded and mixed with air, when it passes downward and enters the surrounding channels formed in the base, as shown by the arrows, and in this heated and expanded state issues from the burner perforations, producing intense heat.

THE VYRNWY LAKE OF THE LIVERPOOL WATER WORKS.

One of the grandest engineering works of modern times, undertaken by the Corporation of Liverpool to supply that city and its suburbs with abundance of the purest water from a sequestered valley high up among the mountains of North Wales, is now approaching its successful consummation. It is the more interesting, because it deals with the primeval features of Nature by a process of artificial restoration, creating once more a lake, which will be the largest in Wales, and not the least beautiful, where Nature, by her own engineering, toward the close of the Great Ice Age, scooped a vast basin in the Silurian rock and made a lake, which afterward, by the rapid disintegration of the rocks, under more severe extremes of temperature than are now experienced, became silted up, and gave place to an alluvial plain cultivated and inhabited by a few villagers. It is now again converted into a greater lake, to be used as a reservoir of water for the supply of a million people dwelling seventy miles away. The population supplied by the Liverpool water works is already 806,000, and will much exceed 1,000,000 soon after the Vyrnwy is made available. Across the intervening country of mountain, woodland, and lowland pastures, the Vyrnwy aqueduct is now completed. "It will be," says Mr. G. F. Deacon, the engineer-in-chief of the works, in his report on the subject to the Corporation of Liverpool, "the longest yet constructed. To the distributing reservoirs at Prescot its length exceeds 68, and to the Town Hall at Liverpool 77 miles—32 miles longer than the famous Claudian aqueduct, and 15 miles longer than the course of the Anio Novus, which, for the last six miles toward Rome, was carried by the same arches as the Aqua Claudia."

The sources of the Vyrnwy are six main streams and many smaller rivulets, rising in mountain moorlands from about 2,200 feet to 1,300 feet above the sea level,

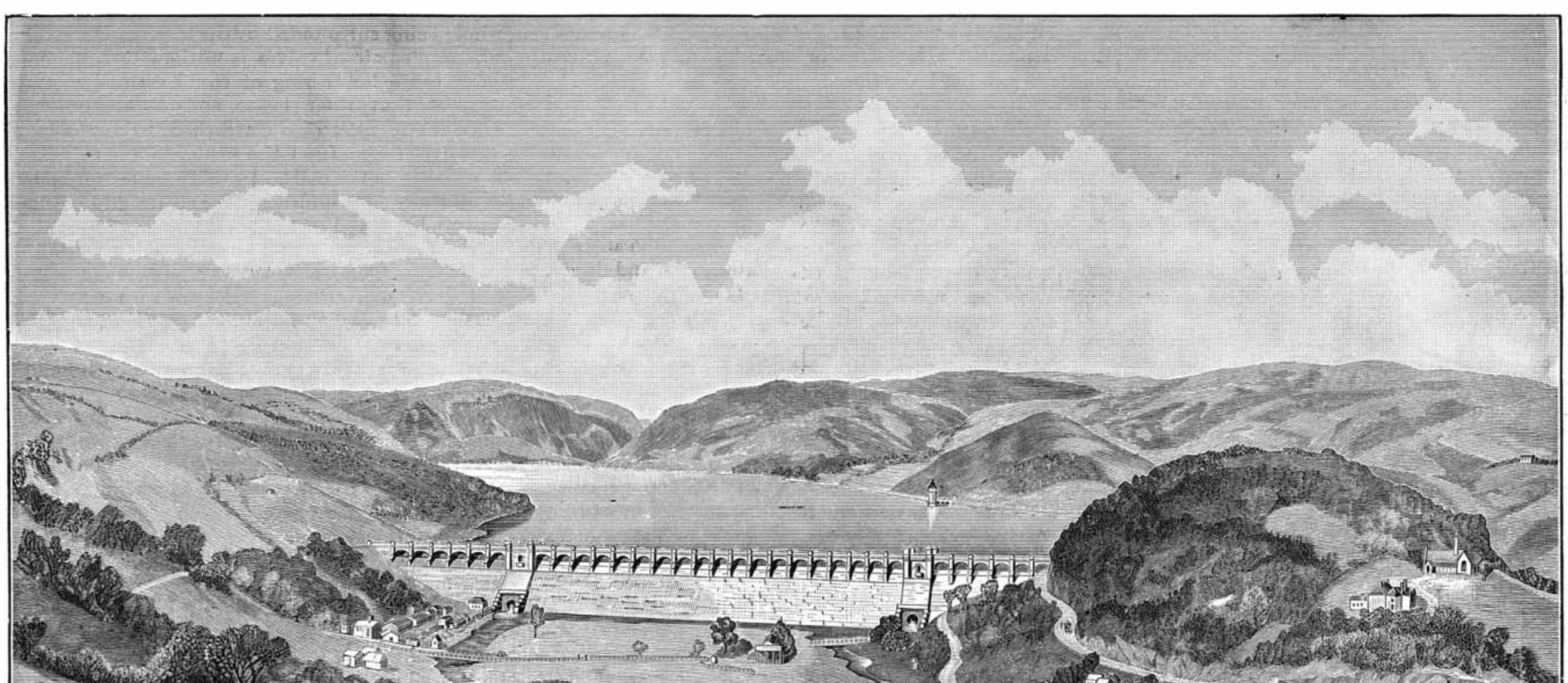


LESSER'S GAS BURNER FOR HEATING PURPOSES.

and pouring directly into the natural rock basin which has been alluded to. This upland recess, with lofty mountains at its head and hills along both sides, extends nearly five miles in length, and its level bottom is about half a mile wide. It was undoubtedly the bed of a lake, cut out by a glacier, like most of the lakes of Switzerland and of Scotland. The natural bar of harder rock at the lower end of this valley, here a narrow gorge, the lower lip of the ancient lake basin, remains considerably higher than the rock stratum below the alluvial and peat deposit in the valley behind it. Mr. Deacon has been able to use the bar of rock as the foundation of his immense dam of solid masonry closing the lower end of the Welsh valley.

The construction of this dam, which is, we believe, unequaled in some features by any other work of its kind in the world, is worthy of special description. Mr. G. F. Deacon, who succeeded the late Mr. Thomas Duncan as water works engineer to the Liverpool Corporation in 1871, recommended the formation, by damming across the valley, of a lake nearly 5 miles long, draining an aggregate area of 23,200 acres. The level of the lake would be about 817 feet above sea level, and he proposed a course for an aqueduct to Liverpool.

On July 14, 1881, in the presence of an influential company, Earl Powis laid the foundation stone of the



THE GREAT DAM OF VYRNWY LAKE—LIVERPOOL WATER WORKS.

masonry dam. It has since been carried out by Mr. Deacon solely, as engineer-in-chief.

It has been constructed at Vyrnwy under conditions very similar to those of the Furens reservoir, in France, and of the Karakvasla dam, near Poonah, in India, constructed by General Fife, R.E. The rock bar crossing the lower end of the valley was laid bare by an excavation 1,100 feet long, 120 feet wide, and from 40 to 60 feet below the surface, removing the alluvial deposit of that thickness and the loose bowlders, while the sloping rocks were benched or stepped to make a thoroughly solid foundation for the masonry. The river was diverted, and the building was then begun. The stone of which the dam is built was taken from a quarry about a mile distant, to the north. This stone, like that of the foundation, belongs to the rock strata of the Lower Silurian system. It is a hard, durable, dark gray stone, weighing 2·06 tons per cubic yard, and having a specific gravity of about 2·721. Stones weighing 10 tons were the largest size allowed to be built into the work, but the average weights were: Stones under 2 tons, 45·99 per cent; stones from 2 to 4 tons, 20·86 per cent; stones 4 tons and upward, 33·15 per cent. The lower beds of these stones, if not perfectly flat, were roughly dressed to a plane surface, and any overhanging pieces or undue projections were cut off. They were then washed by jets of water under the pressure of a 140 foot head.

The stone was too hard for pick work; hammer and chisel, or hammer and set, were, therefore, almost exclusively used. When brought to the dam by locomotives and wagons running on a 3 foot gauge railway, they were lifted into position by steam cranes and deposited on a bed of Portland cement mortar. The interstices between the large stones, when important enough, were then built up with smaller ones, around which cement concrete was rammed. On the finished surfaces so obtained fine Portland cement mortar was again spread, in which other similar stones were set and beaten down with heavy malls. No grouting of any kind was allowed, the necessary intimate mixture and density being obtained by ramming. The cement mortar was at first made with cleanly washed sharp river sand, in the proportion of two parts of sand to one of cement. This was afterward abandoned for a mortar made of one part of pulverized rock mixed with two parts of clean river sand, and of this two parts were mixed with one part of cement. From this pulverized stone, sand, and cement a stronger mortar was obtained than from sand and cement only; the mixture also was quite free from "shortness." As the wall was raised the proportion of cement was somewhat diminished.

After Mr. Hawksley retired from the joint engineership, and in consequence of certain statements that he had made, the Liverpool Corporation instituted a scientific inquiry into the stability of the structure and the quality of the materials employed. One of those who then examined it was General Sir Andrew Clark, R.E., then Inspector-General of Fortifications. In the course of the inquiry a vertical shaft was sunk and a heading driven into the heart of the dam. Eleven large blocks of the concrete filling were removed. When tested by Professor Unwin, F.R.S., and Mr. Kirkaldy, they were found to bear, before crushing, an average load of 300 tons per square foot. The masonry was found to be of the highest character, both as to the concrete filling and mortar bedding. Of the cement, the average tensile strength was 6½ cwt. per square inch. Sir Andrew Clark said of this masonry that "nothing short of an earthquake could possibly disturb it."

The total length of this huge masonry dam across the mouth of the valley is 1,172 feet; its greatest thickness at the base is 120 feet; its height, from the lowest part of the foundation to the parapet of the carriage road on the top, is 161 feet, and from the bed of the river or lake, 101 feet; the height from the bed of the lake to the sill for the overflow of water is 84 feet, which will thus be the maximum depth of the lake. The dam has a "batter," or slope, above the level of the ground, to the degree of 1 in 1·5 on the lake side and 1 in 7·27 on the outer side. The total quantity of masonry in this dam is 260,000 cubic yards, weighing 509,700 tons. The illustration is a view of the outer side of the dam, from a sketch taken by our special artist, Mr. W. Simpson, in the autumn of last year, before the rising of the water in the lake, and while the building of arches on the summit, of which there are thirty-three, elliptical in form, with spans of 25 feet, was still in progress. These arches now support a viaduct for the carriage road, 19 feet wide, and two side pathways; also two finely proportioned towers, containing shafts and apparatus controlling the valves in the two tunnels through the dam below, to regulate the compensation discharge of water from the lake to the river Vyrnwy. From the valley below the lake the outer side of the whole structure appears complete, and these two tunnels are seen with the streams of water flowing from them down the valley. Each aperture is 15 feet in diameter; but at present both have been filled up with brickwork and cement, to allow the lake above to fill with water, leaving only, in the center of each tunnel, an iron pipe governed by two valves with the apparatus in the towers, to regulate the outflow of compensation water to the river.

The discharge water to be conveyed by the aqueduct to Liverpool will pass from the lake by a tunnel, and will be first strained through very fine copper wire gauze in the "Vyrnwy Tower."

The Vyrnwy Tower, some three-quarters of a mile distant from the dam, is a very graceful structure, standing in 50 feet depth of water, 140 feet from the shore. The total height of the tower is 160 feet; the outside diameter at the base is 47 feet, which tapers slightly toward the top. The inside diameter is 30 feet 6 inches. The outer casing is of the same gray masonry as the dam, and the inside is built of cement concrete. This tower serves two purposes: it is the point at which the water is drawn from the lake, and serves to supply the aqueduct from near the surface of the lake, whatever may be the level; and within it also all the water is strained clear of suspended organic matter and impurities before it is sent on its course to Liverpool.—*Illustrated London News.*

THE TORPEDO BOAT STILETTO.

BY GEORGE F. W. HOLMAN, LIEUT. U. S. N.

The Stiletto, illustrated in this issue, built at Bristol, R. I., by the Herreshoff Manufacturing Company, was launched February 25, 1885, and was purchased by the government in the summer of 1888 for use as a torpedo boat.

She is a high pressure, single screw, wooden vessel of 31·8 tons displacement to the load water line, 90 feet long between perpendiculars, 94 feet long over all, of 11 feet beam, of 8 feet depth from level of sheer plank, and of 2 feet 10 inches draught.

In her construction lightness is combined with strength. The framing is of white oak, the keel being in two lengths, scarfed and bolted together; the garboards are side-bolted to the keel; and the frames, spaced 15 inches, and extending from the gunwale to the keel, are securely bolted to the latter and to the garboards; plank floors extend across the keel, to which and to the frames they are bolted; the frames are strung together by a thick strake 2 feet above the water line, a top strake, and a gutter strake lapping over the top strake and the ends of the deck beams; the stem and the stern post are of white oak siding. The hull is strapped diagonally with iron straps to prevent working and twisting, those in the wake of the engine room and fire room being of extra strength and crossing in opposite directions. These straps are outside the frames and inside the planking. The deck beams, of oak, are fastened to the frames by malleable iron knees, lightened by holes and bolted through. The side planking is in two thicknesses, butts and seams breaking joints. The inner planks are of white pine, the outer of yellow pine from garboards to the thick strake and of white pine above them. The deck planking is in two thicknesses of white pine. The seams are not calked, but a layer of white lead is placed between the two thicknesses.

The boat is divided by five bulkheads into six water-tight compartments. The collision bulkhead is 7½ feet abaft the forward perpendicular. The anchor chain stows in the compartment formed by this bulkhead. The second compartment, 24 feet long, contains the officers' cabin and state-room and the steering gear; the third, 18½ feet in length, is the boiler room; the fourth, 11 feet long, is the engine room; the fifth, 24 feet from bulkhead to bulkhead, contains the galley and the quarters for the crew; and the sixth, 5 feet long, is a store room.

The second compartment is entered through the conning tower, the third, fourth, and fifth by hatchways, and the sixth through a manhole. The fire room hatch cover is fitted with a spring catch, and this, as well as the other covers, can be opened from above or below, and egress is easy in case of accident.

The interior receives light in the daytime through the hatches and through fifteen dead lights on each side. Oil lamps are used at night.

The conning tower, about 4 feet in diameter, rises 2¾ feet above the deck, and has glazed slits for an all-round view. From a platform within, the helmsman has conveniently at hand the steering handles, the apparatus for signaling to the engine room, and the whistle lever.

The boat can be steered by hand or by steam. In the fire room, on the starboard side, is a steam steering cylinder, with a stroke of 24 inches. To its piston are connected two piston rods—a forward and an after one—traveling through stuffing boxes in the cylinder heads. The piston, with its rods, forms, virtually, a part of the starboard wheel rope, the after rod being connected by steel wire rope to the rudder yoke and the forward rod, by wire rope and chain, passing around a fair-leader, to a transverse rack forward of the steering wheel. The port end of the rack is connected, by chain and wire rope passing around a fair-leader, to the port end of the rudder yoke. The steering wheel is attached to a horizontal spindle, the forward end of which bears a small geared wheel. The spindle can be pushed slightly forward or pulled aft in its bearings, and can be locked in either position by a small drop pawl. When pushed forward, its geared wheel engages with the teeth of the rack, and, when aft, it engages with multiplying gearing connected with the rack. The latter position, giving more power to the wheel, is habitually used in steering by hand power alone. The spindle has a slight lateral play in its bearings. Its after end is connected by a system of light rods and bent levers with the valve of the steering cylinder, so that whenever the wheel is turned to starboard or to port, the spindle works to one side or the other, and the valve is moved to open the forward or after steam ports of the cylinder. When rotation of the wheel ceases, the spindle resumes its middle position and the valve is centered. Thus, the steam steering gear is always attached, and it is only necessary to turn on steam to the cylinder when it is desired to use it.

The boiler is a Herreshoff patent square tubular, or coil, boiler, 66 inches square outside and 7 feet high, with ten flats of pipes, 58 inches square, the pipes decreasing in diameter from 3½ inches in the first two flats to 1½ inches in the last two, giving a heating surface of 552 square feet on the inside of the pipes. Weight of boiler, 10,343 pounds. The separator, of wrought iron, is 6 feet high and 18 inches in diameter. Under the cabin is a water tank with a capacity for 200 gallons, joined by piping with one under the boiler and firing flat, holding 300 gallons. A steam injector and a Blake steam pump connect these tanks with the boiler.

In the boiler room is a steam ejector for freeing the compartments from water in case of leaks.

Abaft the boiler, and in the same compartment, is the coal bunker, holding seven tons of anthracite.

There is one furnace, with two doors opening aft. Grate surface, 21 square feet. The ashes pass out by a chute through the bottom. The smokestack is jacketed, the space within the jacket forming an efficient ventilator when working with open fire room.

Forced draught is given by a centrifugal fan, 3½ feet in diameter, driven by an independent engine, 3½ inches by 6 inches stroke.

The engines are vertical direct-acting Herreshoff compound condensing engines, with two cylinders acting on cranks at 90°. Diameter of high pressure cylinder, 12 inches; of low pressure cylinder, 21 inches. Stroke, 12 inches. Weight of engines, 4,275 pounds. The cylinders are supported by eight upright steel rods, 1¼ inches in diameter, rising from the bed plate and reenforced by stay rods and braces. The bed is of steel plate, cut for the cranks, and with lighting holes in the middle. The thrust and engine bearings are attached to this bed and the engine is not otherwise secured to the hull, thus reducing the liability to derangement of the engine to a minimum in the event of damage to the hull. Around the top and bottom of the cylinders are lines of ports controlled by ring valves, the valves at top and bottom being connected by stay rods, and the whole being surrounded by the steam chest and jacketed. Each pair of valves is worked by four stems secured to the lower ring at equal distances apart and connected at their lower ends to a crosshead and a Y-shaped rock shaft attached to the link block. Steam is taken from the center of the valve, and exhausted from the ends. In this engine the cylinder is at all times surrounded by live steam, and is, therefore, always kept at the temperature adapted to the most efficient working. The valves are balanced. The clearance is small, and, as steam is admitted all around the cylinder at once, there is but little wire drawing.

The condenser, of copper, is 5 feet long and 2 feet in diameter, over all, and contains 684 tubes. Water is driven through it by an independent centrifugal pump, making 740 revolutions at full speed.

Six pumps are bolted to the bed plate, worked by reciprocating arms attached to a crosshead on each engine: Two air pumps from condenser to hot well, two feed pumps from hot well to boiler, and two force pumps from separator to boiler.

The shaft is of mild steel, 3⅝ inches in diameter, made in two parts, of a total length of 34½ feet, and weighing 1,000 pounds.

The screw, of bronze, is four bladed; diameter, 48 inches; pitch, 80 inches; weight, 250 pounds.

The armament, which the boat is now awaiting, will be Howell automobile torpedoes for attack, and for defense a Hotchkiss revolving cannon, hand grenades, and small arms.

It was originally contemplated to fit the boat with two bow tubes for ejecting the torpedoes ahead, directly in line with keel, but this plan is abandoned in favor of the better one of having a torpedo gun mounted forward, on deck, and capable of train so that torpedoes may be discharged in any direction comprehended within an arc considerably in excess of 180°. The gun and torpedoes are now being made at Providence by the Hotchkiss Ordnance Company.

The enviable distinction belongs to the Stiletto of having made, first, the highest recorded speed for a boat (*a*) of her length and (*b*) of her displacement, over a measured nautical mile course, and, second, the highest recorded speed for a three hour trial for a boat of her displacement carrying a load (in coal, water, crew,