# INTRODUCTION

WHEN the Swedish State Railway Department was commissioned by the Government to submit proposals for the electrification of the railway connecting the two most important towns in Sweden, Stockholm and Gothenburg, much experience had already been obtained on the State Railways with the single-phase system, first with the experimental line Stockholm—Tomteboda—Värtan—Järva, constructed in 1905—1907 and which is described in a book published in 1908, «Experiments in Railway Electrification», and in the second place with the iron-ore line 150 km long between Kiruna and Riksgränsen which was built in 1912—1914 and described in a brochure published by Asea in 1915, »Porjus and the Riksgräns Railway». During the years 1918—1922 the electrification of the iron-ore lines was extended from Kiruna to Gellivare—Boden and Luleå, giving a total length of electrified line amounting to 450 km and with 50 electric locomotives in capacities from 900 up to 2 800 h.p. On this line also investigations were carried out on the pre-

Fig. 1. Overhead line on the experimental railway Stockholm—Tomteboda—Värtan—Järva. Indirect support, double insulation.

Fig. 2. Overhead line on experimental track. Direct support, single insulation, flexible system.

vention of disturbance on telephone lines, a full description of which is given in a book published in 1919, »Investigations Regarding Telephone Disturbances».

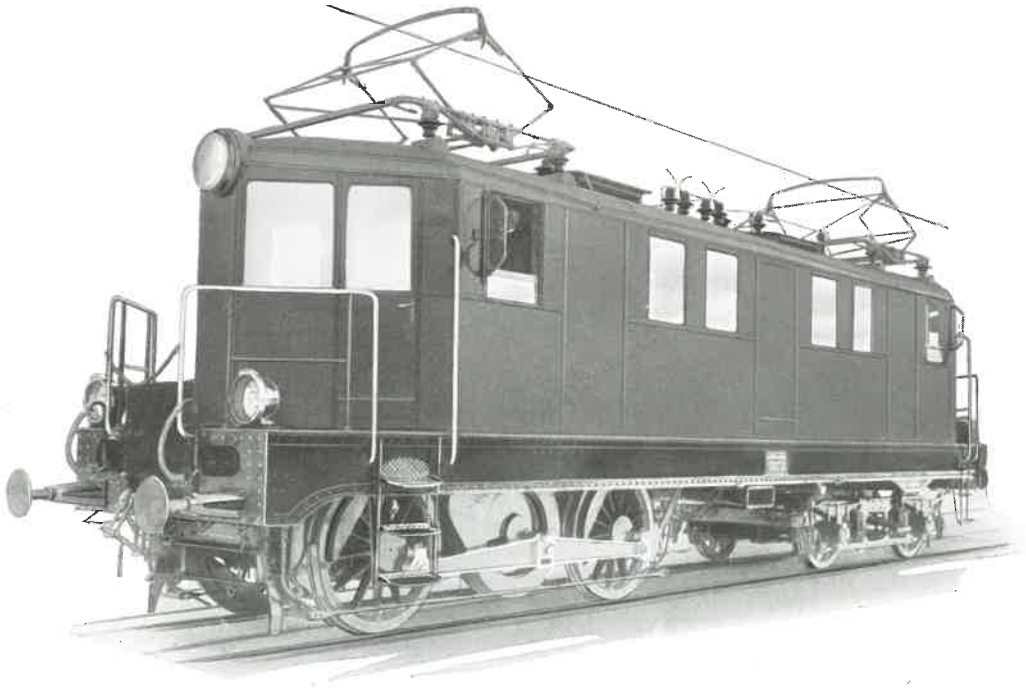


Fig. 3. 450 h.p. passenger locomotive class Z for experimental line Stockholm—Tomteboda—Värtan—Järva.

The proposal submitted by the Swedish State Railway Department in 1920 was for the electrification of the Main Western Trunk Line on the same system as employed for the iron-ore lines, *i.e.* the generation of single-phase power to be transmitted along the line of the railway to transformer substations at intervals of from 30 to 40 km and with track bonds, track booster transformers etc.

Fig. 4. 80 kV transmission line Porjus—Riksgränsen.

When the question came to be fully considered by the committee appointed by the Riksdag *i.e.* the Swedish Parliament, it was found that, having regard to the general power distribution, a number of advantages would be obtained by taking the necessary energy from the existing three-phase networks and converting it in motor-generator stations placed at intervals along the line. It was also decided that the arrangements so far developed for preventing interference with the telephones were not completely satisfactory. The Riksdag accordingly determined that the

Fig. 5. Asea locomotive for 2 100 tons ore train on the Riksgräns Railway, electrified 1912—1914.

electrification should not be proceeded with until these questions had been completely cleared up. For this purpose two committees were appointed in 1920, namely the Electrification Committee and the Telephone Interference Committee, with instructions to submit proposals as to the most suitable means for supplying electric energy and the best preventive measures to be taken with regard to telephone interference. Also on account of the large amount of railway electrification on the D.C. system which was being carried out at the time, especially in America, a number of experts maintained that D. C. would be more suitable for electrification of the Swedish railways, and it therefore followed that the Electrification Committee were additionally instructed to investigate the technical and

Fig. 6. View of Stenbacken station on the Riksgräns Railway.

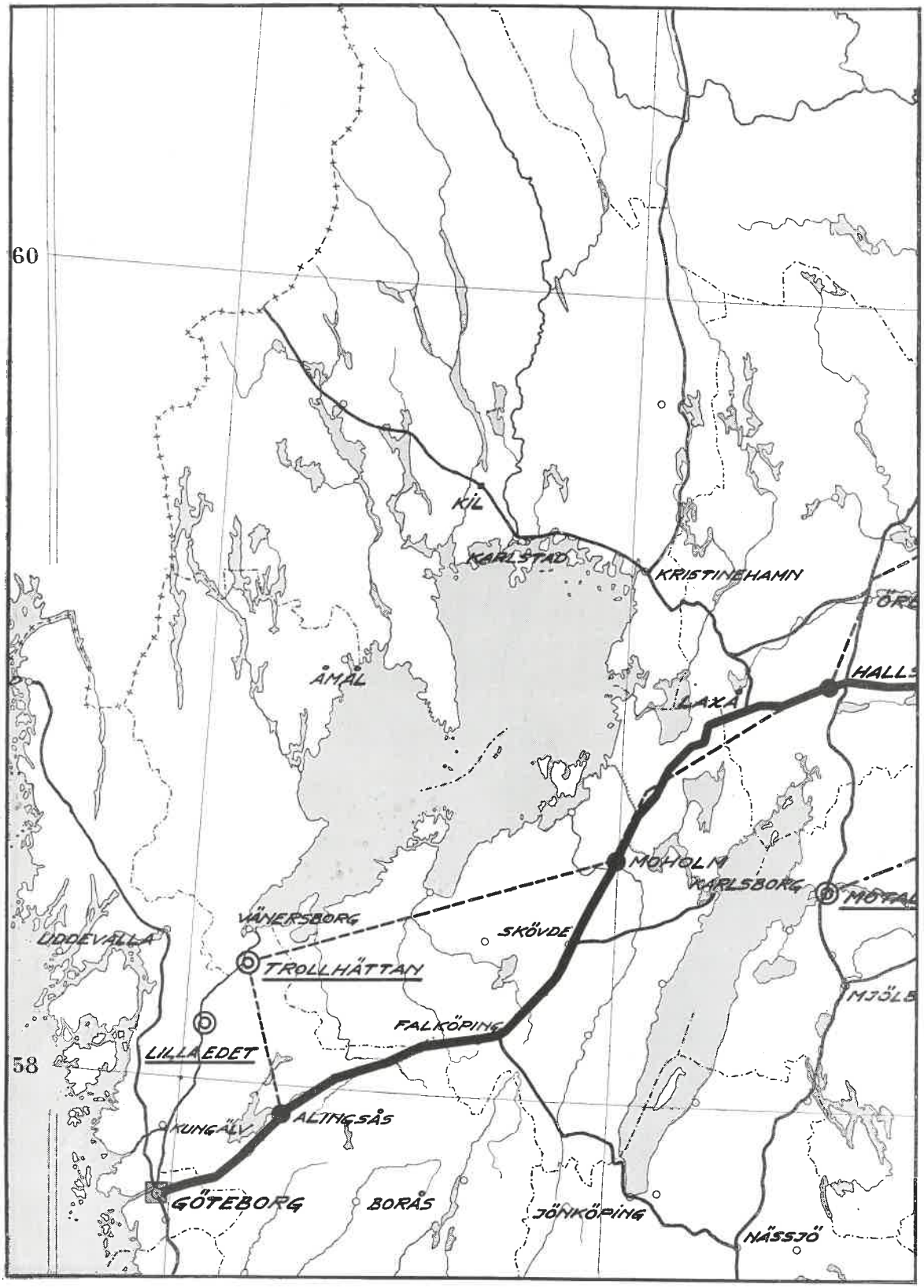
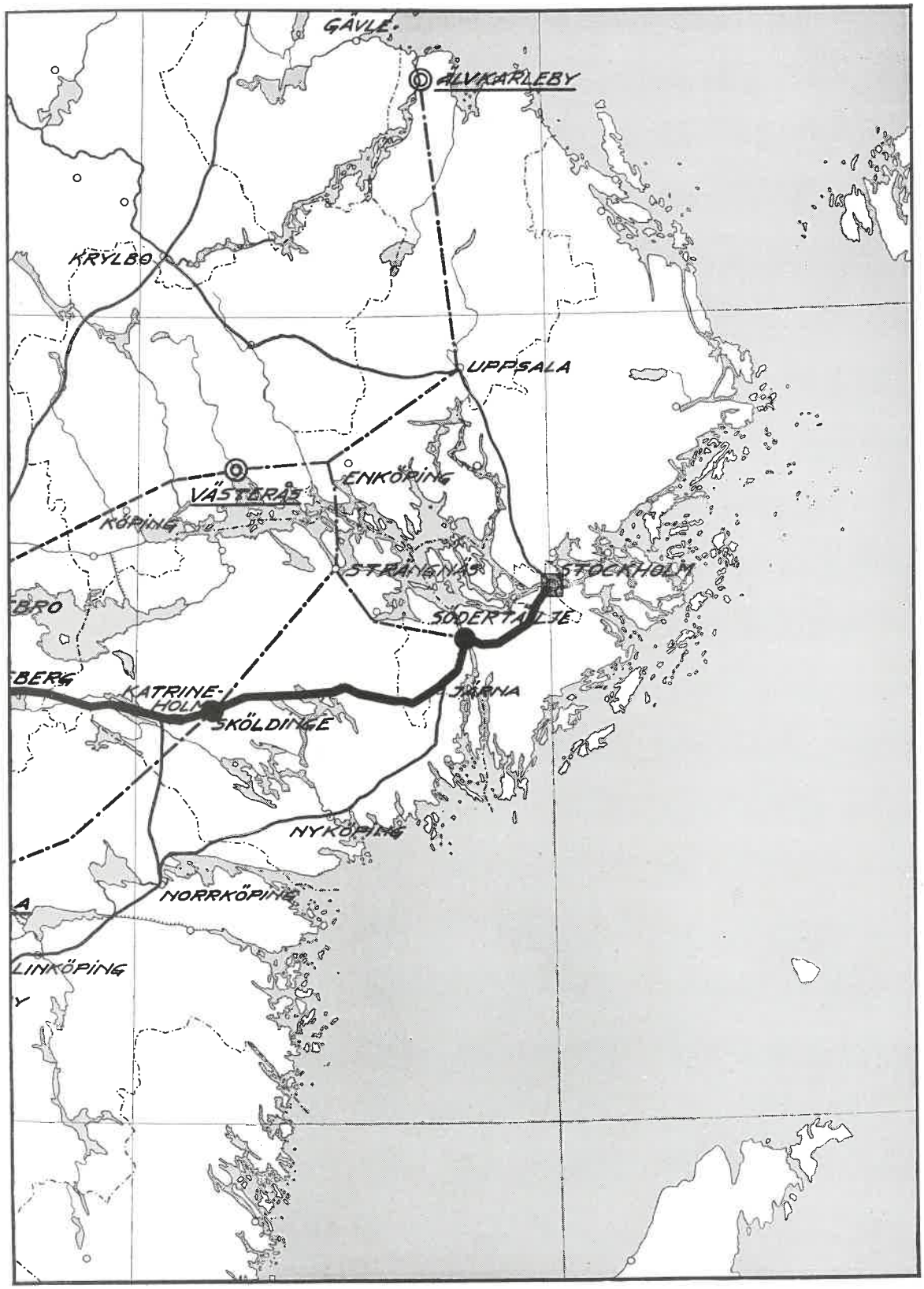



FIG. 7. MAP SHOWING THE STOCKHOLM–GOTHENBURG LINE TOGETHER WITH
Electrified railway. – – – 120 kV main transmission line.




THE POSITIONS OF POWER STATIONS, SUBSTATIONS, AND TRANSMISSION LINES.
◎ State power stations. ● State Railway substations.

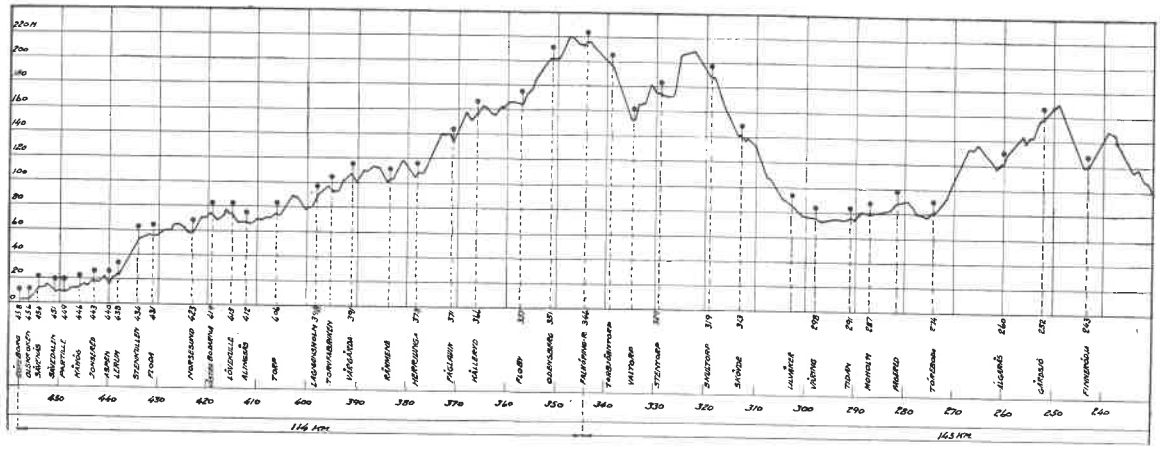


Fig. 8. Profile of the

economic advantages to be expected from the use of D. C. instead of A. C. The investigations and conclusions of these committees, which were of a very full character, became available during the years 1920—1922, and the final recommendations were completed on the 31st December 1922 and the 30th January 1923 respectively.

The report of the Electrification Committee was briefly to the effect that as regards the power distribution throughout the country it would be technically and economically most suitable to supply the railways with power from the existing three-phase networks, and to convert it in converter stations placed along the railway, while electrification with D. C. showed neither technical nor economic advantages over single-phase.

The Telephone Disturbance Committee arrived at the interesting result that the placing of a separate return conductor in a suitable manner in relation to the contact wire and provided with track transformers, together with the transference of the telephone lines away from the railway or

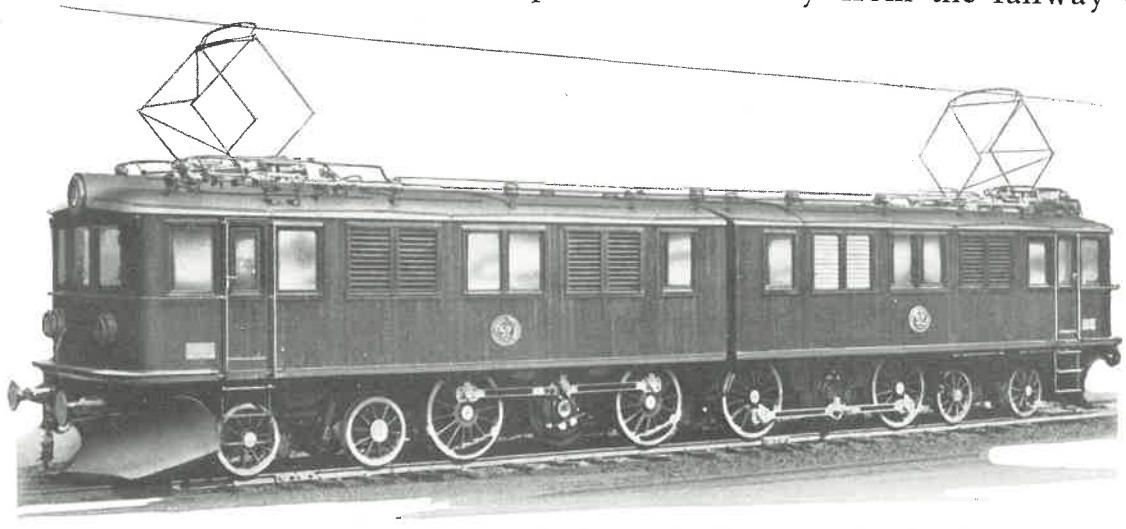
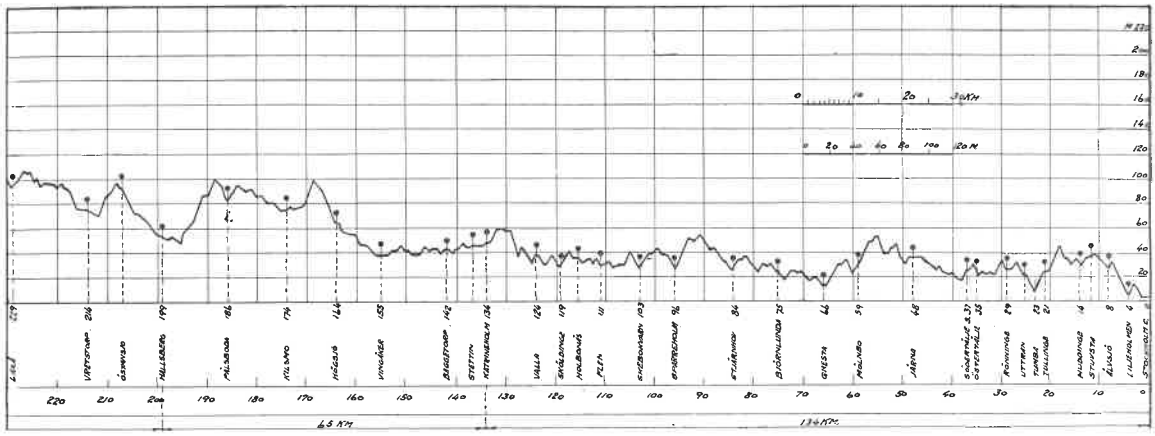


Fig. 9. 2 260 h.p. passenger locomotive class Pb for the Riksgräns Railway.



Stockholm—Gothenburg line.

replacing them by cables with earthed sheathes, entirely prevented interference, while at the same time the distance between converter stations could be increased to 100 km or more.

Accordingly the State Railway Department sought permission in 1923 to carry out the work in accordance with the recommendations of the committees, and the royal assent was obtained in June of the same year. By the autumn the State Railway Department had dealt with the equipment of the substations and with the locomotives, and had commenced preparations for the construction of the overhead line.

All the material was delivered from Swedish shops during 1925 and at the beginning of the next year, and in the spring of 1926 the line was finished, and electric locomotives working trains over the whole distance. With

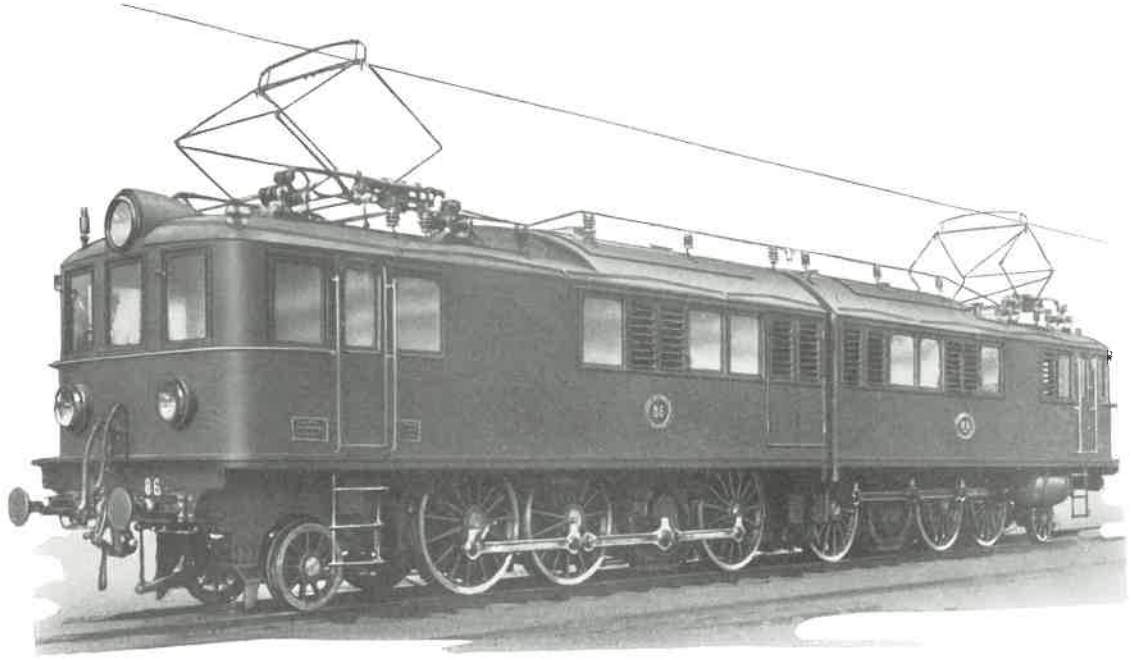


Fig. 10. 2800 h.p. freight locomotive class Of for the Riksgräns Railway.

the completion of this work the single-phase system has been brought a step nearer to its final development, and it is safe to say that this electrification represents the best application of the system which can be found anywhere in the world at present.

Due to the electrification the running times for express and ordinary passenger traffic have been considerably reduced, and the speeds of goods trains greatly increased. The expenses are much reduced, partly on account of the higher speeds, partly due to the disappearance of coaling and firing, and the staff necessary for attending to coal, water and heating stations (normally required owing to the severe winter climate of Sweden).

For the same amount of traffic fewer electric locomotives are required than steam locomotives in use formerly, and the repair and upkeep charges are also very much reduced. In addition, considerable saving is effected in running costs, since the electric power is obtained at a lower price than the coal which would otherwise have to be imported for railway work.

In the following we give some descriptions covering the power stations which deliver the requisite energy, the converter substations, the overhead line installation and the rolling stock, and in conclusion some general data concerning the railway will be of interest. The line has a length of approximately 460 km with a maximum gradient of 10 ‰, and curves of 500 m minimum radius. The line is chiefly single track, but in the neighbourhood of Stockholm and Gothenburg as well as over a considerable section in the middle of the line, double track construction is used. The map reproduced on pages 10 and 11 shows the general layout of the line and the positions of the five substations, Alingsås, Moholm, Hallsberg, Sköldinge and Södertälje, also the location of the power stations, transformer stations, and the direction of the main overhead power lines.

Rotary electric snow plough at work
on the Riksgräns Railway.