

per cent. upon the amount expended thereon, not exceeding \$33,750.

To the Great Northern Railway Company towards the construction of a bridge across the St. Maurice river, 15 per cent. upon the amount expended thereon, not exceeding \$16,425.

Also towards the construction of a bridge across the Riviere du Loup, 15 per cent. upon the amount expended thereon, not exceeding \$15,000.

Also towards the construction of a bridge across the Lac river, 15 per cent. upon the amount expended thereon, not exceeding \$15,000.

Resolved, That the subsidies granted to the Ontario and Rainy River Railway Co., the Canadian Northern Railway Company and the Edmonton, Yukon and Pacific Railway Company, are granted upon the condition, and if received and paid under the authority of this Act, to the above-mentioned companies, respectively, shall be received upon the condition, that the said companies shall not, nor shall any of them, at any time amalgamate with any other railway company, or lease its line to any railway company; nor shall any of the said railways be leased to or operated by any other company; nor shall any of the said companies make an agreement for a common fund or for pooling its receipt with any other railway company, and any such lease, amalgamation or agreement shall be absolutely void, excepting in so far as such agreement may extend to traffic or running arrangements, which have been approved by the Governor-in-Council. Resolved, That the subsidies herein before mentioned, as to be granted to companies named for that purpose, shall, if granted to companies named for that purpose, shall, if granted by the Governor-in-Council, be granted to such companies respectively; the other subsidies may be granted to such companies as shall be approved by the Governor-in-Council, as having established to his satisfaction their ability to construct and complete the said railways respectively; all the lines for the construction of which subsidies are granted, unless they are already commenced, shall be commenced within two years from the first day of August next, and completed within a reasonable time, not to exceed four years from the said first day of August, to be fixed by order-in-council, and shall also be constructed according to description and specifications, and upon conditions to be approved by the Governor-in-Council, on the report of the Minister of Railways and Canals, and specified in an agreement to be made in each case by the company with the Government, which agreement the Government is hereby empowered to make; the location also of every such line of railways shall be subject to the approval of the Governor-in-Council. Resolved, That the granting of such subsidies, and the receipt thereof by the respective companies, shall be subject to condition that the Governor-in-Council may at all times provide and secure to other companies running powers, traffic arrangements and all other rights as will afford to all railways connecting with those subsidized, reasonable and proper facilities in exercising such running powers, fair and reasonable traffic arrangements with connecting companies, and equal mileage rates between all such connecting railways, and the Governor-in-Council shall have absolute control at all times over the rates and tolls to be levied and imposed by any of the companies, or upon any of the railways hereby subsidized. Resolved, That the said subsidies respectively shall be payable out of the consolidated revenue fund of Canada by instalments, on the completion of each section of the railway of not less than ten miles, proportionate to the value of the portion so completed in comparison with that of the whole work undertaken, to be established by the report of the said Minister, or upon the completion of the work subsidized, except as to subsidies with respect to which it is hereinbefore otherwise provided. Resolved, That every company receiving a subsidy under this Act shall each year furnish to the Government of Canada transportation for men, supplies, material and mails over the portion of its line in respect of which it may have received such subsidy, and whenever required shall furnish mail car properly equipped for such mail service, and such transportation and service shall be performed at such rates as may be agreed upon between the Minister of the department of the Government for which such service is being rendered, and the company per-

forming the same, and in case of disagreement, then at such rates as may be approved by the Governor-in-Council, and in or towards payment for such charges the Government of Canada shall be credited by the company with a sum equal to three per centum per annum on the amount of subsidy received by the company under this Act.

THE INFLUENCE OF MECHANICAL DRAFT UPON THE ULTIMATE EFFICIENCY OF STEAM BOILERS.*

(Concluded from June issue).

RELATIVE COSTS.

2,800 NOMINAL H.P. PLANT, WITH CHIMNEY DRAFT.

2 additional boilers	\$ 6,167
Settings, etc., for two boilers.....	1,250
Addition to building, etc.....	2,700

\$10,117

2,400 NOMINAL H.P. PLANT, WITH MECHANICAL DRAFT.

Fan, dampers and ducts.....	\$ 1,500
Saving by using mechanical draft.....	8,617

\$10,117

Considering the matter of increased output solely in the light of comparative cost between the introduction of more boilers or the introduction of mechanical draft, and disregarding any possible cost of change in the chimney, we may again take for illustration the plant of 2,400 rated h.p. Suppose it is desired to increase its capacity to 2,800 h.p. or by 16.2-3 per cent. Then the relative costs under the two conditions will appear as here indicated.

We may now turn to that portion of our discussion which relates to the quantitative efficiency of a boiler plant. No greater waste occurs in modern steam boiler practice than that which is inherent in the employment of a chimney for the production of draft, namely, the loss of heat in the escaping gases. As the chimney depends for its action upon the maintenance of a temperature difference between the internal gases and the external air, it is manifest that with a chimney this waste can never be eliminated. It may be palliated, it is true, by the building of higher chimneys so that the same intensity of draft may be obtained with a lower stack temperature. But such means of providing for the utilization of the otherwise waste heat is expensive. In the case of a fan, however, the power expended as measured in heat units necessary to produce the same results, may, under ordinary conditions, be only about one-seventy-fifth of that necessary with a chimney. In other words the fan renders available for utilization, practically all of the heat wasted by the chimney, while it possesses the further advantage of readily creating the additional draft required when heat abstracting devices are introduced. Donkin and Kennedy in seventeen independent boiler tests found the heat lost up the stack, when no economizer was used, to range between 9.4 per cent. and 31.8 per cent. of the total heat of combustion. As it is not practicable to cool the gases to atmospheric temperature it is evidently impossible to utilize all of the heat, but the ordinary economizer should, with mechanical draft, show a saving of between 10 and 20 per cent.

The importance of mechanical draft in the adoption of means for utilizing the waste heat, is well exemplified in the introduction of retarders and of ribbed tubes. Both of these increase the resistance and almost invariably require fan draft to enable them to create the saving of 5 to 10 per cent., which may be thus secured. The facility with which the intensity of the draft, and the volume of air supplied can be regulated when a fan is employed for draft production, has always been recognized as one of the most valuable characteristics of this method. Such regulations makes possible the most perfect distribution of the air, and its reduction to the minimum amount which will produce satisfactory combustion. For the mere chemical requirements of the combustion of one pound of ordinary coal, about 12 pounds or 150 cubic feet of air is required. But under the conditions of chimney draft this amount is greatly exceeded. Donkin and Kennedy showed in the results of 16 tests that the air supply ranged from 16.1 pounds to 40.7 pounds.

*From a lecture by Walter B. Snow, before the Applied Science Graduate Society, McGill University.