The Canadian Engineer

VOL. I.—No. 5. TORONTO AND MONTREAL, SEPTEMBER, 1893. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY

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IN THE INTERESTS OF THE

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MONETARY TIMES PRINTING CO.
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Per A. W. LAW, Sec.-Treas.

Toronto, September 1, 1893.

IMPROVEMENTS IN THE GAS ENGINE.

Prof. A. B. W. Kennedy, in a lecture delivered some weeks since at the Royal Institution, said that, in regard to the gas engine, its theoretical efficiency is already so high that there is but little need for attempting to raise it. The possibility of improvement lies in bringing the actual efficiency up to the theoretical, which is about 80 per cent. The greatest cause of loss is represented by the heat taken from the water surrounding the cylinder. The fact is we are trying to obtain incompatible results. To reach the high efficiency we make the initial temperature very high. But, then, any such temperature would melt up our machines altogether, and we have, therefore, to adopt the somewhat barbarous expedient of continually keeping the metal cool by a current of water passing through a jacket. This water must, of necessity, pick up all the heat which can get through the metal and carry it away to waste. The result is obvious in the figures. Although, therefore, the theoretical maximum efficiency is so much greater than that of a steam engine, the actual efficiency is not nearly so great. Notwithstanding this, the actual energy utilized per thermal unit of combustion of heat in a gas engine is very considerably greater than in a steam engine. Undoubtedly, great possibilities for increased economy exist here. A great help would be the discovery of some non-conducting material suitable for use in the construction of engines. What is wanted is something as strong and as easily machined as iron, with the conductivity of sawdust, a material which will remain unaffected by excessive temperatures and which will bear any amount of rubbing. In the case of the steam engine, the case is different; we want to raise the theoretical limit of efficiency. But here we are dealing with a material which is liquid at ordinary temperatures and pressures, so that in its working condition it is a vapor and not a gas, and its temperature cannot be raised without at the same time raising its pressure. Considerations of safety and strength of our materials become here very important, but even if left out of account altogether, and the value of the maximum working pressure of steam engines raised from its present limit of 10 atmospheres to 20 atmospheres—that is 100 per cent.—the theoretical maximum efficiency only would be increased about 10 per cent., a quantity hardly worth considering in such a case. Clearly, this is not a very promising direction in which to work.

No doubt the direction in which to seek for improvement is in that of what is called superheating the steam, or raising its temperature after it has been formed—converting the vapor into gas without increasing its pressure. Theoretically, this can be done to any extent, though it is only recently, through the introduction of mineral oils for lubrication, that it has been thoroughly practicable. At one time, when high pressures were looked at askance, and high temperatures were thought almost as impossible, great hopes were entertained of increasing efficiency rather at the bottom than at the top end of the temperature scale. It was proposed to use an auxiliary engine working with ether or anhydrous ammonia, or any other substance whose boiling point might be made as low as the temperature in the condenser of the steam engine. But there are such great practical objections to this plan that it has at present disappeared from the range of practical engineering. Undoubtedly, the most promising direction for improvement is to go up, and not down the temperature scale, and he will be a great benefactor who will devise a good and not too bulky superheater applicable readily to existing work. All this is rather in the direction of potential than of actual improvement. In the latter, however, there are still large possibilities. The losses here are due to many causes, but chiefly to two. The first of these is that the steam is thrown away at too high a pressure, *i. e.*, that it is not expanded sufficiently far in the cylinder. Mechanically this is remediable at once, but only at the cost of making the engine unduly large and costly for its work. This cause of loss is, therefore, likely to remain. The second is, that as the fresh hot steam is always admitted to a cylinder which has just been emptied of steam having a much lower temperature, a cylinder, moreover, which is made of excellently conducting material, a very large proportion of that steam is at once converted into water on entrance, so that for every cubic foot of steam which leaves the boiler and passes along the pipes, perhaps only two-thirds, or even half or less, does work in the cylin-