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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE ULTIMATE DEVELOPMENT OF THE GAS ENGINE.

It is greatly to be regretted that because of some slight hitch in the arrangements, several large gas engines and producer plants, which were promised by German and French builders for exhibition at St. Louis, have failed to materialize. Had these elaborate plants been installed and shown in operation, as was intended, the exhibit would have been an object lesson whose effect must surely have been far-reaching in this country, where it is not generally understood what vast strides have been made in Europe in the development of the gas-engine industry.

Units of from 3,000 to 6,000 horse-power have been built, and others ranging as high as 8,000 horse-power are under construction. Continental builders have been quick to realize the vast possibilities of the gas engine; and one large industrial concern that is using this form of motor in its establishment, recently informed the American representative who arranged for the gas-engine exhibit at St. Louis, that within a few months he hoped to have not a single steam engine running in its large establishment.

Much progress has been made along the lines of the self-contained gas engine, in which the single unit consists of producer, washer, reservoir, and engine complete; and to such an extent has the development been carried, that plans are now under way for the installation on a marine vessel of a self-contained gas engine plant, in which it is hoped to secure a large economy of fuel with a considerable reduction in weights and space occupied.

Future development of the gas engine must be directed as much to the producer as to the engine itself. There are no fundamental unsolved problems about the former, but in the producer there is a wide field for improvement. The large gas engines to which reference has been made above are running generally on blast furnace gas or some form of producer gas. If the supply of coal for producer work were entirely of the anthracite variety, there would seem to be practically no limit to the development of the industry and the wide range of uses to which the producer gas engine could be applied. It is probable that in a substitution of producer gas engines for steam engine installations, there will be economy all along the line, in weights, space occupied, and fuel consumed. The problem of the future, however, is to bring the producer up to such a degree of efficiency that it will handle bituminous coal with as much satisfaction as it now uses anthracite coal; for it is evident that a producer gas engine that is dependent for its efficiency upon anthracite coal can have only a limited range of usefulness. What is needed is such an installation as can take whatever grade of coal is most accessible. As soon as this problem has been solved, the gas engine will receive the greatest impetus in its history.

ENDURANCE OF WARSHIP MACHINERY IN THE RUSSO-JAPANESE WAR.

The extremely arduous campaign in the Far East is putting the warships of both Russia and Japan to an extraordinarily hard test, and in the case of Japan the propelling machinery, including engines and boilers, is being tried out about as thoroughly as could well be asked.

The secrecy observed by the contestants has rendered it very difficult to obtain reliable information as to just how well the ships are standing the heavy strain put upon them, and much of the evidence that has been published must be received with great caution, being largely founded upon hearsay. The best technical article dealing with the subject, is one that was recently published by our esteemed contemporary, The Engineer, of London. It bears the earmarks of having been written by its own naval expert, who, not long before the war, was given exceptional facilities to visit and describe the principal dockyards of Russia.

According to this authority, the strongest interest centers in the Japanese ships, because of the very severe steaming test imposed by their continuous service on the high seas. Not a single ship of the fleet is able at present to maintain its original speed, though most of the loss is due to foul bottoms rather than deficiency of engines and boilers. Up to the time of her loss, the battleship "Hatsuse" had proved the most efficient steamer, one of her officers having written, a few days before she was sunk, that no defect of any kind had appeared in her motive power, and that her loss of speed from foul bottom was only about half a knot. The most serious falling off of speed was in the cruisers "Asama," "Yoshino," and "Chitose," and the battleship "Fuji," most of which had experienced trouble with their boilers. The armored cruiser "Iwate" was badly hit during the battle of February 9 in the region of the boiler room, but although leakage of the boilers, which are of the Belleville type, occurred, there was no serious loss of speed. The speed of the 22-knot "Asama" has sunk to about 18 knots, and the other cruisers mentioned above, all of which were high-speed vessels, are supposed to be good for about 18 knots. The battleships "Fuji" and "Yashima" have fallen in speed from their original 18 and 19 knots to about 14 knots, the assigned cause being that it is not considered safe to urge their old-type boilers. The battleships "Mikasa" and "Asahi" and the armored cruisers "Yukumo," "Azumo," and "Idzumo," at the time the article was written, were steaming fast and well, the Belleville boilers having given no trouble whatever. The battleship "Shikishima," which is equipped with Belleville boilers, had no trouble in her boiler room, but some slight injury had been done, probably by a projectile, to her machinery. The destroyers had all fallen off greatly in speed under the tremendous strain to which they had been subjected, but the general sentiment was that, bearing the circumstances in mind, the performances of the vessels had been satisfactory.

The big armored cruisers "Gromoboi" and "Rossia" of the Russian navy are spoken of as being in good steaming condition, an estimate that was verified by their escape shortly afterward at the close of the battle in the Corea Strait. The "Retvizan," which, it will be remembered, was torpedoed in the first attack on Port Arthur, had her engines thrown out of alignment by the shock, which also developed leaky tubes in the boilers. It is a surprise to learn that the "Czarevitch" suffered no injury whatever to engines or boilers when she was torpedoed at the opening of the conflict, and also that, although the torpedo hit her rudder, her propellers suffered no hurt. After being patched up at Port Arthur she was able to steam at a good speed, although the terrific hammering she received in the latest engagement cut the speed down to 4 or 5 knots an hour. The cruiser "Pallada" was struck amidship by a torpedo, that passed through the side and exploded partly in the coal bunker and partly within one group of her Belleville boilers. The tubes of the boilers were torn out and twisted into an S-shape. They were subsequently withdrawn, straightened, and replaced, mostly by the ship's own engineers. The battleship "Pobieda" was hit by a mine in the port boiler room. There was a big inrush of water and the fires were put out, but no one was injured. Strange to say, no tubes burst, and the ship returned to harbor under her own steam. The only repairs necessary were to patch up the hole torn in the ship's side by the torpedo. The main engines were quite uninjured. Although in the early days of the war the Russian destroyers were inferior in speed to the Japanese, the hard service to which the latter have been put has equalized matters.

The lessons of the war, as far as the engine room is concerned, are summarized as follows:

First. The impact of heavy projectiles has a strong tendency to affect the alignment of machinery by shock, but has less effect than might have been expected upon boilers, whether of the water-tube or cylindrical type.

Secondly. All small ships, especially torpedo craft, wear out quickly and lose heavily in speed as the result of hard service.

Thirdly. The deterioration of big ships is considerably less; and in the case of vessels which, like the "Idzumo" and "Bayan," were well cared for in the days of peace, the deterioration is very little indeed.

Fourthly. The disablement of machinery by gun fire is quite improbable, the danger being limited to partial injury.

Fifthly. Cylindrical boilers have proved inferior to water-tube boilers of the Belleville variety. The tubes have been easily swept at sea, whereas the ships carrying cylindrical boilers have had to return to harbor frequently for cleaning.

Lastly. It has not proved possible to maintain full speed for any length of time in either fleet, although the "Bayan," on the occasion of her escape from the Japanese, is said to have steamed for nine hours at top speed. One cause of failure has been the physical difficulty of getting the coal from the bunkers quickly enough, whence a lesson is drawn as to the great importance of coal economy.

PRODUCTION OF COAL IN 1903.

Returns made to the United States Geological Survey show that the United States has again exceeded all previous records in the production of coal. The forthcoming report on the country's coal production, which Mr. E. W. Parker, statistician, will soon make, will show that the total output of the coal mines of this country in 1903 amounted to 359,421,311 short tons. This is an increase of 57,830,872 short tons, or 19 per cent, over the production of 1902, which amounted to 301,590,439 tons. The production of 1903 was nearly double that of 1893, and more than three times the output of 1883. The increase of production in 1903 over 1902 was equal to the total production of all kinds of coal in 1878, only twenty-five years ago.

Large and significant as was the increase in the amount of coal produced, the increase in the value of the product was still more noticeable. The value of the coal product at the mines in 1903 amounted to $506,190,733, which, compared with the value of the output in 1902 ($367,032,069), shows an increase of $139,158,664, or nearly 38 per cent. The percentage of increase in value was almost exactly double that of the increase in production—a significant fact which social scientists may interpret as they please.

Of the total production in 1903, 74,313,919 short tons (66,351,713 long tons) represent Pennsylvania anthracite, valued at $152,036,448. This is in contrast to the production of 1902, when the output was curtailed by the prolonged strike in the anthracite regions and reached only 41,373,596 short tons (36,940,710 long tons), valued at $76,173,586. The increase in anthracite production in 1903 over the production of the previous year was 32,940,324 short tons (29,411,003 long tons), or nearly 80 per cent in quantity, and $75,862,862, or nearly 100 per cent in value. The production of bituminous coal (which includes lignite, or brown coal, semi-anthracite, semi-bituminous and cannel coal, and scattering lots of anthracite) amounted to 285,107,392 short tons, valued at $354,154,285, which, as compared with 1902, when the production was 260,216,844 short tons, valued at $290,858,483, shows an increase of 24,890,548 short tons, or a little over 9 per cent in quantity, and of $63,295,802, or a little less than 22 per cent in value.

From this appears that 57 per cent of the total increase in production, and 54 per cent of the increase in value was due to the return of normal conditions in the anthracite fields of Pennsylvania. The average price for a ton of bituminous coal, which is obtained by dividing the total value by the total product, was $1.24 for a short ton in 1903 and $1.12 in 1902. The average price of a ton of anthracite coal was $2.05 in 1903, as against $1.84 in 1902.

Of the thirty States and Territories which contributed to the output in 1903, increased production over 1902 was shown in all but four. Two of those in which the production decreased were among the eastern States, Maryland and Georgia, and two were in the Rocky Mountain region of Colorado and Montana. The greatest decrease was shown by Maryland and was probably due to the largely increased output of Pennsylvania anthracite. Colorado's production fell off only 32,000 tons, notwithstanding the fact that mining operations were seriously affected by labor troubles. There was only one State, Georgia, in which the value of the production was less than in 1902.

Next to the increase in the output of Pennsylvania anthracite the most important gains were shown by West Virginia, 5,679,582 short tons; Pennsylvania bituminous, 4,696,690 tons; and Illinois, 4,267,294 tons.

In order that some idea of the bulk represented by the coal production of the United States in 1903 may be obtained it might be stated that, if the entire production were loaded on freight cars with a capacity of 30 tons each, the trains containing it would encircle the globe at the Equator about three and one-third times. If the entire production were loaded on freight cars in one day, the trains would occupy one-quarter of the entire railway trackage of the United States. Taking an average of 30 cars to a train, it would require sixteen times as many freight locomotives as there are in the United States to move this tonnage in one day. If spread over the surface of Manhattan Island, which has an area of 22 square miles, the entire island would be covered to a depth of nearly 25 feet.

The Paris-Lyons Mediterranean railroads have introduced automobile trains upon their service between Paris and Montereau, a distance of 45 miles. The carriages are each 36 feet in length by 8 feet wide, and 9 feet high. The first-class compartments have accommodation for 12 passengers and the second class for 24 passengers. Twelve more passengers can be accommodated upon a glazed platform at the rear of the carriage, while the engineer has his position in front. Each automobile costs $8,000, as compared with $22,000 for an ordinary steam locomotive.