AMERICAN

DISTRICT STEAM COMPANY.

Belly System,

LOCKPORT, N. Y.

GIES & CO., LITH., ENG. & PRS., BUFFALO, N. Y.

AMERICAN DISTRICT STEAM CO.

HOLLY SYSTEM

—OF—

Street Distribution in Cities and Villages

FOR PURPOSES OF

HEATING AND POWER SUPPLY.

OFFICERS.

R. S. BISHOP,	*President*
W. C. ANDREWS.	*Vice-President*
I. H. BABCOCK,	*Treasurer*
B. D. HALL,	*Secretary*
BIRDSILL HOLLY,	*Engineer*
E. P. HOLLY,	*Superintending Engineer*
CHARLES E. EMERY,	*Consulting Engineer*

OFFICE,
LOCKPORT, N. Y.
1886.

LOCKPORT, N. Y.:
WARD & COBB., Book and Job Printers, 91 Main Street.
1886.

The American District Steam Company, in January, 1882, succeeded the Holly Steam Combination Co., Limited, which last-named corporation commenced operations in the year 1877.

After nine years of experience in the construction and operation of District Steam Systems on a large scale, for purposes of Heating and Power, the Company believes it is justified in claiming the entire success of the enterprise, and the country may now look forward to a more rapid development of the work in all or most of our chief cities and villages.

What is the District System of Steam Distribution?

It is a steam generating station in capacity, depending upon the service to be performed; it may be one boiler, or one hundred, aggregating one hundred horse-power up to fifteen or twenty thousand; mains of wrought-iron pipe radiating therefrom, laid under the streets and protected so as to prevent radiation of heat, with provision for expansion and contraction of the iron; from the mains, services taken off and leading to the buildings on either side of the street; in the buildings, whether residences, stores, churches, or public buildings, radiators of some kind to contain steam at reduced pressure, and measured to each consumer through a meter.

The same generators and system of street mains and services supply steam for power. It may be to run elevators, to pump water, to generate electricity for lighting on the premises; to do all the varied branches of manufacturing required by industries in large cities.

Civilized society demands the best service which science can master in supplying its necessities, and in ministering to its every-day comforts. To perform this service effectually, it must enter the home and the apartment, and come in contact with the throbbing pulses of daily life. This is what the District System of Steam Distribution does to a far greater extent than any other system.

Accustomed to the safe and economical convenience of gas for lighting our houses, and to the use of the hydrant water service system in cities, we were prone to believe that invention had reached a limit in this direction; yet, precisely in the same manner as light and water are supplied, the steam system brings your

FIRE TO YOUR DOORS IN PIPES,

as gas and water are, fulfilling every requirement of fire in dwellings—warm your apartments, cook your food, wash, dry and iron your clothes, run your steam engines, clear the snow from the streets, heat and ventilate your school-houses and public buildings, extinguish fires, and, in fact, do all and everything that either fire or water (for steam is both) may accomplish in the domestic economy of cities, at a cost below what you now pay for the uses of fire, and what is more especially interesting to cities where soft coal is used, without soot, smoke and ashes, with their vexatious train of coal-buckets and ash-barrels.

All of this, and more, may now be confidently and positively asserted from the combined experience of its critical and practical use in many cities and villages, and the adoption of the system in others preparing to inaugu-

rate it during the ensuing year. It is not inappropriate to remark, in this connection, that hindrances which have interposed in some cities, whereby companies have been delayed, have proceeded solely from local, political or mercenary motives, and in no instance from opposition to the system; and it is not improper to state that its reception by the people in cities where it has been adopted, has been a grateful enthusiasm amounting to an ovation. It is also proper to state that embarrassments which have occurred in the case of one or two steam heating companies, have been in consequence of mismanagement on the part of officers or employes of the local companies, and not from any defects in the mechanical or practical features in the problem of District Steam distribution.

WHO ARE BENEFITED.

In the first place, property-owners. No street is entered with a steam-pipe without the business and property on the street being materially enhanced in value. Property is more rentable, and at better prices. Fire risks are materially reduced, and, consequently, the cost of insurance.

DANGER FROM EXPLOSION

is reduced to a minimum. All pipes laid are of wrought iron, and tested beyond the possibility of an explosion from any pressure that is ever required. The boiler station is always under the control of a skilled engineer and fireman. It is easy to see, that when one establishment is made to supersede a hundred, it may be five hundred small boilers in basements for purposes of heating and of small manufacturing, under the supervision of careless and incompetent servants, that the balance of immunity from risk is largely on the side of the District System. There is no doubt that we, of this age, are wiser than our ancestors; that is, we know more upon a greater variety of subjects than was ever dreamed of in their philosophy. Most likely our successors, fifty or a hundred years hence, will congratulate themselves that their lot was not cast in the slow-going latter half of the nineteenth century.

Certain it is, that the fifty years last past, or thereabouts, have seen wonderful advances in the mechanic arts and the appliances which contribute to the welfare and comfort of society and of individuals. To enumerate them all, would require a volume.

FIFTY YEARS AGO,

many wise men looked with contempt upon the proposition of George Stephenson to transport people by steam in cars running on iron rails. Now, the civilized world is grid-ironed with highways of steel, and the railroad train, rushing from one end of the land to the other, in all directions, is a more familiar object than was the stage-coach then. We cross the ocean in six days, against wind and tide, when our fathers took six weeks to

accomplish the same journey. Other wise men have scoffed at other marvels which have followed closely in the wake of railways. By the telegraph, we convey intelligence to the uttermost parts of the earth, over mountains and under seas. With the telephone, friend talks with friend, and the familiar voice is recognized hundreds of miles away. The wonderful perfection of the power printing press has multiplied intelligence. Machinery of all kinds has been so perfected, that it has become a substitute for labor. Human effort has, therefore, broadened its operations, and the resulting improvements occupy, to-day, fields before unexplored. All these wonderful discoveries, as they succeed one another, demonstrate the natural evolution of true science, as it is taking place in these latter days.

One invention, or discovery, which elevates labor or contributes to the sum of human happiness, is but the stepping-stone to another.

Nowhere are these evidences of advancement better illustrated than in the improved methods of heating our buildings.

The conditions of living in this latitude require our families to pass the greater portion of their time in apartments artificially warmed. It is, therefore, a matter of vital importance affecting our everyday life; and as the subject of warming and ventilating dwellings has occupied the attention and ingenuity of man ever since dwellings were devised, it will be interesting to know wherein District Steam heating differs from, or is better than other methods.

In the days of cheap wood fuel, our forefathers and mothers were quite content with the huge, open fire-place, in which the enormous back-log furnished the glowing perspective to the vast pile of blazing wood, whose cheerful flames lighted and warmed the family circle around the evening board of apples and doughnuts. Those by-gone days of good neighbors, when the pendant crane, Dutch oven, iron spider and tin kitchen rendered any further invention in the culinary art unnecessary. But, alas, for those days of primitive simplicity! Advancing luxury soon introduced the

TEN-PLATE STOVE,

and, finally, the effeminate cooking stove, inaugurating, at the same time, the toilsome career of another innovation, *the saw and buck*, which the youth of those days (like others whose self-interest and personal comfort is affected by the march of progress) soon learned to hate. Then commenced the long list of stove patents, at the very enumeration of which arithmetic stands aghast.

The first ton of coal mined in this country sold in Philadelphia, in 1813, for $21.00. The coal products of Pennsylvania now amount to over $50,000,000 per annum, at less than $3.00. Which the cause and which the effect—the coal or the cooking stoves—is not now under discussion. We cannot discuss either the sanitary or economical features of the primitive methods, for the early log cabins were usually well ventilated, and wood

was too cheap to have a rival. The comparative economy of the coal stove with the cheerful and more healthful open grate, might be considered, but as no successful methods have yet been devised to secure cleanliness or economy in either, they may be regarded rather as models of extravagance, upon which improvement is desirable. Surrounding stoves with a jacket, first employed in school-houses to prevent children from burning themselves against the stove, foreshadowed and suggested

THE HOT-AIR FURNACE,

when some Yankee school-master thought of conducting currents of fresh air from the outside to the inside of the jacket, since which time the accumulating number of patents bids fair to rival stoves. By the air furnace, a purer air is obtained than with stoves, and abundant heat, with less dirt and ashes and greater convenience; but there are no facts offered by their advocates from which to infer economy, and they are liable to grave objections, among which is the unpleasant dryness of the air and almost constant impurity from the deleterious gases consequent upon the burning of animalculous, vegetable and mineral matters, conveyed in the air from without and brought in contact with the heated iron; besides which there is still the annoyance of soot, ashes, coal-bins and ash-barrels, and the cost is far greater than with steam.

PRIVATE STEAM HEATING

by boilers on the premises may be regarded as among the best and latest methods of heating, and has been largely adopted in all modern cities throughout the world. Its advantages, in respect to cleanliness, comfort and economy, have been satisfactorily tested by experience. The mechanical contrivances to facilitate and cheapen this method of warming buildings, have been numerous and ingenious, but none have devised means of ventilating or regulating the temperature and steam supply automatically, and by many the system is deemed gravely defective, and by not a few absolutely injurious, in consequence of the high temperature and impure air. These objections are all and absolutely obviated by the Holly system of

DIRECT AND INDIRECT HEAT,

which furnishes a remedy for the evils of impure air, excessive heat and bad ventilation, and also wholly obviates the annoyances of dust, soot, ashes, with their vexatious train of coal-buckets, ash-pans, barrels, bins, &c.

With a system of pure, warm air at a uniform temperature, which regulates itself automatically, colds, neuralgias, rheumatism and the host of disorders produced by admitting drafts of cold air into over-heated rooms, in order to cool or purify them, will be diminished and, perhaps, banished.

Nothing is more common than to open windows in order to purify the air while sleeping, and under the present methods, it is, perhaps, choosing the lesser evil, but it is a mistake to suppose that we should sleep in *cold* air.

IT IS PURE AIR WE NEED.

We take cold while sleeping more readily than at any other time. In sleep, we are less fortified against atmospheric changes than when awake. It is when we sleep, therefore, and more especially young children, who become restless from the nervous excitements of the day, and throw off the bed-clothing, that abundance of warm, pure air, at a moderate, but uniform, temperature, is required.

Mr. Holly is, by no means, the originator of the idea of general steam heating, for it has not only been hoped for and predicted by engineers for half a century, but many and costly efforts have been made in several European cities to introduce it without success. In a majority of all large cities, hotels, stores, dwellings and public buildings are successfully and economically heated by steam from local boilers. But when it has heretofore been attempted to transmit steam any considerable distance in order to supply heat and power, the results have not been *profitable to the producer or safe or satisfactory to the consumer*, and until Mr. Holly, the problem of general steam heating remained unsolved, and many self-considered expert engineers have gone so far as to assert, as Prof. Locke did in relation to the telegraph, that from the known nature and quality of steam, it never could be.

In fact, the obstacles in the way of a general system of steam service were more numerous and serious than would appear to the inexperienced who witness the apparent ease and precision with which

THE WONDROUS FORCE

is handled, directed and controlled by experts; but steam, with all its docility, is a willful force, and, like many animals, does man's bidding only on compulsion; powerful for good while under wholesome restraint, but tremendous for evil when allowed free license; patient and tireless in its work when supported by its master-spirit, *heat*, but shrinking back into its original element, water, timid and sensitive before its remorseless enemy, *cold*.

CONDENSATION

was, therefore, the first great impediment to the transmission of steam through extended lines.

Science is able to calculate the precise number of heat units carried by steam under any given pressure, and will tell the exact amount of radiation, per lineal foot of pipe, of any specified diameter; from such facts, science

acquires the habit of asserting positively that certain things can, and others cannot, be done. In deference to the claims of science, people whose knowledge only reaches the conventional standards, either hesitate to accept or flatly deny the possibility of anything beyond the sphere of their own knowledge. It was not surprising, therefore, to hear the President of the Brotherhood of American Engineers in New York, during the application to the Board of Aldermen for permission to inaugurate the Holly system, make the statement before some two hundred members present, that "no one had ever conveyed steam one mile in pipes, and, what was more, that no one ever would do it; that he was a *practical* engineer, and knew what he was saying from experience."

Yet, to-day, the New York Steam Company is supplying steam for heating and for power through five miles of street mains, and its business is an assured success.

This was said, also, at a time when that still

MORE PRACTICAL ENGINEER,

Mr. Holly, was practically supplying steam for heat and power to three hundred buildings through nearly four miles of pipe, at a loss by condensation not exceeding five per cent. per mile, proving, beyond a doubt, not that steam will not condense, but by means of the most common-sense devices, that he had been able to arrest radiation of the heat from the pipes, and obviate the consequent condensation to an extent, that the loss is less than the estimated loss of the gas companies in the distribution of gas.

Another stumbling-block in the way of the transmission of steam, was the alternate

EXPANSION AND CONTRACTION

of metallic pipes by heat and cold, to which they would necessarily be subjected sufficiently to cause them to bend and buckle, endangering the joints and breaking off lateral pipes taken from them. This obstacle was obviated by practical devices which accomplished the end in view.

In addition to these, there were many mechanical details necessary in order to render a general system of steam supply successful, that is,

PRACTICAL, PROFITABLE AND SATISFACTORY TO ALL CONCERNED.

No meter for determining the quantity of steam consumed had been devised. It was necessary to originate some better and more reliable method of reducing steam pressure and regulating the supply in buildings automatically, whereby SAFETY AND ECONOMY could be secured independent of the discretion of ignorance or carelessness; simple and efficient traps for

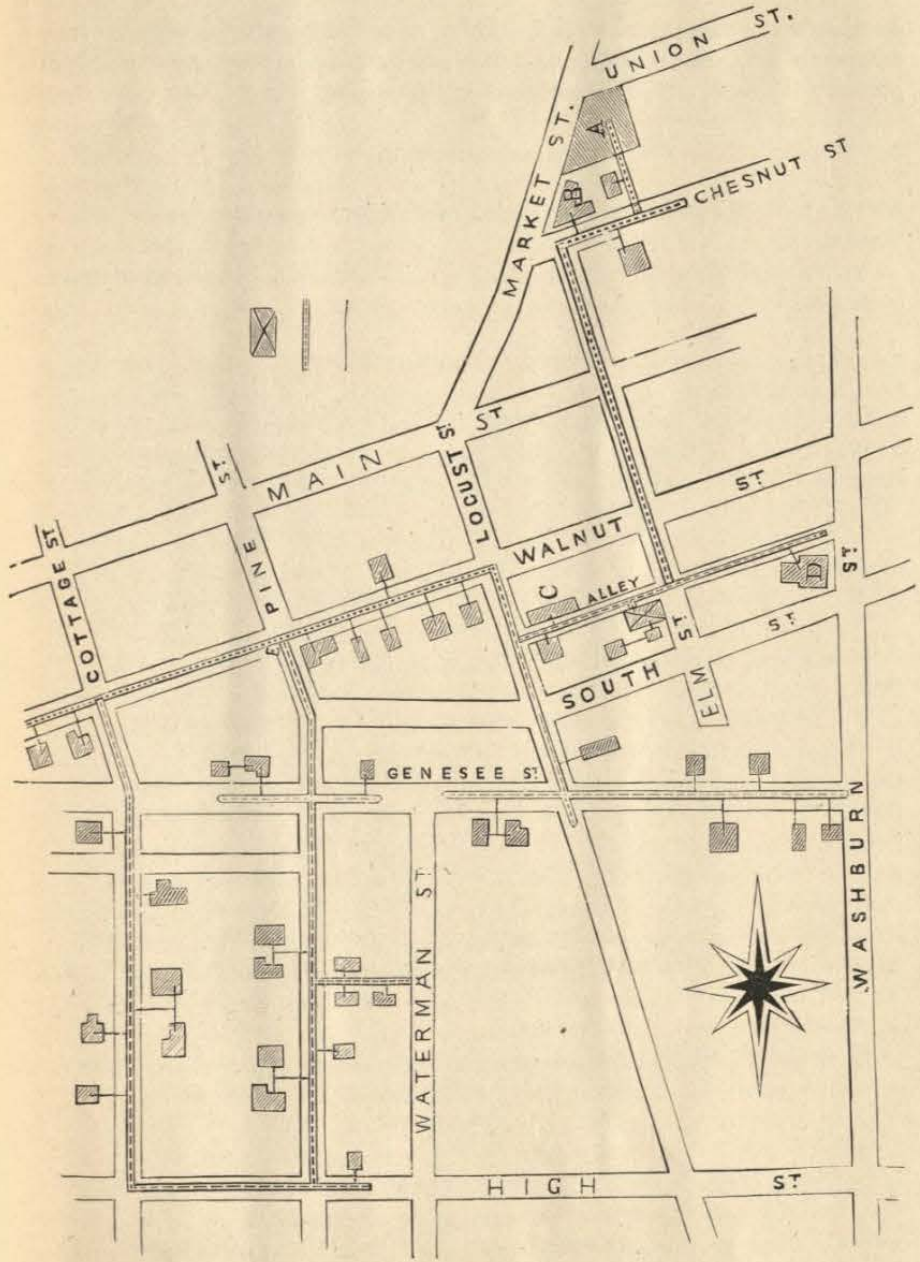


PLATE I.

carrying away the water of condensation, means of regulating the temperature of rooms automatically, and some practical device for cooking at low pressure. These and other requirements met the

DARING MECHANIC

who should attempt to override the axioms of previous experience or tradition.

When investigating and assorting the crude facts and materials presented by nature and experience,

UNWISE LEARNED MEN

are prone to adjust the focus of vision at too great distances in search of the wonderful and abstruse afar off, at the same time overlooking the more simple and obvious within easy reach. It is, perhaps, charitable to believe that this has been the case during the long-continued search of the learned after some practical system of general steam supply. Every age is apt to overestimate the amount of attained knowledge, and undervalue the unknown. As Mr. Holly owed no allegiance to the schools, and is singularly devoid of the pride of self-derived intelligence, he was able to appreciate the determined facts of science at their value; and fully realizing the difficulties before him, had the patience and perseverance to sift out the useful experience of the past, select, combine, improve and invent. He had the genius to recognize principles and predict results, and what is still more important, the courage to apply his ingenious combinations and inventions to the test of practicé, notwithstanding the adverse opinions of the learned and traditional experience of engineers. We are justified in asserting that the introduction of his system is but the inauguration of a complete revolution in the domestic economy of the civilized world, and this generation will live to see the district system of steam heating side by side with water and gas, or electric light, in every city or village disposed to utilize the benefits of modern invention.

The initial system of steam supply through street mains was constructed in Lockport, N. Y., in 1877, the character and extent of which may be estimated by reference to

PLATE I,

exhibiting a diagram of the boiler-house and location of mains and laterals. Two boilers, 5 x 16 feet and one upright, were planted, and three miles of underground pipe laid, the largest being but four inches in diameter. The first winter, forty buildings were supplied with heat, comprising dwellings, stores, shops, hall and school-house, scattered along the line of pipes, and power was furnished to one elevator and one twenty horse-power engine.

The *eclat* of an enterprise so novel and bold, attracted the attention of engineers and scientists from all parts of this country, Europe and Canada, and the experiments were conducted throughout the winter with all the critical care and accuracy that science and experience could suggest. Regarded as a "new departure" from the beaten track of engineering art, the skepticism of experts gave the experiment more the character of an "inquisition" than a scientific test of a mechanical problem, but in the spring, after the close of the long trial, the most captious mechanical infidel was compelled to admit

THE UNQUALIFIED SUCCESS

of the combination as a general system of steam supply to cities; and among the citizens of Lockport who had used the steam, one would seek in vain for a single person to condemn it even with faint praise or a lukewarm opinion, for, as expressed in the report of a commission of New York City experts, "the enthusiasm of the Lockport people over the results is boundless,

THE LADIES

being by far the most emphatic and demonstrative in their encomiums upon its superior cleanliness, comfort and convenience."

During the winter of 1878–9, the pipes were extended to over four miles, and over two hundred buildings were warmed—the number being limited by the ability of the company to supply fittings. During that winter, the system was fully and fairly tested by companies formed in *Detroit, Mich., Springfield, Mass., Auburn, N. Y., and the Soldiers' Home, Dayton, O.*, and the results confirmed previous experience concerning its safety, efficiency and economy. The combined experiences of that season established upon a firm basis the enterprise of District Steam distribution for heating, and for power.

Some embarrassment existed, because, at that time, the meter had not been perfected, and the companies generally based their charges for steam at a fixed price per thousand cubic feet of space per annum. But this plan of charging can never give entire satisfaction, because it is not just; some houses are less exposed, and, therefore, require less heat than others. Some consumers desire to economize by not heating their entire space at all times, but the fixed rate removes all motive for economy; the consumer can even afford to be extravagant since it costs him no more, and the company suffers serious loss because it is powerless to prevent extravagance and imposition. But the meter provides a remedy for all these evils. The consumer pays for what he uses, and no more, and is, therefore, interested in an economical use of steam, and the company knows at all times what its consumers are doing, and whether it is getting a proper duty from the fuel consumed under its boilers.

In fact, all experience, so far, concurs in proving that a meter is indispensable to the practical success of District Steam heating. But the problem was finally solved when Mr. Holly, about three years ago, achieved the difficult task of constructing a steam meter, which has now been in practical use by a large number of companies, and is endorsed as being practically reliable and correct—the first actual steam measure yet produced.

After the critical trial of the first two seasons at Lockport, skeptics were compelled to admit that heating buildings could be satisfactorily accomplished, but still doubted the practicability of furnishing power to any considerable extent. But since that time, the abundant practical experience of many companies, notably that of the New York Steam Company, demonstrates the entire feasibility of a steam supply for power through long lines of pipe. We quote from a recently published pamphlet of that company, as follows:

"We have now over two hundred buildings on our lines, including 160 engines for power, supplied with steam wholly by this company from its Station B. It will be news to many, that nearly all the principal newspaper establishments in New York City are, and many of them have been for months, operated with steam supplied wholly by this company—the Times, the World, Commercial Advertiser, the Tribune, and five others; and many printing companies are now so supplied with their power and heat, notwithstanding most of them have boilers on their own premises. The new Produce Exchange, with nine elevators, and electric lights; the new building of the Mutual Life Insurance Co. of New York, on the old post-office site, Nassau street, with six elevators and fifteen hundred incandescent electric lights, are now contracted for, and our steam is in their buildings. These buildings have no steam boilers on their premises. This is a new departure, and the time has come that the owners of new buildings, located on the lines of the New York Steam Company, should no more think of putting in steam boilers than of erecting gas works on their premises."

It is, therefore, proper to assume, emphatically, that the system has passed beyond the sphere of experiment, and may be regarded as *an established fact.*

THE MECHANICAL DETAILS

of the system we will present briefly, by detailing the course of the steam from the boilers through the various devices to control and regulate its use until it is finally condensed into pure distilled

WATER FOR DOMESTIC PURPOSES.

In this system of heating, it is desirable to have as few plants as possible placed at central points, as convenient as may be, to coal and water. Plate II represents the boiler-house at Lockport, and its relative location in the

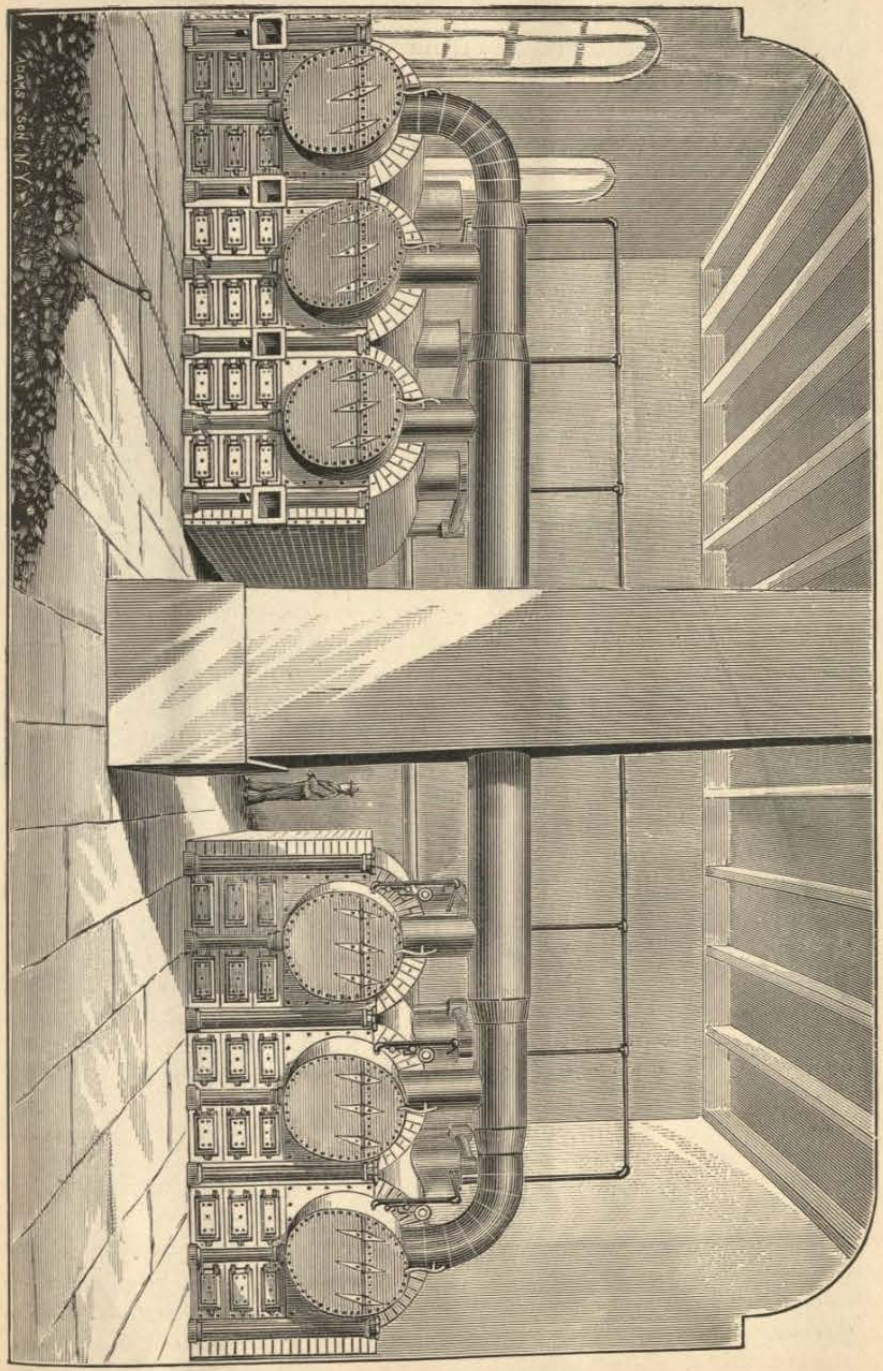


PLATE II.—Sectional View of Inside of Boiler House.

city may be seen by reference to Plate I. As the profit to those who supply the steam will depend upon its economical production, it will become of the first importance to omit nothing known to modern engineering art that will secure the largest amount of evaporation of water, at a minimum cost for coal, as steam is used merely as

A CARRIER OF HEAT.

It is, of course, unnecessary to say that the best and most economical boilers should be selected, and the most careful and competent engineers and assistants obtained. It is by no means an unimportant fact to be considered by cities with reference to this system, that the dangers and annoyances of boilers will be confined to a few localities, and their objectionable features obviated in cities like New York, St. Louis and Cincinnati, where thousands of boilers are distributed through the city, and every sidewalk is a mine, within which is an element of

DANGER,

in charge, in many cases, of engineers ignorant, faithless and reckless.

Inasmuch as the economical production of steam is of the very first consequence to parties about to inaugurate the District System, a few notes from the extended experience of the parent company will be appreciated. Understanding the general process and products of combustion, it would seem that the production of steam, and economical combustion of fuel, should be among the plainest of scientific problems. Whereas, it is in point of fact among the most obscure, and each year, for half a century, the patent office has groaned with inventions to save fuel, abolish smoke, evaporate water and utilize steam, each, perhaps, some improvement upon the last, but still leaving a great need unsupplied. Believing that whatever device was able to utilize for the purpose of evaporating water, the largest results from the most perfect combustion of fuel would be the desideratum in steam heating, the company have welcomed every plausible improvement, and conducted the most extensive and careful tests at vast expense, and with absolute impartiality. Among many others, their attention was called to a report of U. S. Government experts, upon what was called the

MURPHY SMOKELESS FURNACE,

shown in Plate III, and, subsequently, by the report upon it as a *smoke consumer* by the Cincinnati Industrial Exposition of 1879.

After several years of practical operation, and many careful tests with this furnace, we freely accord to it great merit wherever bituminous slack coal is the fuel to be used in generating steam. But experiment has also developed a valuable discovery bearing upon the subject of economy in steam heating,

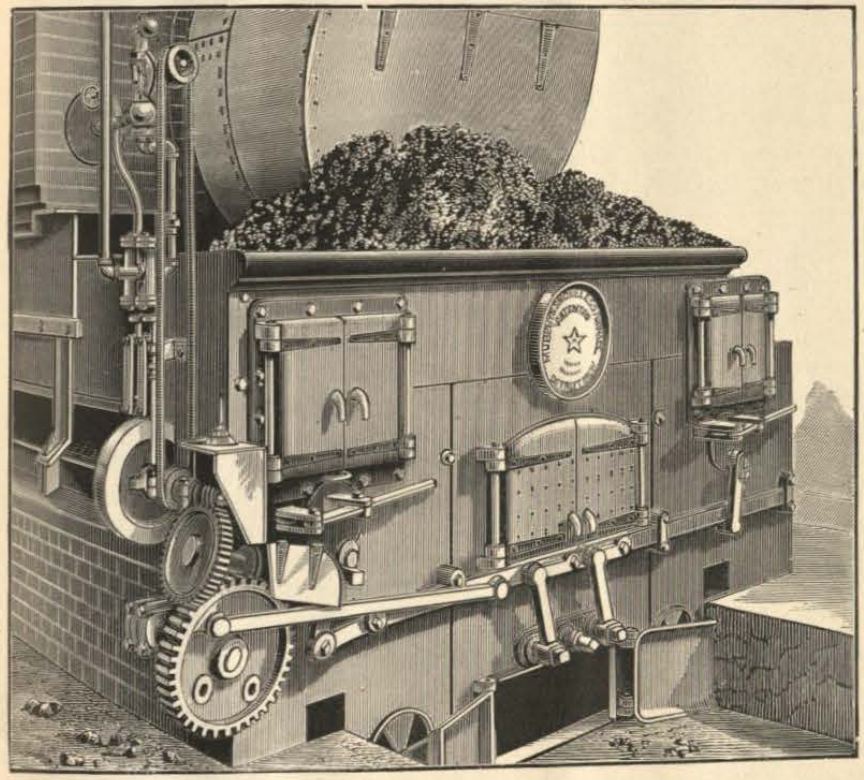


PLATE III.—Murphy Smokeless Furnace, with Automatic Feed.

BY UTILIZING THE EXHAUST STEAM FROM ENGINES.

Although more or less use has been made of exhaust steam for heating purposes in times past, it is still urged by engineers generally, that "the power takes the life out of steam;" that "back pressure embarrasses the engine;" and that "there is no economy in doing it." The absurdity of these statements will be readily understood by reflecting—

1st. The engine cannot take the life out of the steam for heating purposes, since life, in this sense, means heat, and no heat is lost excepting the small amount lost by radiation in the engine. The pressure is principally gone, but in place of pressure we have the greatly increased bulk, showing the action of the engine and its effect upon the steam to be identical with any reducing valve, which device must be used in every building for reasons of economy and safety.

2d. Every well-constructed engine can be made to run against a back pressure of ten to twenty pounds without difficulty.

3d. To evaporate a given quantity of water under a pressure of 200 lbs. to the square inch, costs 4 per cent. more fuel than to evaporate the same quantity under the pressure of 7 lbs. Thus, if the units of heat are not diminished by reason of running the engine, excepting the minimum amount of loss by radiation, and if the back pressure costs only the ratio of a higher pressure, the following proposition is theoretically true: Suppose an engine must have 50 lbs. net pressure to carry its certain load, we will give it 65 lbs. and exhaust its steam into a heating main or pipe, thus doing nearly a double duty in first running the engine for power, and, secondly, in warming buildings or other purposes, for which steam is required.

The Holly Double System, constructed on this plan, has been fully tested on a large scale, and has demonstrated the practicability and the results claimed in the proposition.

In this connection, it is safe to assert that if the electric light should ever become of general practical utility, it must be with the aid of the District System of general steam circulation, for the simple reason that it requires steam-power in order to generate electricity for its subdivided lights. If this be true, the multiplication of boilers and engines necessary to light a city would prove a serious and costly hindrance to its general adoption. But with the District Steam pipes laid in the streets, innumerable small engines could be placed in vaults under sidewalks or convenient basements, and made to work the electric generators. One man could easily attend to fifty engines in a district, while he would find it difficult to manage even five boilers satisfactorily without the aid of firemen—to say nothing of the dust, labor and danger of boilers. The exhaust steam from each engine could be used for warming the building whose basement was employed, or returned into the secondary system of heating mains.

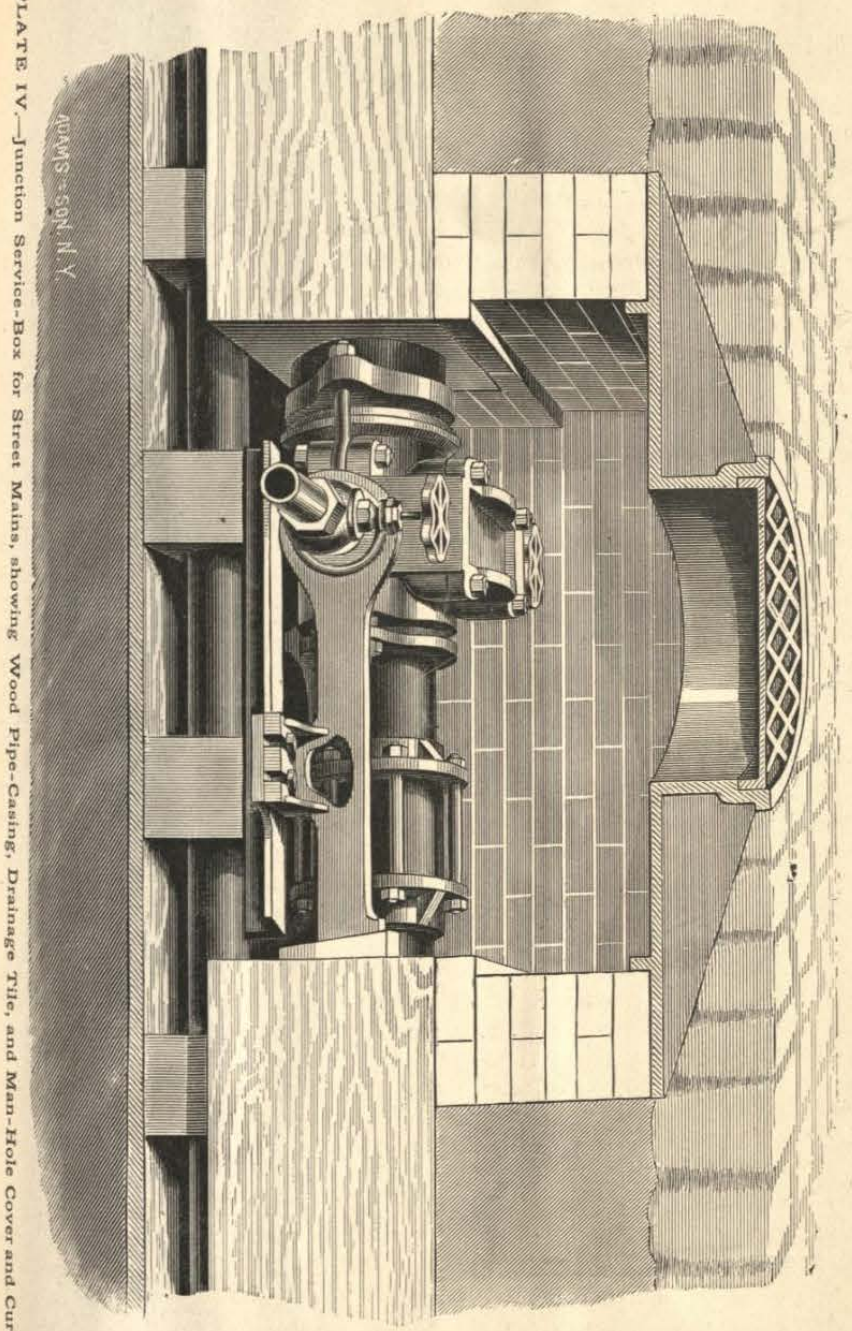


PLATE IV.—Junction Service-Box for Street Mains, showing Wood Pipe-Casing, Drainage Tile, and Man-Hole Cover and Curb.

From the boilers, the steam passes into

THE MAINS AND LATERALS.

The material used after experiments with cast iron and other substances, is the ordinary *lap-welded wrought-iron steam-pipe*. These pipes are always tested by the manufacturers to a tension far above any possible use, for example; a 12-inch pipe of this kind, ¼ inch thick, has a tensile strength of 60,000 lbs., and would bear a pressure of 2,500 lbs. to the square inch, but no pressure exceeding 100 lbs. will ever be required in this system.

The expansion of wrought iron between the extremes, say 32° and 307°, is $\frac{1}{512}$ of its length, about 2¼ inches in 100 feet. It was the inability to obviate this, that defeated the efforts to inaugurate a general system of steam heating in European cities. This difficulty was completely overcome by the ingenious device of

THE JUNCTION AND SERVICE-BOX,

seen in Plate IV. These are placed at convenient intervals along the line of 100 to 200 feet. The arriving-pipe from the boilers is inserted by a nickel-plated extension, or telescopic joint, made steam-tight by passing through a stuffing-box. The departing-pipe is immovably attached to the box, so that one end of each 100 feet of pipe is fixed and the other movable, affording free play to the expansion and contraction.

All service-pipes are taken from the junction-box, which is securely bolted to the mains, and anchored to the masonry. The bottom of the box being placed lower than the pipes, all water of condensation is carried forward and deposited in it, to be taken up and carried to cooling coils in the house system, and the heat utilized before it is allowed to escape.

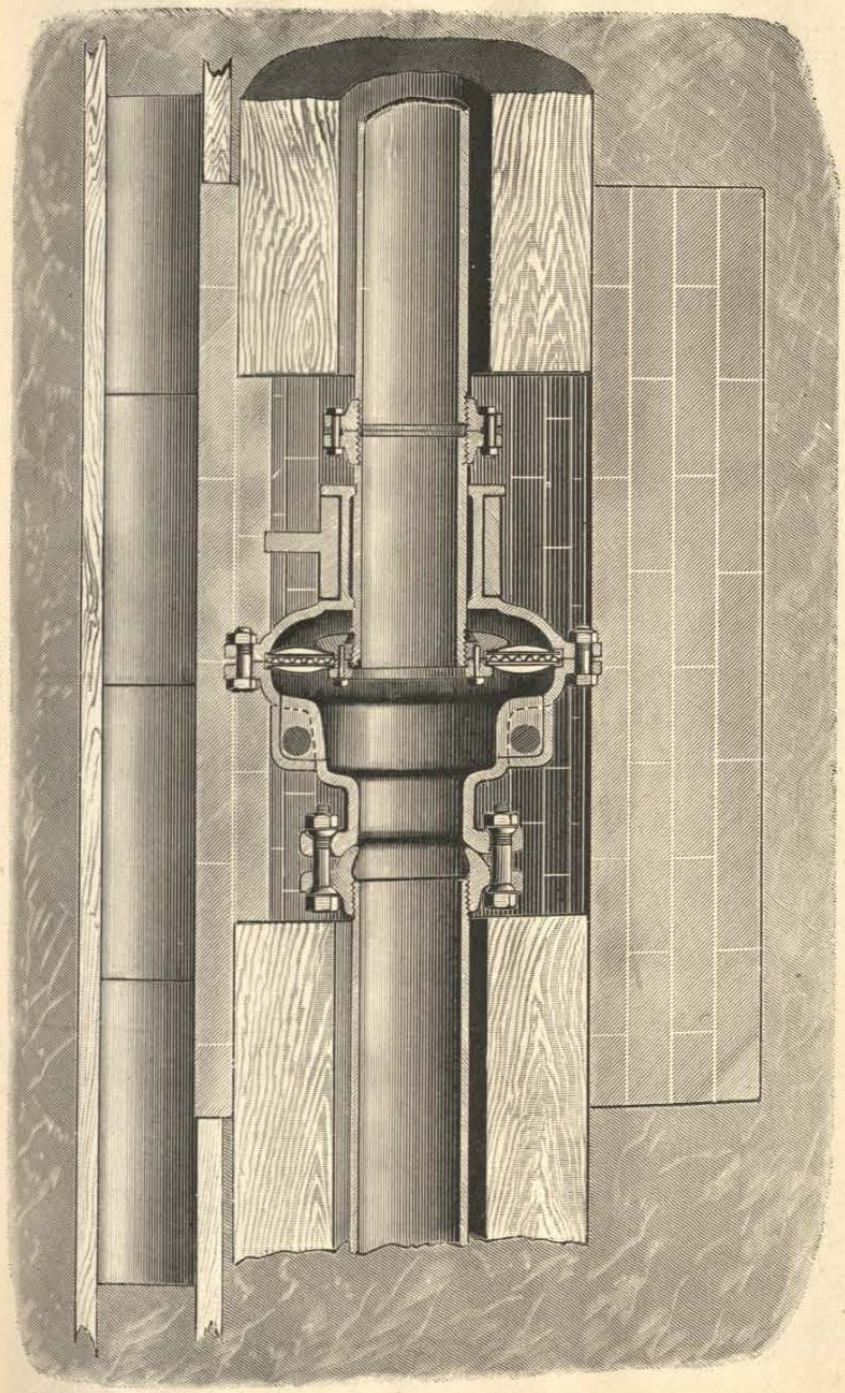
Another, and improved device for large cities, for taking care of the contraction and expansion of the iron pipes, is the

SERVICE VARIATOR.

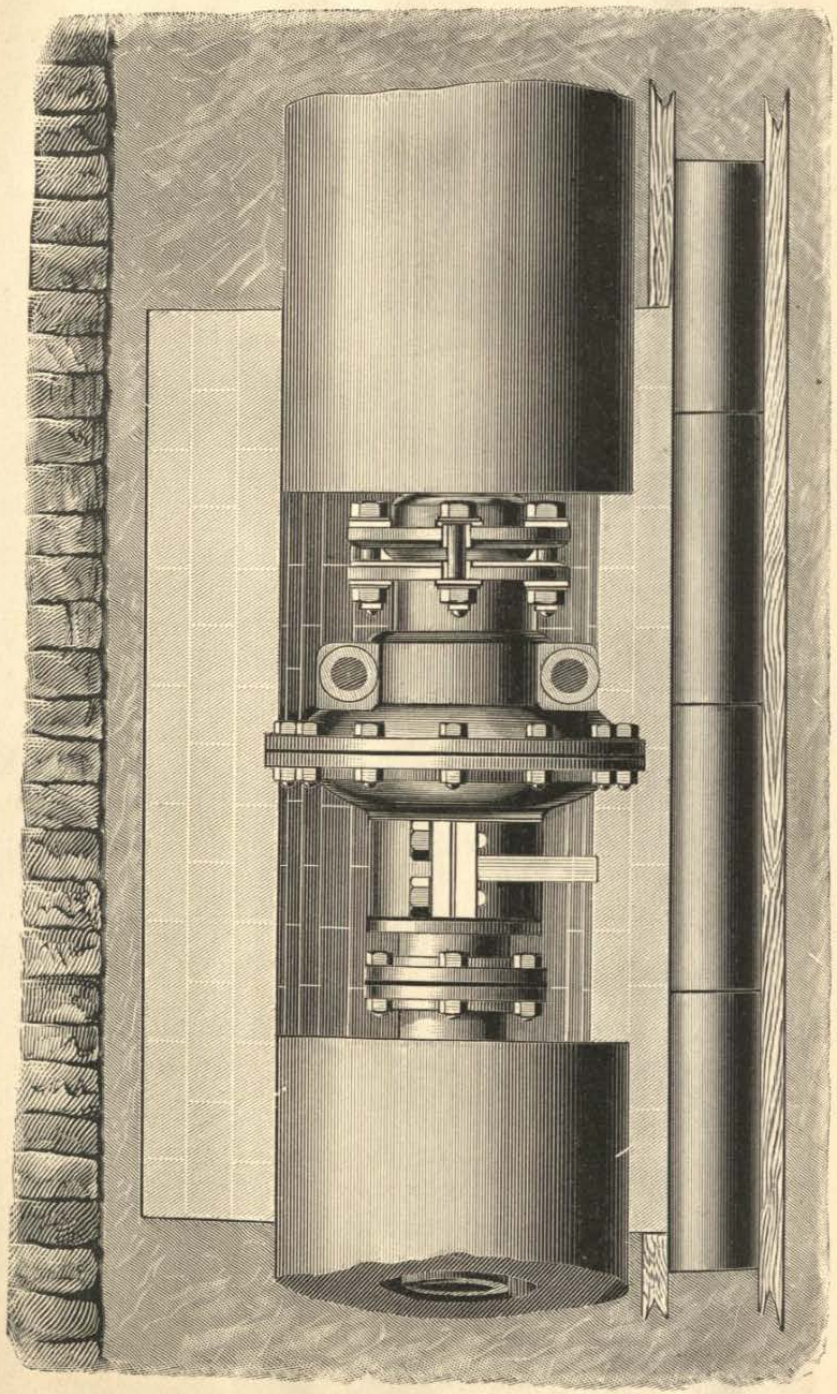
This device is placed at intervals of fifty feet along the mains, and dispenses with packing altogether. (See Plates V and VI.) No man-holes are required, the whole being enclosed and covered, the same as the body of the pipe. From the variator, the steam passes through service pipes to the building, and to another ingenious and useful contrivance, called

THE REGULATOR, (SEE PLATE VII,)

by means of which the pressure of steam is reduced, and the supply to the building regulated automatically, with unerring precision. This is accomplished by a diaphragm of rubber-packing, acted upon by a weighted lever, and moving a slide-valve. The valve is weighted to 5 lbs. or 2 lbs., as required. So delicate is this instrument, that it will determine the pressure as weighted, regardless of the change of pressure on the other side of the diaphragm.



SECTIONAL VIEW.
PLATE V.—Service Variator.



PROFILE VIEW.
PLATE VI.—Service Variator.

THE METER. (SEE PLATE VIII.)

This is regarded by experts as the most novel and ingenious device in the series, and is the first actual steam-measure yet produced. By this only reliable means, correct and proper relations are preserved between the producer and the consumer. After several years of actual use by our companies, this meter is demonstrated to be practically correct, and in all recent work, no consumer is allowed to take steam except it be measured to him through a meter. Passing the regulator and meter at a given and automatically regulated pressure, an accident from steam within the building, even in the most ignorant and careless hands, is no more liable to occur than from a tea-kettle.

The next duty of the steam is in

THE RADIATORS,

and all the varying styles which inventors and manufacturers have put in the market, are adapted to use under the District System. In this connection, let us make a brief estimate as to the cost of furnishing steam heat by radiation. One cubic inch of water makes a cubic foot of steam, which will warm a cubic foot of air 70°, for 16 hours. To make this more clear: One cubic foot of air requires seven-tenths of one unit of heat to raise its temperature from 32° to 70°. Now, a cubic foot of steam contains 42 units of heat, which is enough to heat the air fifty times in 16 hours. Again, one pound of coal will convert nine pounds of water into steam furnishing 1,000 heat units per pound. One pound of coal represents, therefore, 9,000 units of heat. On this basis, a building containing 12,000 cubic feet of air space would require 504,000 units of heat, representing 56 pounds of coal per day.

Now, let us follow the steam, or rather water, (for after losing all this heat, it becomes water at 212° of heat,) *we cannot afford to lose the heat, and we want the water.* It is conducted in protected pipes from all parts of the building where steam has been used, back into the basement, through the trap into coils of pipes set in a brick chamber; into this chamber, cold air is admitted from outside of the building as in the air-furnace, and coming in contact with the coils of hot water, abstracts the remaining units of heat, and passes up through the registers into the rooms above, warm, pure air, while the water, now cold, passes into the well for future use, if required, or to the sewer.

THE TRAP.

Plate IX is a simple and most effective device to permit the escape of the water of condensation, while retaining the steam. By reference to the plate, its operation will be at once apprehended. We have followed the steam from the boilers to the well, but are not quite done with it yet. The

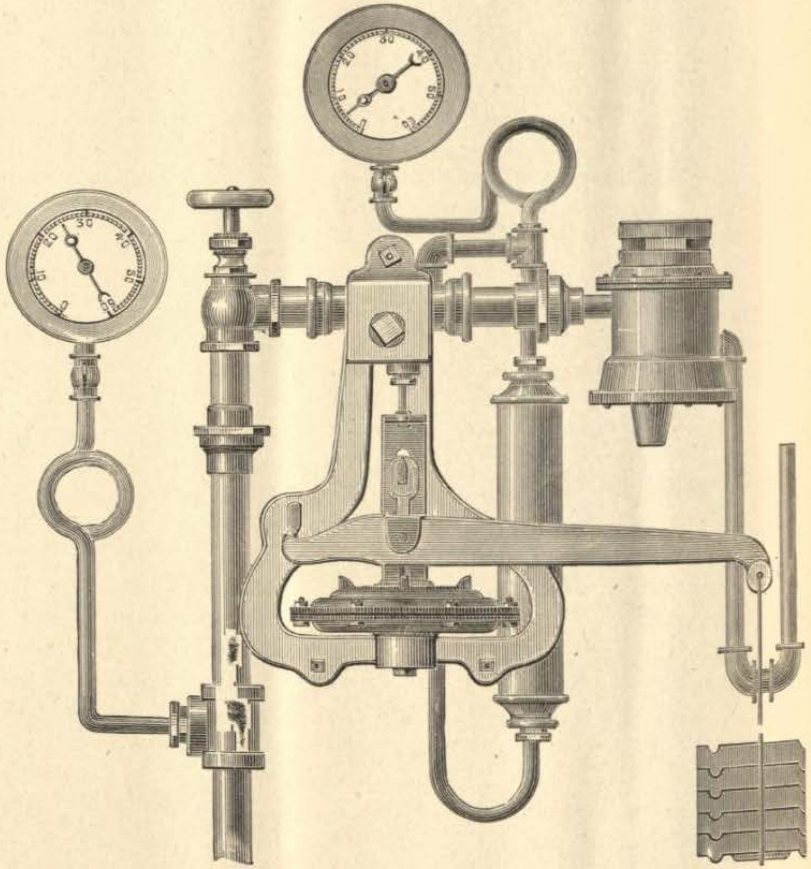


PLATE VII.—The Regulator.

SECTIONAL AND PROFILE VIEW.

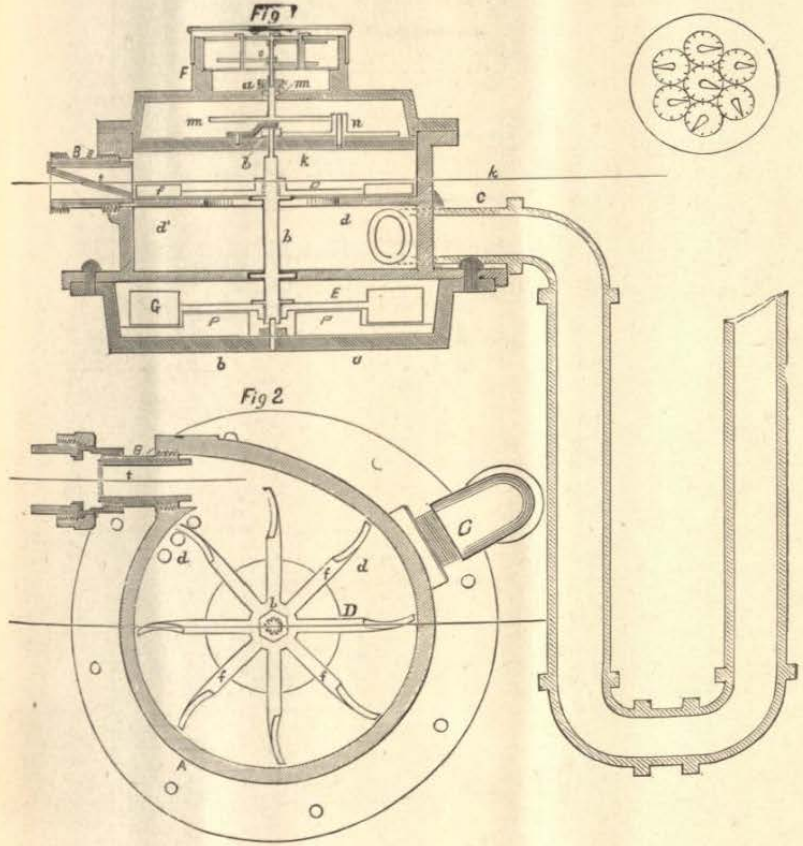


PLATE VIII.—The Meter.

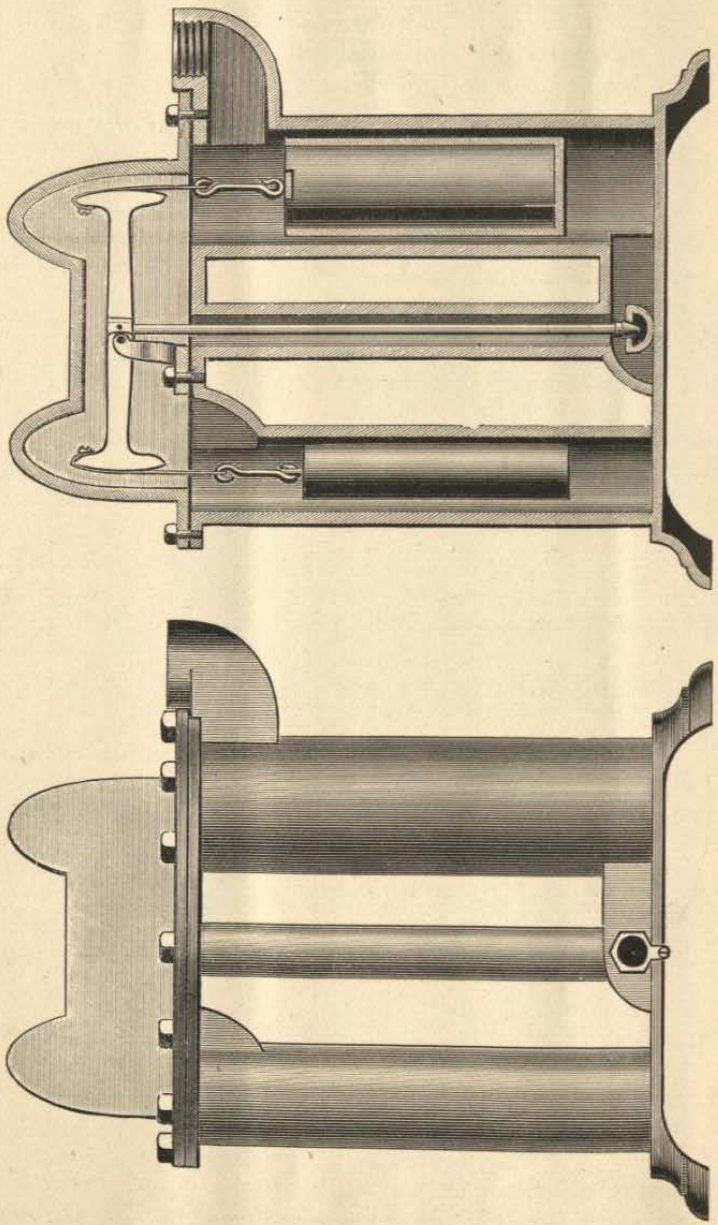


PLATE IX.—The Trap.

District System proposes, after once entering a building, with all this array of pipes, boxes, meters and paraphernalia of devices, to leave nothing undone that can be accomplished by steam, and to do it so effectually, that fires for any purpose may be wholly dispensed with. Ample provision is made to maintain a constant supply of pure hot water for

BATHING AND LAUNDRY

purposes, for which the boiler of a local steam system, or of the range, may be brought into use.

Coils of pipe arranged in any suitable or convenient closet, furnish the best possible

DRYING-ROOM FOR CLOTHES.

Hot water for instant use may be had at any moment, day or night, by means of a novel apparatus like the sprinkler of a watering-pot, attached by a rubber tube to any radiator or pipe in the house, and in an incredibly short time, any quantity boiled without the least noise or slop—for example, a bucket of water in three minutes, and sufficient for a bath in ten minutes. From its peculiar power of creating silence from materials so noisy, this little device has been aptly named

THE ANTI-THUNDER BOX,

and such is its convenience and efficiency, that in many dwellings the apparatus for storage of hot water is omitted. As a matter of economy, buildings completely fitted will require

THE ACCUMULATOR,

by means of which

GREENHOUSES AND CONSERVATORIES

may be heated directly with steam, or by the hot water of condensation. Water can be conveyed to all the rooms of a dwelling, either by atmospheric pressure or by direct application of steam, or by the use of the range-boiler or an accumulator pipe. Water can be forced by steam pressure to a tank in the attic, either hot or cold, and thence distributed through the building in the usual manner. These matters are usually left to the discretion of owners and steam-fitters, but the Holly devices to supply every probable requirement of a household, are all simple and efficient.

In order to solve the last of the series of steam-heating problems, and complete the mechanical revelation, whereby the entire domestic economy

DR. SAM'L SILSBEE'S

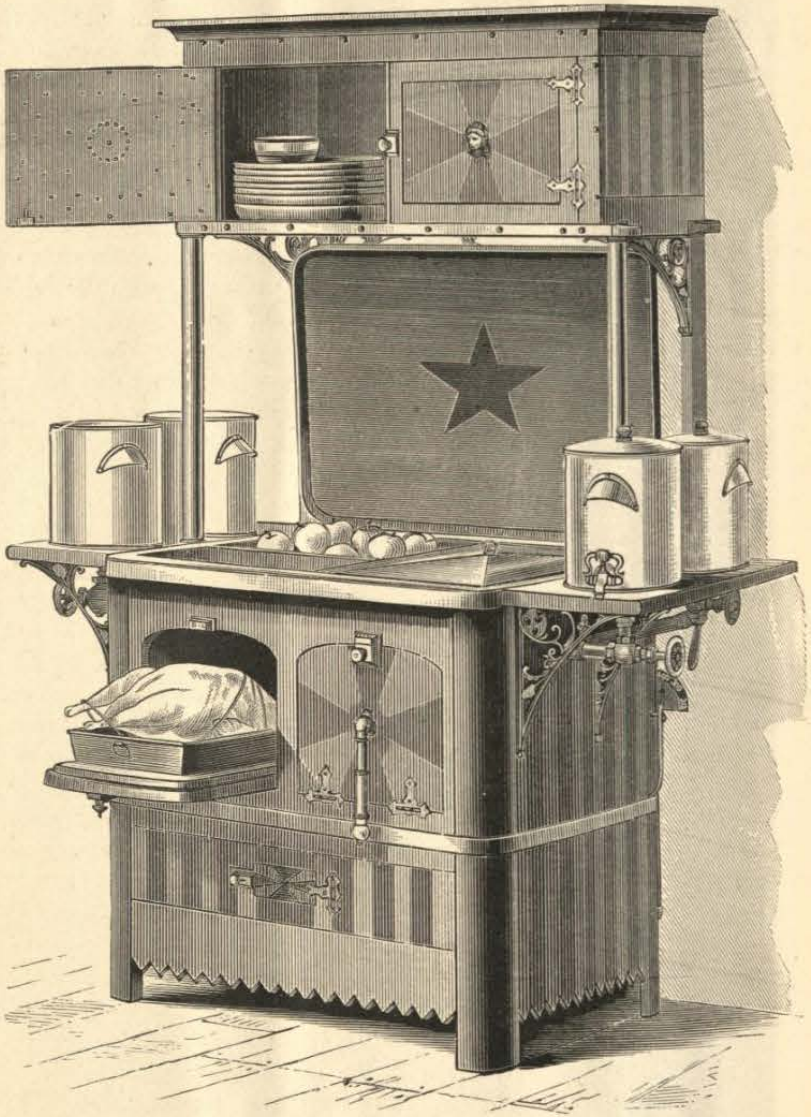


PLATE X.

SUPERHEATED STEAM RANGE.

of a people shall be improved and elevated, it was necessary to provide some practical method of

COOKING BY STEAM,

not only as a step in the progress of improvement in the culinary art, but in order to enable steam-heating companies to furnish steam supplies with advantage during the summer as well as the winter months. It has long been believed, that if some one in some manner would devise a method of using steam heat for cooking purposes, that it could no longer be said that food has a divine origin, but cooks have not. Innumerable steam stoves for stewing, boiling and frying, at atmospheric pressure, have long been in use, and the steam tables of Southern steamboats, made of iron with depressed compartments surrounded by steam at high pressure, have been used for keeping food hot, and cooking hashes, meats, &c. All of these devices have been common and popular. Since both animal and vegetable food can be cooked at the temperature of boiling water, but to *brown* meats, *broil* beef-steak and form the crust of bread, required a temperature of not less than 300° to 420° of heat, being an amount due to a steam pressure of 60 pounds to 350 lbs. In Germany, bread is baked in ovens heated by steam at high pressure, and French cooks have long been in the habit of preparing their nicest broils of delicate game by high pressure steam, but the danger of such a system among ignorant and careless servants, even had inventive genius provided efficient means, would be an effectual bar to its general use. Stoves designed to cook with pressure have been invented and are in use in several public institutions where neither time nor economy is usually considered, but similar principles applied to household stoves proved to be awkward, inconvenient and inefficient, and none had yet been devised by which the required temperature could be attained under the low pressure maintained by the District System in dwellings. The problem began to assume the mysterious dignity of a paradox, when it was proposed by Dr. Silsbee to superheat the District steam for purposes of baking, broiling and roasting, and the result is the handsome, convenient and THOROUGHLY PRACTICAL STOVE shown in Plate X. The stewing, boiling and cooking of vegetables is conducted with the District steam at low pressure, but when it is desired to

BAKE, BROIL AND ROAST,

or heat flat-irons, it is only necessary to cut off the District steam, and light an Argand gas burner, or, in the absence of gas, a gasoline or coal-oil lamp, and in a few minutes, without precaution or other preparation, the steam that already surrounds the ovens at 212° of heat, becomes superheated to any temperature desired, as indicated by a thermometer, and the cooking is

done in the usual manner as in other stoves and ranges. In order to leave nothing to the ignorant or careless discretion of an attendant, an

AUTOMATIC THERMOSTAT

is arranged to control and regulate the temperature. Every provision is made to ensure *cleanliness*, *safety*, *convenience* and *economy*. Superheating is only resorted to for the purposes named—all other culinary and domestic processes being conducted at the low pressure; superheated steam being *absolutely without any pressure whatever.*

The only danger *possible* is overcooking, which is automatically obviated. For example, the hotel rule for roasting meats is 20 minutes to the pound, while the average time by superheated steam is 12 minutes. Bakers require 30 to 40 minutes for 1¼-pound loaves, which, by the superheater, is done in 20 minutes. A 2-pound steak is broiled in 8 minutes; mutton chops, in 4 minutes; oysters broiled in 4 minutes; a 12-pound turkey required 2 hours; an 8-pound roast beef, 1 hour; 1 gallon of coffee, from cold water, 8 minutes; light biscuit or buns, in 8 minutes; potatoes baked in 28 minutes, and so on through the entire list of edibles.

We have been thus tedious in detailing the history and progress of "the system," because the public desire such information, and it seems to be the most desirable and satisfactory way of replying to the questions daily asked from all parts of the world. It is difficult to enumerate or to overestimate the advantages to be derived by the general adoption of steam heating in cities, and more especially those using soft or bituminous coal for domestic and manufacturing purposes. In many cities, the annual loss to works of art, fine goods and merchandise would pay for laying pipes. Housekeepers will appreciate the

CONSPICUOUS ABSENCE

of fires, with their long train of vexatious annoyances and profitless labor, and none will regret the final departure of coal-bins and ash-barrels. Meals may be cooked in less time, and far better, than by any other known method, without waste of fuel or loss of time. Dwellings may be kept at any temperature required, and thoroughly ventilated at the same time. Pure hot and cold water is supplied in abundance, without extra cost.

MANUFACTURERS

may run machinery of all kinds without the expense, annoyance and care of boilers and furnaces. *Snow may be melted* at a cost of about six cents per ton.

SCHOOL HOUSES,

churches and public buildings of all kinds may be warmed and *ventilated* more perfectly than by other methods at far less cost, and cities where the system is generally adopted, will be saved almost the entire expense of removing ashes.

Impetus will be given to mechanic arts, laborers will find employment in new avenues of industrial art, and large amounts of money distributed annually among the working classes.

STEAM FIRE ENGINES

may dispense with furnaces and boilers altogether, by attaching hose to street steam hydrants; more than this, every building may have a steam fire apparatus of its own, on its own premises, by simply having a standpipe within, connecting with the street mains, so that any floor in the building can, in a few minutes after a fire is discovered, be flooded with steam, and the fire instantly extinguished. In our large cities, vast wealth is concentrated in small areas of territory, and very few, if any, of the so-called fire-proof structures are practically fire-proof; and the liability of a great fire like that of Chicago or Boston is constantly staring property-holders in the face. It is well known that steam, if supplied in sufficient quantities in an enclosed apartment, is the most effective element in extinguishing fires. It simply expels and takes the place of air, and the fire goes out. Why has this potent agency not been employed to any extent before? Plainly because the requisite conditions never before existed which the District System now affords. A small boiler on the premises would not supply steam enough to do any good. But the District System, with its immense batteries of boilers and large reservoirs of steam, held by the mains at high pressure, furnishes an adequate supply. This supply is always on hand, night or day, week-day or Sunday. It can readily be seen that the effect will be to materially reduce the

COST OF FIRE RISKS

within the limits of the steam supply. The magnitude of this whole enterprise, especially in all large cities, is as yet but dimly realized by the general public. Something may be seen from what the New York Steam Co. is doing, and what it proposes to do in the near future. It already has five miles of large steam mains in use in the streets constantly under pressure of eighty pounds, day and night, Sundays included. (See diagram, Plate XI, showing number of consumers on December 1st, last.) "In other words, it is turned on to stay, and we see no reason for failure at any time, at any moment for an indefinite time to come—say twenty-five years, fifty years, a hundred years—call it as you please." Its active boiler capacity is

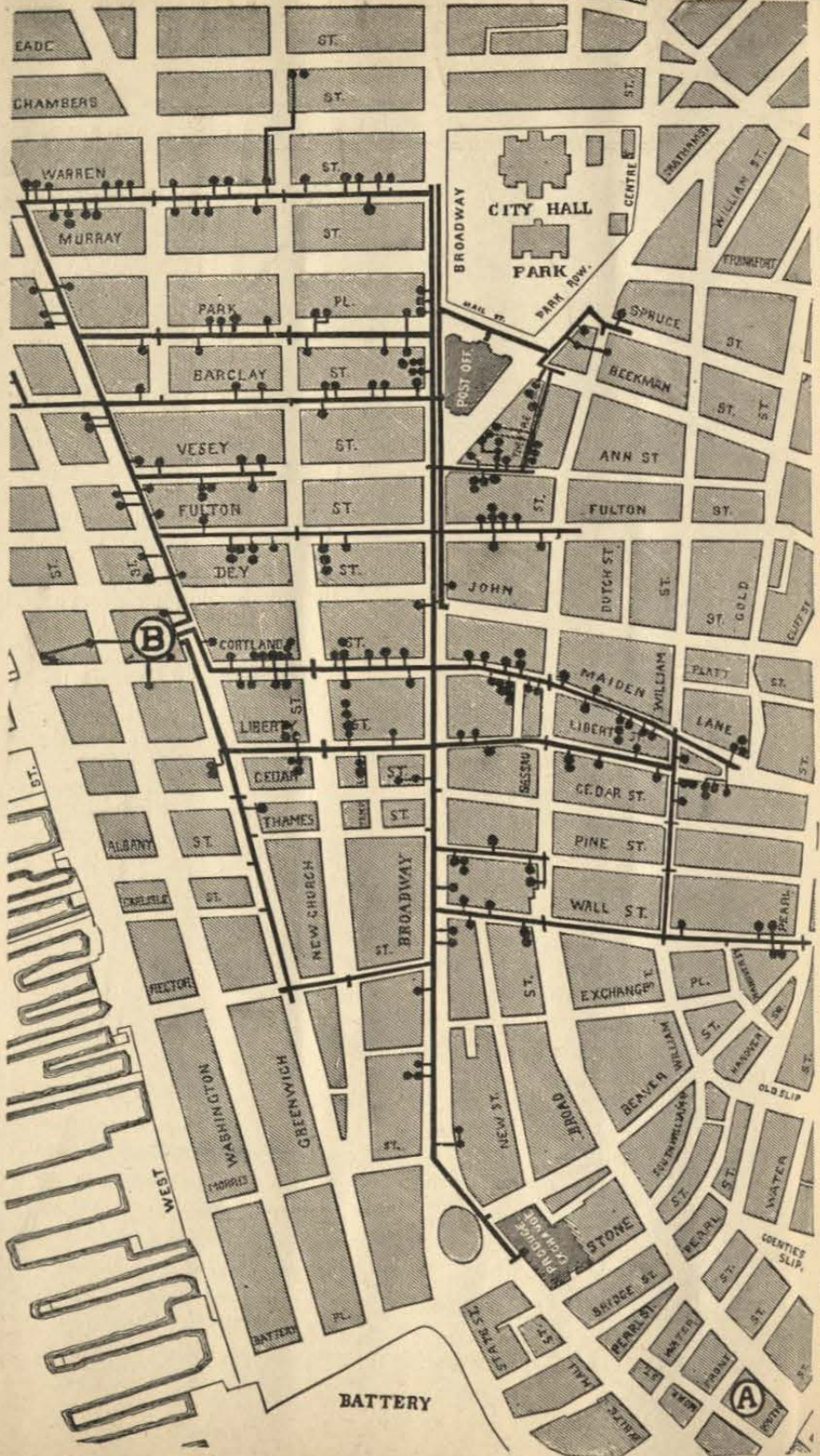


PLATE XI.—New York Steam Co., Station B, located on Greenwich St., to contain 64 Boilers, 250 Horse-Power each. Five Miles of Street Mains already in use, under constant pressure of 80 lbs.

already 8,000 horse-power. They say, further, "Our arrangements are being made also for extending the steam system into the principal streets in the upper part of the city next season, and thence forward as rapidly as possible, until all the well-built streets are fully supplied." This will require 250 to 300 miles of street mains. Station B, now in use, will, when fully occupied, consume 1,000 tons of coal daily. Properties for nine other stations are purchased, amounting to about one million dollars in value.

At this date—March, 1886—that Company is supplying steam to 350 engines, and over 300 different heat consumers, steam having been on the mains continuously since April, 1882. A large number of the best buildings in the lower part of the city are heated from the Company's mains; among them the U. S. Court House and Post Office, including the running of 14 elevators in the building, and using about $40,000 worth of steam yearly; the City Hall building; the Astor House; Trinity building; the Mutual Union Telegraph Co.; United Bank building; Drexel building; Bryant building; the Coal and Iron Exchange; several of the daily newspapers; a large number of banking buildings in the city, and many of the important eating-houses, obtain their entire supply from the Company.

There is an emphatic and increasing demand from the public for

DISTRICT HEATING

in some form, as shown by the introduction of natural gas to cities and villages within the gas belt, through long lines of pipe, at great expense, and this in spite of the great risk to property and life, as a large number of buildings have already been wrecked and many valuable lives sacrificed, and scarcely a day passes without recording some such catastrophe. Natural gas is usually inodorous; a leak occurs in a basement, and is not observed until a light is introduced, when a grand explosion follows. It must, by mingling with the air which the occupants of houses are compelled to breathe, be very detrimental to health.

District Steam Heating, on the other hand, is entirely safe, being conveyed under the streets in wrought iron pipes, which will stand many times the pressure ever required, and when introduced to buildings the pressure is reduced to a very low point; and there is nothing in connection with it that can vitiate the air we breathe.

All new enterprises must have a season of experiment. We have now passed this ordeal. The devices have been perfected, and the quality of work, and our new method of anchorage are brought to a state of great efficiency. Our variator device, shown at pages 19 and 20, is proving all that could be desired. There being no packing, or packed joints, there is no occasion for opening streets for repairs of any kind. The work, when once completed, is permanent, and is subject to much less expense for repairs than either gas or water mains.

The system wherever introduced is

POPULAR WITH THE PEOPLE,

and customers are readily secured as fast as they can be cared for. The Williamsport Steam Company had 65 consumers of steam the first winter, the second or last winter 130. Next winter they are promised 200. As to

FINANCIAL RESULTS,

the subject, on some accounts, is a delicate one to treat, as no business firm or corporation likes to publish the results of its operations. A new company in starting will require a certain amount of business in order to pay its way. After passing that point, additional business brings profits, and quite rapidly, as income increases largely, while expenses are not much increased. To illustrate: A company, which we can name, heated 2,500,000 feet of space the first winter, and paid its way. The second winter 5,500,000 feet brings net profits of 8 per cent. on total capital. The third winter, with 8,000,000 to 9,000,000 feet, brings a net 15 to 18 per cent. Further additions will show still better results.

Another company pays 15 per cent. annually, and will re-lay its mains, and enlarge them so as to take on additional consumers who are anxious to be served. Another company in a village of 3,000 inhabitants pays a regular 6 per cent. dividend, besides adding to surplus account. The original plant at Lockport, though built and operated under disadvantages, is paying about 15 per cent. profit on first cost. Companies in other places are doing equally well, and there are no exceptions where our recommendations and business methods have been followed. We invite

CAPITALISTS

to investigate this subject, and believe they will not fail to become favorably impressed with the wisdom of making investments in their own localities, under their own supervision, rather than in the one thousand and one visionary schemes which are constantly being urged upon their attention in far distant fields. Like the prizes in a lottery, the one who wins in these cases serves to enchant the one thousand who draw blanks. The history of investments shows that nothing pays better than that which contributes to the wants of the people of a village or city, whether to their necessities, comforts or luxuries, and consequently, to their health and happiness.

It is not difficult to show that a Steam System supplies a great public want —more so, perhaps, than do any of the systems heretofore introduced; and whose operations are now regarded as indispensable to the wants of communities. The petroleum lamp supplies light for one-fifth the cost of gas; and yet, all who can in any way afford it, use gas, because it is safer, and cleaner, and better—and so gas stocks become valuable. But we need light only from three to five hours out of the twenty-four; while during the cold season, or seven months out of the twelve, we require heat every hour of the day in our dwellings, and, for some purposes, the year around. And yet, the cost of heating by this system is not greater than by stoves and furnaces, which are as much inferior as is oil to gas.

By the use of steam taken from street mains, a perfect summer temperature can be uniformly maintained throughout our dwellings at all hours, because the fires never go out, and steam is always present at uniform pressure, and can be had by opening a valve. That is why there has never yet been a lack of patronage wherevever the District System of Steam Heating has been introduced.

The system is fully and strongly secured by a large number of patents, not only upon devices in use, but the combinations of parts are adjudged particularly strong.

The American District Steam Company owns not only the large number of patents issued to Birdsill Holly, but also all patents relating to steam supply issued to Charles E. Emery, the distinguished engineer of the New York Steam Company. While the company will continue to welcome any useful improvement, they are also determined to defend their rights against infringements. That the simplicity and excellence of their devices have thus far given entire satisfaction is, perhaps, no proof that improvement is impossible, but it may also be truthfully affirmed that the mechanical devices invented to evade the Holly patents have in no instance proved to be improvements or successful. One or two efforts have been made to infringe, resulting in mechanical failures, so that no proceedings have been required by us to protect our rights.

CORRESPONDENCE

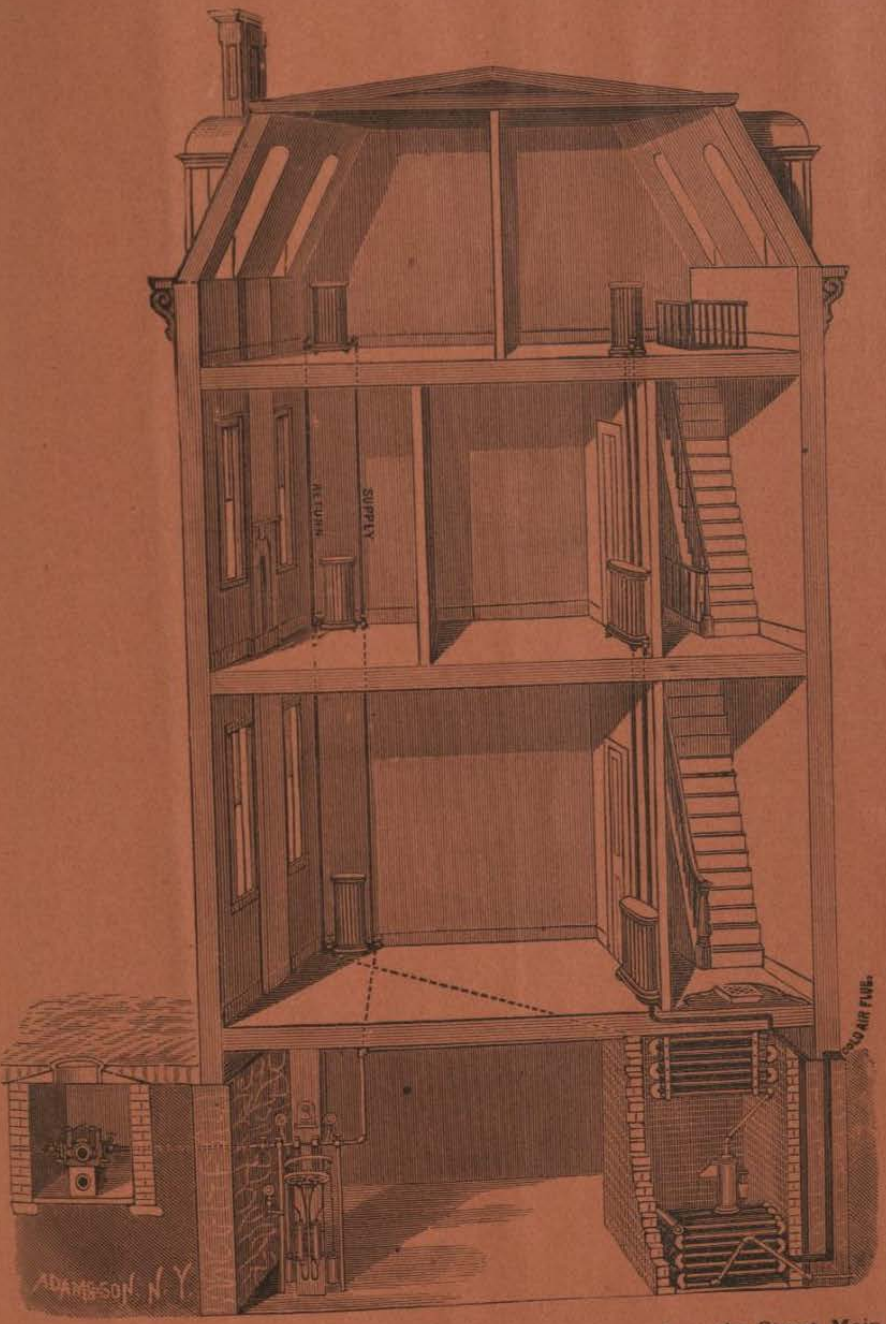
is invited from parties who may desire to become interested in this enterprise in their respective localities. All necessary information will be given to aid in organizing companies, and in constructing works to the best advantage. Our engineer will make surveys, maps and plans, free of expense, when desired, accompanied with estimates of cost for constructing boiler stations and lines of street mains ready for actual use.

We are prepared to construct work under contract, and experience has shown that this is the only safe and economic plan for the new company, to whom the work of construction is untried, and whose engineer will doubtless be without that practical knowledge so essential to perfect workmanship.

As a rule, the more compactly built the district to be occupied, the better, but there is plenty of good territory in all cities where the enterprise will pay, and where the popular demand will call for its introduction. Yet, many villages and suburban towns, where the comforts and conveniences of life are in equal demand, will be found especially adapted to district steam heating.

Wherever there are groups of residences with churches and schools not too widely scattered, a small system of underground pipes, with a boiler station adapted to the work, under the charge of a careful fireman, the enterprise will be found entirely feasible. The cost will not be greater than for individual steam, and the improvement will be accepted by the people with avidity.

All correspondence should be addressed to the Company, at Lockport, N. Y.



Sectional View of Building, showing course of the Steam from the Street Main to Radiators, thence to Trap and Cooling Coils in basement.