in proportion to the work required of it; it can be run at any speed attained by ordinary locomotives, and is under perfect control, only one man being required to drive it; one charge of air enables it to run a distance of fifteen to twenty miles; fresh charging from the stationary compressor can be effected as quickly as the changing of horses, and finally the cost of working is less than steam-power and much less than horse-power. The trials at Woolwich have been perfectly satisfactory in every way, and there is every probability that the patent will ere long be brought into very general use, a limited company having already been started for working it, the temporary office being at 3 Victoria Street, Westminster, S. W.—*London Graphic*.

THE NEW ORLEANS AND TEXAS RAILROAD.

AFTER years of "hope deferred," with all the uncertainties and vicissitudes attendant upon so unsatisfactory a state of things. New Orleans has at length reached a triumph in her commercial prospects—possibly the greatest in her commercial history.

At 5:15 A. M. on Sunday, the 29th of August, 1880, the first through passenger train—a special for the conveyance of those most interested in the consummation of the enterprise—left the Algiers depot, New Orleans, for Houston, Texas, without change. The first train from Houston, with a distinguished party of railroad men on board, arrived the evening before.

It is about unnecessary to state that New Orleans was almost in a fever of excitement over the event, and well she might be; for by the completion of this road the Crescent City becomes the center and shipping port for all the commerce of the great Southwest, a trade which has hitherto been forced to find exit by way of St. Louis or Chicago. The exports from Texas alone, which are annually increasing in an indefinite ratio, exceeds in value fifty millions of dollars, very little of which ever found its way to New Orleans; while the future of imports for the Empire State must be largely by way of the new route.

The history of the enterprise is a checkered one; for in addition to the general depression in railroad affairs all over the country, the New Orleans and Texas has suffered, with all Southern enterprises, from the political situation. And independently of the special good which the completion of this road affords New Orleans, it is a promising omen for the future of the Southern railroad interests which needs the spur of successful effort to point the way to future growth.

The following is a brief history of the road: As early as 1854 an act of incorporation passed the Texas legislature, granting a charter to A. M. Gentry *et al.*, to build and equip a line of railway from the city of Houston to the Sabine River, at a point where Orange now stands. In 1855 a survey was made, and thereafter a road was built. But the road was poorly constructed, and from many other causes rapidly declined. The bondholders and the civil war nearly blotted it out, and the military authorities taking possession of it, it became almost a total wreck.

On September 1st, 1869, Judge J. F. Crosby, of Houston, took possession of it as receiver under an order of the United States Court, it having a debt of \$3,000,000 over it. In 1870 some temporary repairs were effected, and during that year and the one following, two forced sales were made, when it was purchased by the original bondholders, represented by John T. Terry, of New York, who is now president of the road.

In 1874, a new company was organized, and Judge Crosby was charged with rebuilding the entire line from Houston to Orange. The work of reconstruction was completed in 1876, since which time the road has been in active operation. After that date every exertion was made to secure a connection to New Orleans, which at last, in October, 1878, resulted in a contract entered into between President Charles A. Whitney, representing the Morgan Company, and President J. J. McComb, of the Louisiana Western, and the building of the line from Orange to Vermilionville, giving an all-rail route from Houston to New Orleans. The Louisiana Western, or the Gap, as it has been called, is a successor to the old New Orleans, Mobile, and Texas line. Three years ago, Col. Thomas Adams, of Philadelphia, succeeded in interesting capital in its behalf. Work on it was begun in 1878, and the last spike driven August 26, 1880. The road has been substantially and well built.

The other factor in the system is the Morgan Road. In 1851, a charter was granted, and the New Orleans, Opelousas and Great Western Railroad was incorporated to run from New Orleans to Opelousas, La., expecting to connect with a line to Texas. The road was constructed and in running order to Morgan City in 1857. To build this 80 miles a bonded indebtedness was incurred. The road was nearly ruined during the war, and in 1869 the bondholders foreclosed their mortgage, and the whole thing was sold by the sheriff to Commodore Charles Morgan, who has since successfully operated it. It was extended from Morgan City to Vermilionville only a few months ago.

The distances from New Orleans to Houston are as follows: New Orleans to Vermilionville, Morgan's Louisiana and Texas Railway, 144 miles; Vermilionville to Orange, Louisiana and Western Railway, 112 miles; Orange to Houston, New Orleans and Texas Railway, 105 miles, making a total of 361 miles.

The first train from Houston reached Algiers, opposite New Orleans, at 7:40 P. M., August 28, having made the run in fourteen hours and thirty minutes deducting two hours and fifty-three minutes for detentions and stoppages, the actual running time was eleven hours and thirty-seven minutes—splendid time for a new road. The following railroad officials were on the train:

Houston and Texas Central—Gen. G. Jordan, vice-president; A. H. Swanson, general superintendent; J. Waldo, general freight and passenger agent; Capt. Haynes, geologist, and W. B. Botts, attorney. Houston East and West Texas—Paul Bremond, president. Central and Montgomery—F. A. Rice, president. Texas and New Orleans—Judge J. F. Crosby, vice-president; C. A. Burton, superintendent; W. H. Masters, freight and passenger agent, and P. B. Watson, auditor. Texas Transportation Company—Chas. Evershade, superintendent. Texas Express Company—C. T. Campbell, superintendent. Louisiana Western—Theodore Adams, manager; C. R. Adams, assistant manager.

The importance of this connection for New Orleans cannot be overestimated. Houston is at present the great railroad center of Texas. From it railroads branch in every direction, in fact, between fifteen and sixteen hundred miles of Texas lines center there. From Houston, westward, the Texas Central runs to Austin; then there is the Houston and San Antonio Railroad, which will form, with the New Orleans and Texas, a complete link of 575 miles due west, with

a fair prospect of the line being continued to El Paso, to join the California Southern Pacific. So that the possibilities of an increased commerce of large proportions may be safely anticipated by New Orleans. That she does anticipate such a possibility is evinced by the movements already suggested for increasing her present facilities. To the cattle trade of Texas she at once has an eye, and the question of stock yards is presented. Altogether, there are signs of an enlarging spirit in business circles, and prospects of an era of push in the Crescent City to which the completion of the New Orleans and Texas will materially contribute.—*Railway Review*.

COST OF WORKING A GAS ENGINE.*

ON THE COST OF WORKING A GAS ENGINE, COMPARED WITH THE SAME WORK DONE BY STEAM POWER.

By Mr. F. T. LINTON, Leith Gas Works.

It may perhaps be as well to explain that, in the remarks which I have the honor to lay before you, I do not propose going into any description of the principles of construction of the various gas engines now in the market. I have no doubt that the members are conversant with these already, from the various communications of late years on the subject, and especially the very able paper read last year by Mr. Carr, of Halifax, before the British Association of Gas Managers.

My desire is simply to put before you what my experience has been on a gas engine which was erected at the works of the Edinburgh and Leith Gas Company in the spring of last year; and, as I suppose that my brother managers, like myself, are being frequently applied to for information and advice as to these engines, I thought that, if I put together a few notes as to the cost of working our gas engine, with a comparison of the cost of doing the same work by steam power, it might be of some little service.

The engine is an "Otto" silent gas engine, made by Crossley Brothers, of Manchester, and is of three and a half nominal horse-power. It is employed to drive various machines in our workshops, such as a Roots blower for three smiths' fires, a large screw-cutting lathe, a screwing machine, a drilling machine, a circular saw, two smaller lathes, and two grindstones. The amount of power required varies considerably, as, at one time, nearly all these machines may be in use, and, at another time, not more than two or three of them. In all cases, however, the smoothness and regularity with which the engine works are very noticeable—there being no sensible diminution or acceleration of speed as the different machines are put in or out of action.

The attendance required is very slight.

The engine can be started in a minute's time, and the lubricating being done by an ingenious self-acting arrangement, no further attention is needed till the engine requires to be stopped, which is done instantly by shutting off the gas. The only other labor needed is to examine the slide valves once a week, to see that the passages to the cylinder are clear; and this does not take more than from fifteen to twenty minutes.

There is a water cistern in connection with the cylinder jacket for keeping the cylinder cool, but I have found that the amount of water required after the first filling of the cistern is practically nil, as the temperature of the water has never risen so much as to require a stream of fresh water run in—the rest during meal hours and at night being sufficient for cooling the water down to the atmospheric temperature. Were the engine, however, working continuously, as in driving an exhaustor, a small stream of water would be necessary, and would have to be taken into account in estimating the expense of an engine for such a purpose.

The cost of the engine for the year from May 15, 1879, to May 15, 1880, working fifty-seven hours per week, was:

Gas for engine and sidelights, 99,000 cubic feet, at 4s. 2d. per 1,000 ft.	£	s.	d.
Sixteen gallons of sperm oil for lubrication, at 3s. 6d. per gallon	2	16	0
Attendance estimated at one hour per day, at 4d. per hour	5	4	0
Making total of working expenses,	28	12	6

The first cost of engine and cistern complete was £170, and the annual tear and wear may be taken at the rate of 7½ per cent.:

Equal to	£	s.	d.
Depreciation, the same	11	18	0
Making together	23	16	0
Add to this working expenses as above,	28	12	6

Total charge for year 52 8 6

The amount of the working expenses would necessarily vary with the varying price of gas in different localities. What is given above was the selling price in Edinburgh and Leith last year, but, of course, the actual expense, where it is used in a gas works, will be not the selling but the cost price of the gas.

With regard to the percentages charged for tear and wear and depreciation, these are, I am sure, ample, looking to the well finished and substantial style in which these engines are got up, the absence of complicated working parts, and the large bearing surfaces of the parts liable to be worn out.

The amount of power derived from the above expenditure has been on the average at least two horse power. As explained before, the use of several of the machines is intermittent, but it takes about one and a half horse power to drive those that are constantly in use; and the addition of a half horse power to the average for those that are used occasionally (including as they do a circular saw of large size and a heavy screw-cutting lathe), is a very moderate estimate. This works out to an expenditure of about 17 cubic feet of gas per indicated horse power per hour, which is much below what is stated to be used when the engine is worked with a full load, and seems to bear out what was stated by Mr. Carr in his paper last year, that, contrary to what might be expected at first sight, the engine works more economically when not used up to its full power.

The cost of a steam engine and boiler of three and a half nominal horse power, and equal in respect of workmanship to the "Otto" gas engine, would be about £110; and the usual allowance for tear and wear and for depreciation would be ten per cent. per annum for each, on an engine and boiler of this size. This, relatively to seven and a half

* Paper read before North British Association of Gas Managers—Perth Meeting.

for the gas engine, is not at all excessive, as, of course, the boiler involves more wear and tear and depreciation:

The working expenses would be:

	£	s.	d.
For fuel at 8s. per week for fifty-two weeks	20	16	0
Wages of attendant at 12s. per week,	31	4	0
Oil for lubrication (same as gas engine)	2	16	0
Water supply for boiler	2	10	0
Making total working expenses	57	6	0
Add for wear and tear 10 per cent. on cost	11	0	0
Add for depreciation 10 per cent. on cost	11	0	0
Making total charges for year	79	6	0

It will be borne in mind that the cost of fuel will be more or less than what is given above, according to locality; but it is a fair estimate, checked by actual experience of the working of a small steam engine and boiler in our works, and by comparison of what it cost various users of similar engines in the neighborhood. The wages of an attendant I have taken at 18s. per week, and I have allowed 6s. off that, on the supposition (which in many cases, however, could not be realized) that the man could devote so much of his time to other work.

The general results, then, are as follow:

	£	s.	d.
Working expenses of gas engine	28	12	6
" " steam engine	57	6	0

and, taking tear and wear and depreciation into account, the total annual charge would be,

	£	s.	d.
For gas engine	52	8	6
" " steam engine	79	6	0

The advantage is, therefore, largely in favor of the gas engine, and I venture to think that if I have erred at all in the comparison it is in under, not over estimating the cost of the steam engine. I have also to point out that our engine is constantly going during working hours. There are, however, an infinite number of cases where power is needed only at intervals, and in such cases the comparison would be still more in favor of the gas engine.

In all cases where we have supplied gas for these engines the testimony of the users has been highly in their favor; and not long ago one gentleman gave me his experience as being, that "when he had a steam engine it cost him 18s. a week for wages to the attendant, and from 10s. to 12s. a week for fuel; but that now his cost was from 4s. to 5s. a week for gas, and no attendant needed."

In addition to the saving in cost, however, the gas engine has other advantages: It occupies small space; is always ready at a moment's notice; does away with the risk and danger of explosion, thereby reducing cost of insurance, and allowing insurance to be effected in places where, with a steam engine and boiler, the companies would not undertake it. It also needs no special building or chimney, and does not make the premises where it is used uncomfortable with heat, dust, and cinders.

One drawback it has, not as regards those who use it, but as giving trouble occasionally to gas managers, namely, that the action of the engine causes an oscillation of the lights taken from service immediately adjoining that of the engine, when the main pipe is small, say, under 4 in. in diameter. The supply should, therefore, be always taken from a large main where practicable, or, at any rate, where the main is less than 4 in. in diameter, no other service should be taken in close proximity to that for the engine. I had lately a correspondence with Messrs. Crossley about this, and they promised to send me a governor which is used on the Continent for preventing this oscillation, but it has not yet come to hand. I may also note that the pressure of gas in the main must be at least equal to that of seven-tenths of an inch of water.

That gas engines will, ere long, come into extensive use, I think certain, not only as supplementers to some extent of steam engines, but also as affording a cheap and efficient motive power in a great number of places where the use of steam is difficult or impossible. It is obviously the interest of gas companies and gas managers to forward their employment as much as possible, because they not only increase consumption of gas, but, by using it chiefly during the hours of daylight, no corresponding increase of capital expenditure is involved; and their extensive use would not only benefit gas manufacturers, but also gas consumers in general, by reducing the cost of making the gas.

SHAFT FURNACE FOR THE REFINING OF CAST IRON.

ACCORDING to M. Krupp, when a mixture of pig iron with basic oxides of iron, and with or without the addition of oxides of manganese and lime, is treated in a shaft-furnace, which is furnished with a garniture of ores of iron, "bauxite," manganese, bituminous shale, or any other substance in which carbon predominates, or which is basic; or if the above mentioned mixture is treated in a shaft-furnace consisting of a reservoir of double walls, between which a current of cold air circulates, and the melting-pot or breast-pan of which is furnished with a basic or neuter garniture, then the cast iron loses its greatest part of manganese, silicon, sulphur, and phosphorus, and, besides this, a part of the ores is reduced and the yield is augmented.

When this system of refining in a shaft-furnace is adopted, it is of little importance to know whether the carbon of the cast iron is attacked or not, for when a sufficient quantity of coke is present, the product arrives in the melting-pot, or in the breast-pan, at a temperature which is higher than the melting point of the final product, be this latter cast iron or steel. The cast iron which is to be refined in the shaft-furnace needs no manganese to preserve its carbon. The iron would only then lose its fluidity, if a remarkable decarburization took place in the melting-pot or in the breast-pan.

It is better, with this system, to use a furnace with a cooling shaft, without garniture in the melting chamber, because the walls cover themselves with a layer of ores, and all repairing of the garniture is thus avoided. For the lower part of the furnace can be used a cooling reservoir and a breast-pan, which has a carboniferous garniture and can easily be replaced. Fig. 3, opposite, represents a furnace of this kind, the upper part of which, A, is suspended from the feeding platform, B; the air penetrates and circulates around the shaft by means of a slide, a. The molten metal flows out through the opening, b, which occurs at the