

the air is generally conveyed through flues built into the interior walls; the volume and rate of discharge being governed by the register through which the air escapes.

The object always is to discharge the air either at or towards the cold outer wall, but it must be admitted that it takes a great deal of experience in this line to enable any one to lay out a perfect working system.

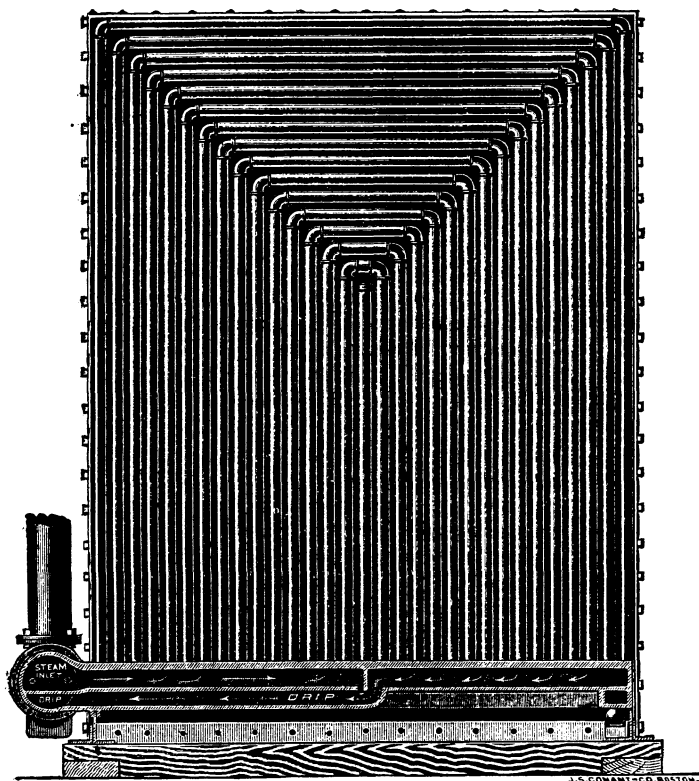


FIG. 2.

This system, known as the "blower system," possesses many advantages. Above all, it is positive. The air, being forced into the building, must of necessity thoroughly circulate through it, creating perfect distribution of heat, and ample ventilation. The source of supply of the air introduced being always under control, there can be no opportunity for the presence of injurious impurities. In any system dependent upon natural agencies to produce venti-

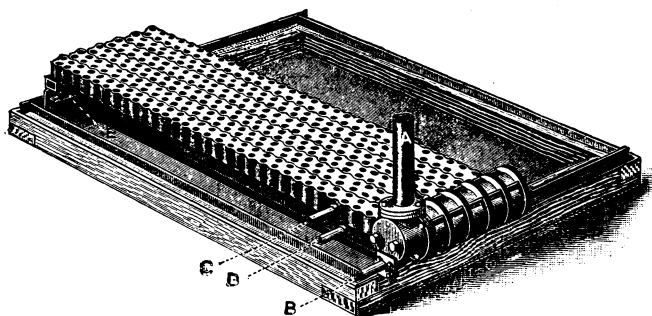


FIG. 3.

lation, changes in the weather always have a serious, and in some cases a perfectly nullifying effect. With mechanical ventilation, this can never occur, for the pressure produced by the fan is far in excess of that due to any changes in the atmosphere.

In the blower system, a marked saving is made in the amount of heating-surface required. The large amount of air passing through the heater causes such a rapid condensation of steam, that each square foot condenses from three to five times as much steam as will be condensed by the same area in an ordinary coil-radiator; in other words, only one-third to one-fifth the pipe is required to do

the same amount of heating. The saving in the heating-surface will usually pay for the fan and engine, so that the system becomes no more expensive than a direct-heating system.

But while in a direct system there is always danger from fire, freezing, and leakage, this is all obviated in the blower system. All the pipe is combined in a single heater, incased in a fire-proof jacket, and all valves are within easy reach, placing the entire control of the apparatus in the hands of a single individual. Furthermore, a much more rapid change in the temperature of the building is possible with the blower system than with any other system, either direct or indirect.

Most assuredly the system is worthy of investigation by any one requiring either heat or ventilation. It is now in use in some of the largest manufactories in the country, such as the Pacific Mills, Lawrence, Mass.; the New O. N. T. Clark Thread Mill at Kearney, N.J.; the Morgan Engineering Company, Alliance, O.; Niles Tool Works, Hamilton, O., etc.

Mr. Sturtevant has recently issued a handsome eighty-page illustrated treatise on ventilation and heating, which we are informed will be sent to any one requesting it.

BRICK FOR STREET-PAVING.

THERE are perhaps fifty cities in the United States using brick pavements. Some have had them over fifteen years. In Decatur, Ill., brick pavements have been in use for six years; in Bloomington they have been used for fifteen years; and in Charleston, W.Va., for a longer time. They are in use in Jacksonville, Peoria, Quincy, and Springfield, Ill., also in Kansas and Nebraska; and a number of cities in Ohio are using them with good results.

All brick pavements have not given satisfaction, as the contrary effect has been produced when common building-brick has been used. They begin to show the effects of wear in a very short time if soft brick is used, but good hard brick gives satisfaction. There is no paving-material equal to hard brick, excepting granite blocks, and it is doubtful if they would last as long were they as small as bricks. There are few cities in the United States where brick could not be laid for one-third the cost of granite blocks.

It may be urged that suitable clay for manufacturing paving-brick is scarce, but there is nothing in this country so plentiful. Of over twenty different samples of clay sent from various portions of Illinois and other States to the Decatur Tile Company, all excepting one have been made into paving-brick, although some kinds are much better for the purpose than others. This company has made about five million bricks per year during the past four years, seventy-five per cent being paving-brick. Over five miles of the streets of Decatur are paved with brick, and the City Council is planning to have more of them thus paved.

The clay used by the tile company mentioned is a common yellow joint clay, having a large percentage of silicate and iron. It is tempered or soaked for twenty-four hours before using, then carried by a belt to a stone-separator and crushers. Dropping from the crushers to an elevator, it is fed to the brick-machine. From this machine it runs in three streams upon a moving table, and is cut by wires, fastened in a frame, into bricks eight and a half inches in length. The die through which the clay is pressed on leaving the machine is 4 by 2½ inches. The bricks are then set upon drying-cars to be dried in hot-air tunnels, or set on slats in a building warmed by steam, or placed on a drying-floor heated from the burning kilns or small furnaces. When dry, they are carried in wheel-barrows and set "skintling," or at angles across each other, to allow the heat to pass between them in the down-draught kiln. Experience has proved that good paving-brick cannot be burned in open, up-draught kilns, if made from the clay described.

While some kinds of clay will stand fire long enough to burn as hard as rock in open kilns, yet even then the bricks would be much better in shape and quality if burned in closed kilns. The bricks are burned from six to seven days, the first three or four days very slowly, called "water smoking." It is necessary to watch very closely when finishing the burning, as there is great danger of running the bricks together and spoiling the whole mass.

The great drawback to using all kinds of clay is owing to the

gravel found in many clay banks. There are machines for separating the larger stones and crushing the smaller stones, which work very well excepting where there is limestone. The only remedy for that species of clay is washing, which is too expensive for common brick-making. A machine that will separate all gravel or other hard substances from the plastic clay, and leave it fine enough to be worked into terra-cotta, has been tested, and fulfils all the requirements. It is very simple, and will separate large quantities of clay with very little power. This machine will help manufacturers to use clays which at present are worthless, but which may become sources of wealth when passed through suitable machinery.

Some may smile at the idea of making bricks by machinery, but it is believed that brick-making by hand will soon become a thing of the past. The stiff-clay, machine-made brick will be used for paving purposes, bridges, docks, tunnels, and all works that require great strength; while dry-pressed brick will become the building-brick of the future.

Four specimen bricks made by the tile company mentioned, and picked up at random, were submitted to a test by the Chicago Forge and Belt Company about three years ago. The ultimate crushing resistances of the samples were 252,000, 228,000, 210,000, and 318,000 pounds respectively. The bricks measured $7\frac{1}{4}$ by $2\frac{1}{4}$ by 4 inches.

The construction of a brick pavement is a simple matter. The foundation being brought to the proper grade, there is spread over it six inches of gravel or sand, which is struck off with a board gauge fitted for the grade of the street. A course of brick is then laid on the flat surfaces, running lengthwise the street. It is not necessary that this course should be as hard as the upper course, being only a foundation for the brick that will receive the wear. Over this an inch of screened sand is spread, gauged, and properly smoothed off. The top course is laid with the bricks on their edges, lengthwise across the street. Care is taken to break joints in both courses. The whole is covered with an inch of screened sand, which is swept into the crevices. After this is done, a roller weighing five or six tons is passed over the pavement several times. If the street is properly rolled, it will be as smooth as wooden pavement, and almost as noiseless.

The street should be drained in some manner, as the lasting qualities of the brick and the even surface of the street depend to a great extent upon the drainage, as it is a well-known fact that water weakens brick very much. It would be a good plan to run a six-inch drain tile outside of the curbing, connected with a four-inch tile running through the curbing at the corner of each block. This will carry off all surface water; and, if the six-inch tile is about three feet below the surface, it will drain the sides of the street, so that water will not reach the foundation of the street.

The upper course should be very hard. The brick should be vitrified. It may be objected that if they are burnt to a glassy surface they will chip off or be crushed. That objection is not sustained. In Decatur are whole blocks paved with brick as smooth as glass and as hard as flint, and no brick of that description shows any signs of wear. The wear comes on the objects passing over the bricks, which are harder than steel, for a file will not scratch them: in fact, when broken open, they resemble flint.

Horses do not slip or fall on brick pavements as they do on granite blocks, owing to the small surface between the seams. Another advantage possessed by vitrified brick is that they will not soak water. If water and frost are kept out of brick, they are almost indestructible. Professor R. T. Brown says, "Clay well burned is as nearly a neutral substance as any in nature: its elements, being well united and in chemical equipoise, have no affinity for other substances that might disengage them from their combination. It is therefore chemically indestructible."

The Decatur Tile Company laid a block of brick four years ago, on a private contract, agreeing to make all repairs for five years free of charge. The street has not yet needed any repairs whatever, and from present appearances it will not be necessary to make any for the next twenty years. The first cost of such a pavement is low, the best pavement in Decatur costing only from \$1.25 to \$1.50 per square yard.

It was formerly thought that only certain kinds of clay could be

used for paving-brick, and the Decatur Tile Company is believed to have been the first to make it of common clay. Now there are a number of factories using the same kinds of machinery, and making the same quality of brick from such clay.

The following, from the *Clay Worker*, is of interest in this connection: "Brick-making has been dormant for nearly thirty centuries. From the time that clay-workers moulded and burned the bricks for the Royal Palace of Nebuchadnezzar, and stamped the royal signet on them, till the beginning of the present century, not a single step had been taken toward improvement in any of the processes involved in making and burning brick. Within the last fifty years, however, brick-making has been waked to new life, and now scarcely one of the old processes in its original form remains. Every thing, from the selection of the clay, to its preparation, moulding, drying, and burning, is stamped with innovation, may we not say with improvement? Machinery has been called in to aid this march of progress; and what had been the drudgery of hard labor, from the days when the Israelites toiled in the brick-yards of the Rameses, is now thrown on the broad shoulders of steam-power." It may be added that the greater improvements have been made in the last seven years, and still greater may be expected. By bringing the fuel and clay together with proper appliances, we may have good, clean streets in all our cities. And it would pay the farmers well if brick pavement should be extended into the country, as it would enable them to market their produce in winter, when otherwise the roads are impassable. It would also do away with road-taxes for a generation at least, for a road properly paved with hard brick ought to last fifty years, with very little repair. For a road paved, fifteen feet wide, with two courses of brick, at the prices of material and labor already given, the cost would be about ten thousand dollars per mile. Such roads might be considered expensive, but they would prove to be a good investment in the long-run.

J. G. SHEA.

A FIVE-MASTED SAILING-SHIP.

THE preference of ship-owners for large cargo-carrying vessels is becoming more and more pronounced, and the companies more particularly engaged in the part of the shipping trade in which sailing-ships are worked seem to vie with each other in securing "the largest ship afloat." Intimation is given in *Engineering* that a contract has been placed with a firm on the Clyde, who make the building of sailing-ships a specialty, for the construction of a five-masted steel sailing-ship to carry 6,000 tons dead weight. Not only will this be the first five-master, but it will be the largest sailing-ship afloat. At present a vessel named "Liverpool" has this distinction. She has a gross tonnage of 3,330 tons, her length being 333 feet, breadth 47.9 feet, and depth 28 feet moulded. Brokers, too, like the big ship, and the reason is so evident that it is not necessary to refer to it; but underwriters do not seem so much enamored with it. Quite recently one of the largest vessels—shorter by 10 feet, but broader by $1\frac{1}{2}$ feet, than the "Liverpool"—was chartered to take coal; but, when all the debatable points of a charter were settled, the underwriters had to be reckoned on, and they desired such a premium as made it quite impossible to proceed further in the matter,—something like £10 to £15 per £100. They contended that the greater the quantity of coal carried, the greater the danger of fire. This vessel, however, has made several voyages, and no difficulty is now being experienced with the insurance firms. They will be educated to a higher standard, although at present a little conservative. There is another difficulty, however, which cannot be so readily overcome. Such large vessels can only be employed profitably in certain trades, and great inconvenience must arise unless suitable graving dock accommodation can be afforded at the large trading ports. No difficulty will be experienced at home; but in Calcutta, for instance, one of the big ships now afloat presented itself recently for admittance to the dock, and it was found that her beam was too great; and yet boats with more beam will be built. The result was that she had to load, and hope for better accommodation at her next port. San Francisco and New York have large docks, but the importance of Calcutta port for ships cannot be ignored.