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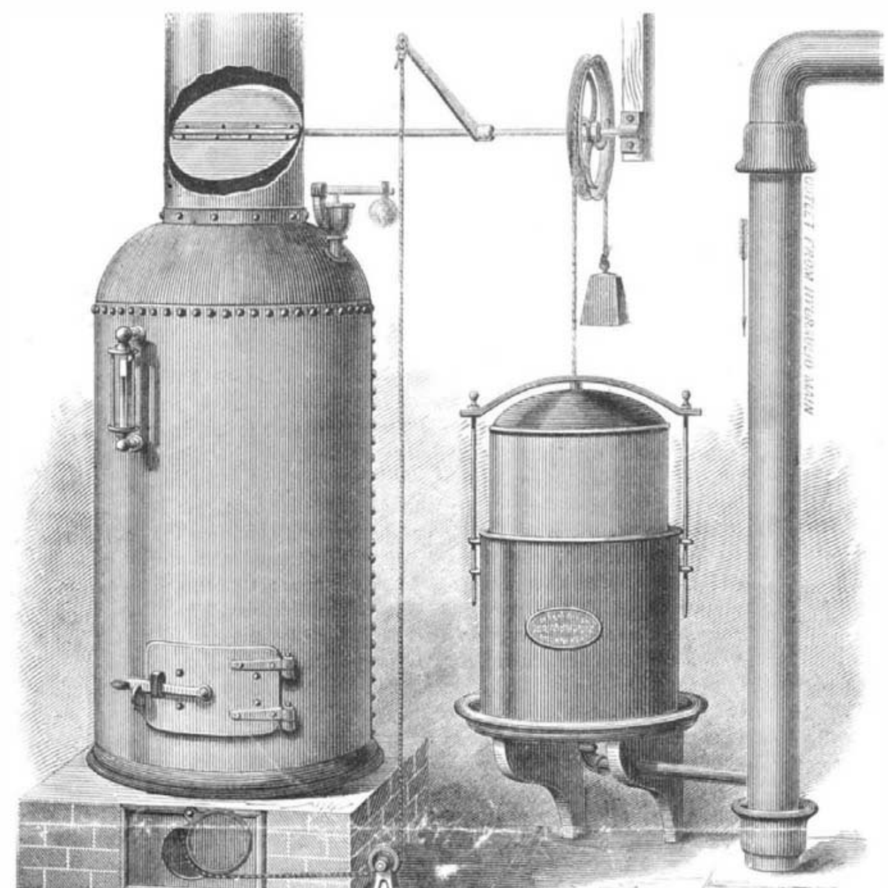
AUTOMATIC FIRE GOVERNOR FOR GAS WORKS.

The invention illustrated in the annexed engraving consists in a common gas governor, connected with the outlet of the hydraulic main, and also with the dampers in the chimney and under the fire. The arrangement is such that as soon as the engine does not exhaust fast enough, a slight pressure, being left on the retorts, is communicated to the governor, causing the latter to rise, thus opening the dampers at both of the above named points, and putting on all draft until the requisite speed is obtained. The pressure then being removed, the drum descends, closing the dampers, and preventing the fire making more steam until a future supply is once more required.

The disposition of the simple mechanism is clearly shown in our illustration, so that detailed reference to the various parts is unneeded. It will be seen that, as the governor is controlled by the pressure of gas on the hydraulic main, the amount of steam will vary, according to the make of gas—whether it be ten, fifty, or a hundred pounds—and all without any attention on the part of the men, except to replenish the fire.

The Yonkers (N. Y.) Gas Light Company have had the apparatus in successful operation for several months past, where it can now be inspected. It is claimed to dispense with the engineer in many places, besides performing his work in a better manner; to save fuel, as burning to waste is prevented; to preserve the boiler, since the door need not be opened except when the fire requires renewal, and to obviate the use of compensators and engine governors.

The invention was patented through the Scientific American Patent Agency, August 4, 1874, by Mr. James Slade, of Yonkers, N. Y., who may be addressed for further information.



SLADE'S AUTOMATIC FIRE GOVERNOR FOR GAS WORKS.

IMPROVED COAL SCREEN.

The invention which we illustrate herewith will be found a very convenient device for use in coal yards, since it allows of the separation of the coal from the adhering dust and small particles with much less trouble to the workman than is necessitated in employing the ordinary screen. It consists of a box having an inclined open front portion for the reception of the screen, which last is supported by the projecting ends of its side pieces resting against the bottom portion of the box, while its upper part is sustained by levers, A. These levers are pivoted to the side walls of, and inside, the box, and are adjustable so that the screen may be inclined to any angle, as required by the quality and size of coal, ore, sand, or other material to be treated.

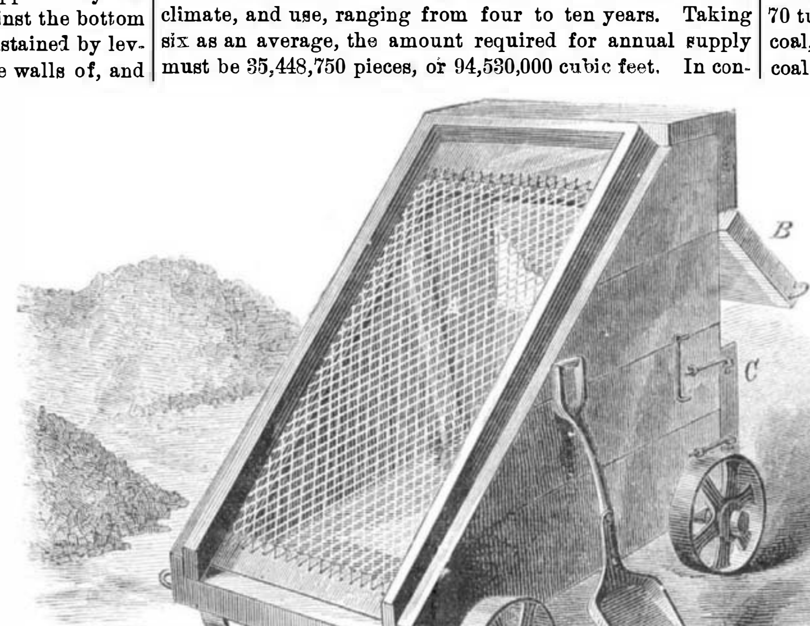
The rear portion of the box has an upper hinged door, B, which is provided with suitable latches, and there is also a detachable door, C, secured by hooks and staples or other convenient fastenings. The apparatus is mounted upon trucks, so as to render it readily transported from point to point in the yard.

As the material is thrown against the screen, the fine stuff falls through and into the bottom of the box. When a quantity has accumulated, the upper door, B, is opened, and a rake is introduced to draw the screenings to the rear of the receptacle. As soon as the latter is full, the device is wheeled away to the dumping spot, the lower door also removed, and the contents withdrawn.

This simple arrangement prevents the laborious carrying of heavy screens about a yard, and, besides, preserves the yard free from unsightly heaps of dust and refuse to collect. Since there is no possibility of anything passing through the screen, except small fragments, the waste of good coal—which often happens through pieces from the screened heap becoming mixed with the sifted stuff, and requiring too great a loss of time to pick out separately—is avoided.

The doors may be arranged at the side, or a trap may be provided at the bottom, as most convenient.

Patented through the Scientific American Patent Agency, by Mr. Henry L. Leach, of foot of E. 36th street (E. R.), New York city, who may be addressed for further information.



LEACH'S COAL SCREEN.

Consumption of Wood by Railroads.

At the end of 1873, there were reported 71,564·9 miles of main lines, and 13,512 miles of sidings and double tracks, making 85,977·9 miles of railroads within the United States. Of the main lines, 5,462·3 miles were in the New England States, 14,209 in the Middle States, 33,905·9 in the Western States, and 2,681·3 in the Pacific States. Upon these roads locomotives were running, and a large proportion of them used wood for their fuel. The number of ties used varies from 2,200 to 2,800 per mile. If we take 2,500 as a mean, we find that 212,692,500 pieces of timber, eight feet long and from six to eight inches between upper and lower surfaces, are required to supply this single item.

The durability of ties varies with the kind of timber, soil, climate, and use, ranging from four to ten years. Taking six as an average, the amount required for annual supply must be 35,448,750 pieces, or 94,530,000 cubic feet. In considering this, we must remember that a large amount of waste occurs from hewing, and from leaving the upper parts of trees, some of which are used as firewood, the remainder being a total loss. It must also be borne in mind that the demand for timber by railroads, besides for ties and for fuel, is very great, including fencing, bridges, buildings, and structures of various kinds, so that the risk from fires is exceptionally great, and that our requirements in this direction are increasing even more rapidly than our supplies are wasting.—*National Car Builder.*

A New Plaster Bandage.

A surgeon connected with the Southern Dispensary, in Brooklyn, N. Y., has recently invented a new method of applying the plaster splint, which, according to the *Tribune*, promises to be an important improvement. A common merino sock is drawn upon the foot and leg. It may extend as far up as is necessary to include the fractured locality. A small rope is run down the back seam in the center of the leg, around the heel and over the toes, returning up the middle of the instep and front of the leg. Six or seven pieces of flannel are then cut out to fit the leg and foot, allowing for shrinkage. The ends of the bones having been carefully adjusted, the stocking, upon which the rope has been attached as described, is drawn upon the foot and leg. The flannels are soaked in warm water and applied, the plaster of Paris paste being rubbed in with layer after layer. After the last layer has been applied, the plaster is allowed to set. When the plaster has become hard, the splint is perfect, and the patient can get about, on crutches, very comfortably. If the leg swells, and it is necessary to remove the bandage, the whole thing can be done inside of three minutes. The cord that has been run around the stocking now forms a line of division in the splint. To remove the splint, all that has to be done is to slip out the cord and slit up the stocking along the line where the cord was. Then the splint, divided in halves, can be removed as though it had been laid upon the limb to obtain a cast. Considerable time is thus gained by using this method of applying the plaster splint. When the broken limb becomes inflamed, it also is extremely painful and very tender to the touch. The slightest jar sends a thrill of pain through the body of the patient, who has sometimes been obliged to be chloroformed to enable the surgeon to remove a plaster splint applied with a bandage. By the new method, the limb need hardly be moved or touched.

Natural Gas for Fuel.

Messrs. Rogers & Burchfield, the makers of a well known brand of sheet iron, at Leechburg, Pa., produce weekly about 70 tuns of such iron; to make this amount 9,100 bushels of coal, or 140 bushels per tun, would be required if they used coal for fuel. They have now been using gas for seven months, procuring it from an abandoned oil well, 1,250 feet deep, situated about 1,000 feet from the works, and from which the gas is conveyed by a three inch pipe. The branch pipes leading to each furnace are half an inch in diameter. They have one battery of four boilers, driving an engine of six foot stroke, thirty inches in diameter, at the rate of forty-five strokes per minute, which furnishes power for six pairs of sheet rolls and one bar train, steam being taken from the same boilers to drive two hammers; another boiler furnishes steam for a blowing cylinder, which supplies the blast for seven knobbling fires and one refinery; another boiler furnishes steam for a small engine driving the rolls for the manufacture of tin plate. This is all done by gas, which is also applied directly in five puddling furnaces, in which the waste is three or four per cent less than with coal, and the quality of the iron is greatly improved; they also furnish gas for four sheet furnaces, and find it much superior to coal, the waste in these furnaces being about five per cent less than with coal; and further advantages gained are softer iron and a finer surface to the sheet. They have three large annealing furnaces, where they anneal in airtight boxes, putting about ten tuns in each box, requiring about ten hours to complete the process of annealing, at a saving of about one half in annealing boxes; and in the tinning establishment the pots of tin, into which the sheets of iron are dipped, are also heated by gas.

To use gas there is no change required in the construction of puddling furnaces, except that they use the patent water necks. These necks are an absolute necessity in using gas for fuel, as without them the intense heat, generated by the gas, destroys the lining of the stack and melts off the dampers as fast as they can be replaced. The grate bars, the manufacturers state, never burn out, and the puddler's tools last about three times as long as they did when coal was used. In furnaces where the water necks cannot be used, they are compelled to use a jet of steam to lessen the heat.

Their production has increased about thirty-three per cent since they began to use gas, and the iron made commands from $10 to $20 per ton more than the same class of iron manufactured at the Apollo works, where they use coal, the iron being made from the same class of stock. These facts were communicated to the American Iron and Steel Association.

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NEW YORK, SATURDAY, NOVEMBER 7, 1874.

Contents:

(Illustrated articles are marked with an asterisk.)

GAIN FROM THE USE OF FEED WATER HEATERS.

In an ordinary boiler, one pound of average coal will produce by its combustion between eight and nine thousand units of heat that are available for generating steam. Supposing the feed water to enter the boiler at a temperature of 32° Fah., each pound of water will require about 1,200 units of heat to convert it into steam, so that the boiler will evaporate between $6\frac{2}{3}$ and $7\frac{1}{2}$ pounds of water per pound of coal. Better results than these are often realized, especially in the case of tests, but the figures given above are believed to correspond with those of ordinary practice. The amount of heat required to convert a pound of water into steam varies with the pressure, as will be seen by the following table:

Units of heat required to convert one pound of water, at the temperature of 32° Fah., into steam at different pressures:

Pressure of steam in pounds per sq. inch, by gage.	Units of heat.	Pressure of steam in pounds per sq. inch, by gage.	Units of heat.
1	1,148	10	1,155
20	1,161	30	1,165
40	1,169	50	1,173
60	1,176	70	1,178
80	1,181	90	1,183
100	1,185	110	1,187
120	1,189	130	1,190
140	1,192	150	1,193
160	1,195	170	1,196
180	1,198	190	1,199
200	1,200		

If the feed water has any other temperature, the heat necessary to convert it into steam can easily be computed. Suppose, for instance, that its temperature is 65°, and that it is to be converted into steam having a pressure of 80 pounds per square inch. The difference between 65 and 32 is 33; and subtracting this from 1,181 (the number of units of heat required for feed water having a temperature of 32°), the remainder, or 1,148, is the number of units for feed water with the given temperature.

In the use of an ordinary non-condensing engine, in which the steam is exhausted directly into the atmosphere, each pound of steam, as it escapes, carries off the greater part of the heat that it has received in the boiler. This can be rendered plain by an example: Suppose the feed water enters the boiler at a temperature of 70°, that the pressure of steam is 90 pounds per square inch, and that the back pressure in the cylinder, under which the steam is exhausted, is 1 pound per square inch:

Temperature of feed water	70
Subtract	32
Difference	38
Units of heat required to convert 1 pound of water at 32° into steam at 90 pounds pressure	1,183
Subtract	38
Units of heat required to convert 1 pound of water at 70° into steam of 90 pounds pressure	1,145
Units of heat in 1 pound of steam at 1 pound pressure, from water at 32°	1,148
Subtract	38
Units of heat imparted to feed water, that are carried off by each pound of exhaust steam	1,110
Multiply this by 100	111 000
Divide by 1,145	96 941

which is the percentage of the heat, imparted to the feed water, that is carried off by the exhaust steam.

There remains, then, only about 3 per cent of the heat, imparted to the water by the combustion of the coal, that is utilized in the engine. This is a rather serious consideration for the steam user, who may figure up his account with the boiler and engine somewhat after this manner: One ton of coal costs $6.50, and evaporates, by its combustion, 15,000 pounds of water, at a cost for fuel of $0.00043 + per pound. When the steam resulting from the evaporation of this water is used in the engine, 96·94 per cent of the heat imparted to it by the fuel is exhausted into the air. This is the same as throwing away 14,541 pounds of the water that has been evaporated, leaving 459 pounds for useful work, so that really each pound of water used in the engine costs $0 014 +. There are very many engines running today to which this account will apply, engines that are sending into the air nearly all the heat imparted to the water by the fuel. We showed, in a preceding article, how considerable saving would generally result by attaching condensing apparatus to a non condensing engine. This cannot always be done, however; but there are means by which some of the heat carried off by the exhaust can be utilized. The most obvious method is to turn the exhaust steam into vessels through which the feed water passes, so that some of its heat may be imparted to the water, which will then require the consump tion of less fuel for its conversion into steam. There are a number of heaters in the market which are guaranteed by their manufacturers to deliver the feed water into a boiler at the temperature of 212°, and we can state from our own experience that this is not an uncommon result, while a temperature of at least 200° should be realized from the use of any good heater. It may be profitable to consider the effect of attaching such a heater in the case previously cited. The feed water will then enter the heater at a temperature of 70°, and be delivered into the boiler at a temperature of 200°, having had its temperature increased 130° by the exhaust steam, which has lost a corresponding amount of heat. Each pound of water will require 1 015 units of heat for its conversion into steam of 90 pounds pressure, instead of 1,145 units, which were needed when the heater was not in use. This gives a gain of 130 units of heat for each pound of water evaporated, being 11 35 + per cent less heat than was required when the feed water was pumped into the boiler at a temperature of 70°. Each pound of exhaust steam, also, instead of carrying off 1,110 units of heat into the air, will only take 980, or 11 71 + per cent less than it formerly did. The account previously given will now figure up as follows:

The combustion of one ton of coal will evaporate about 16,900 pounds of water, at a cost of $0 00038 + per pound. In the engine, an amount of heat corresponding to about 16,300 pounds of the steam is thrown away in the exhaust, leaving 600 pounds for useful effect, at a cost of $0.0108 + per pound.

These examples, which correspond well with cases in ordinary practice, will enable our readers to estimate with tolerable accuracy the results that will be realized from attaching a heater in any given instance. It will be observed that, in the case supposed, no allowance was made for increased back pressure by the use of the heater. This was because the hypothetical heater was properly designed. A good heater does not increase the back pressure in the piston. There are many forms of the apparatus, however, that offer so much resistance to the escape of the exhaust steam, as to more than neutralize the gain that would otherwise be derived from their use. It is easy to see, for instance, that if the introduction of a heater increased the heat of the feed water 10 per cent, but also increased the back pressure so as to call for the expenditure of 12 per cent more fuel, the arrangement would be anything but economical.

A SPECIAL EDITION OF THE SCIENTIFIC AMERICAN.—ONE HUNDRED THOUSAND COPIES.

We shall, during the coming month of December, issue a special edition of the SCIENTIFIC AMERICAN, aggregating one hundred thousand copies, which will be gratuitously circulated among manufacturers of all kinds, machinists, mill owners, and, in brief, representatives of all industries in the United States and in Canada. At considerable outlay of time and expense, we have procured a list of one hundred thousand names, embracing the leading business men of the above important classes; and to each individual a copy of the SCIENTIFIC AMERICAN, enclosed in a separate wrapper and prepaid, will be mailed. The item of postage alone will thus cost the large sum of two thousand dollars, and the issue will find its way into every post office in the country.

Our motive for printing this extra edition, at an outlay of some six thousand dollars we do not desire to conceal, nor could we do so even if such were our wish. Our aim is to increase our subscription list; and in pursuance of this object, we take such means as will enable others beside ourselves to derive benefit from the enterprise, in direct proportion to the amounts they invest in its furtherance. To this end, therefore, we propose to admit a few advertisements. It will readily be apprehended that, since the publishers are distinctly pledged to print the large special edition above noted, and to mail the same (pre-paid) to names selected with care and judgment, every person having goods, productions, or ideas to bring to the notice of the class above mentioned is here furnished with the means. Moreover, it should be remembered that the names to which we refer are not those of our regular subscribers, but of business men not accessible through the ordinary newspaper channels.

We would direct especial attention to the fact that, although a circulation of 100,000 copies is guaranteed, there is every probability that this will be greatly exceeded. Our offer of last year included a circulation of but 60.000; but before we had supplied the demand, 120,000 copies were printed and mailed. For this immense excess, we imposed no extra charge upon our advertisers. The same course will be adopted this year. The extra benefit is given freely to those firms who send us advertisements for the special edition.

To the enterprising manufacturers and inventors who advertise in our regular columns, and indeed to everybody at all conversant with the advantages of a good medium, we need not point out the benefits to be derived from our proposition. For further particulars, see advertisement on another page.

COST OF TUNNELS.

"Among the various plans for disposing of the Jones' Falls stream or improving its channel, which have been presented to the council committee, is one by J. E. Sudler, civil engineer, proposing to divert it by a tunnel from a point beyond the city across to the valley of Gwynn's Falls, and thus throw its waters into the middle branch of the Patapsco, or Spring Gardens. This tunnel would pass in good part under Druid Hill Park, and through a rock formation which, it is believed, lies beneath all the hills in that quarter. Never having looked to diversion in that direction, and without pretending to have examined into or formed any judgment in the premises (the plan lately suggested by the mayor in his special message to the council for improvement within the city being still pending), it may yet be worth while to inquire into what has been the cost of like tunneling accomplished in other parts of the world. The aggregate cost of this tunnel for Jones' Falls, the length of which is 16,000 feet, is put by its author at $2,800,000, or $145 per lineal foot, which is a fraction over $2 per cubic yard. With regard to other tunnels already in existence, their cost is given as follows: The great Mont Cenis tunnel cost about $800 per lineal foot, including equipment of road, etc. The Kilsby double track railroad tunnel (England), in the construction of which very great difficulties were encountered from the tapping of quicksands, cost $262 50 per lineal foot. Bletchingly tunnel, for a double track railroad in England, cost $120. Terre Noire, on the Paris, Lyons, and Mediterranean railroad, cost but $50 per foot; and the very difficult Hauenstein tunnel, between Basle and Berne, Switzerland, cost $133 per lineal foot. The Hoosac tunnel, through a formation of mica slate and quartz, with working shaft upwards of 1,000 feet in depth, cost $360 per lineal foot.

These tunnels were all completed several years ago, and the cost per cubic yard of material excavated varies from $1 50 to $14. The difficulties met with in their execution have led to the invention of improved apparatus, by the use of which the cost of boring, drilling, etc., is reduced from 100 to 300 per cent. The diamond boring machine was thoroughly tested by Captain Beaumont, R. E., in Lancashire and Cumberland. At Stoughton, the borer reached a depth of 689 feet in two months, that could not have been got at in less than two years by hand labor. In the Clifton tunnel, Bristol Port and Channel Dock Railroad, in hard mountain limestone, the drills advanced at the rate of two inches per minute—outside diameter of boring, two inches. The machine advanced at about five times the speed that could be attained by as many men as could find room to work at a heading. The motor is compressed air. Dynamite is used for blasting, and found to answer admirably. With the aid of these machines the work of tunneling through the hardest rock presents no difficulties of any extraordinary character, and may be executed at a cost very little, if any, greater than the excavation of the same material in open cutting." —*Baltimore Sun.*

To the above, may be added the cost of that portion of the Underground Railway, in New York city, now nearly completed, on Fourth Avenue, between 44th street and Harlem