THE POLYTECHNIC UNIVERSITY, BUDAPEST AND THE HUNGARIAN INDUSTRY

CONNECTIONS WITH THE GANZ WORKS

By

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The Technical University educates the engineers of the future who will find employment in industry either in the field of design or in production. The connection between university and factory is maintained even after graduation or employment: the two institutions are, so to say, interdependent. The Polytechnical University can provide the basic knowledge enabling the graduate to make a thorough study, covering every detail of the chosen branch of industry and a critical assessment of the experiences acquired. The experiences of the engineer must find their way back to the university in order to assist the latter in providing the very knowledge actually needed in the industry and in developing the curriculum accordingly. Through the basic knowledge acquired at the Technical University and through the experiences gained in designing and manufacturing an engineer may develop a given product to a certain degree of perfection. The requirements to be met are by no means constant but steadily increasing until a state is reached when the basic knowledge and the experiences will prove insufficient and new ways will have to be found or at least the knowledge to be widened by systematic research. This is where the Polytechnical University again comes in. The engineer employed in the industry may be prevented by his everyday tasks from devoting time to an absorbed study of the technical literature which nowadays has swollen amazingly. The cultivation of the occasionally necessary auxiliary sciences (e. g. mathematics) at the Technical University imposes the latter the task to find new and improved methods for the industry. Within the connection between the Technical University and industry there is a third link: the research institutes, where the scientists of the university and the experts of industry make a joint effort to find the solution of problems presented by the industry.

The constant cooperation between university and industry creates yet another connection: eminent experts in some branches of industry may and are to be elected to professorship or lecturership at the Polytechnical University. Thus the chairs will be occupied by specialists who do not shut themselves up behind a desk, in a library or a laboratory but have, beside theoretical knowledge even practical experience.

Let the 113 years old Ganz Works be quoted as an example of the relationship between the Polytechnical University and industry. The managers of this factory have always recognized in due time the significance of some novelty by which they could secure work for the factory and at the same time enhance its reputation. Let us begin with the chilled-iron casting, a pioneering work in the manufacture of wheels for railway vehicles, which later was used in the manufacture of machines for the milling industry (Mechwart-type rolling mill). In the last years of the 19^{th} century novelty was represented by the Diesel-engines. Between 1903 and 1905 the Ganz Works took up the manufacture of steam railcars then started all over Europe in order to reduce the costs of railway passanger traffic. During the World War I the manufacture of steam turbine for warships was introduced. In the post-war years the Ganz Works put the railcar — this time driven by internal combustion engine — as a novelty on the market the manufacture of which was taken up again for the improvement of the railway passenger traffic. The railcar gave an opportunity for the development of the Ganz—Jendrassik-

the extent of comprehensive knowledge to show its manufacture requires. This again involves the help of the Technical University.

For sake of information as to the wide use of Ganz-type railcars let us mention that 8 per cent of the appr. 10 000 railcars of the world are of Ganz made.

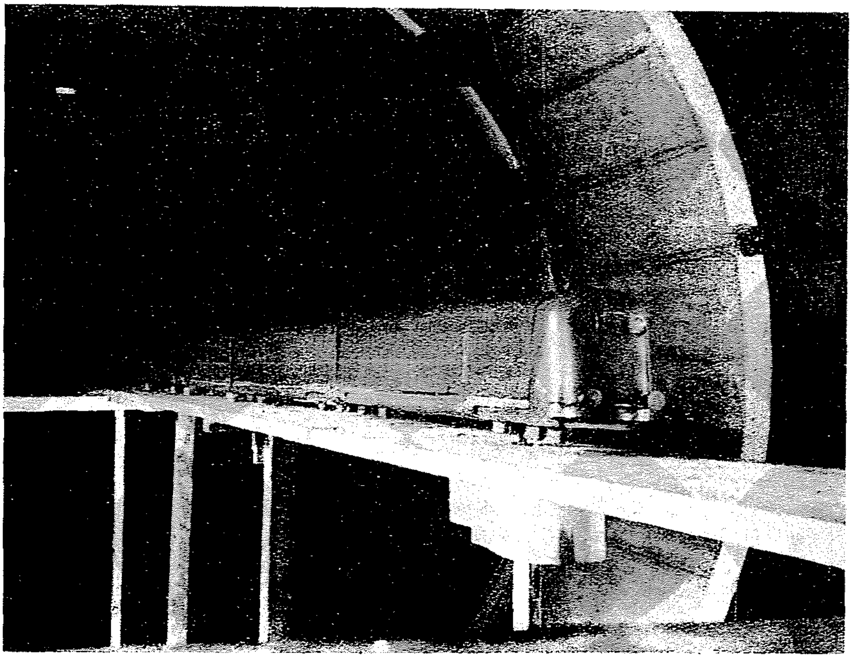

Fig. 1. Measuring train resistance in air tunnel at the Department of Aerodynamics of the Politechnical University, Budapest

type oil-engine. Following the oil-engine, experimenting with gas-turbines also started but was interrupted by the World War II. All these — in their time — novelties made the occasional cooperation of the Technical University necessary.

The Ganz Works have given a great number of professors to the University. Here only EMIL ASHBÓTH, DONÁT BÁNKI, JENŐ CSERHÁTI, EMIL SCHIMANEK and KÁROLY ZIPERNOWSKY should be mentioned.

We shall describe one of the best known product of the Ganz Works, i. e. the railcar,

The railcar — as already mentioned — was introduced in order to make the passanger traffic faster and its costs lower by building the passenger transporting vehicle and the hauling vehicle in one unit. This fact involves that the car is a more or less complicated unit whose machinery is crammed into a small place bound in every direction and limited by an upper weight. In order to lower the operational costs a power consumption as low as possible must be aimed at.

Progress demands the transportation of more and more passengers, and the raising of the standard in travelling comforts. This can be achieved by the increase of travelling speed. At any rate an increase in the requirements means an increase of the power to be built into the car. Nevertheless, the vehicle having thus become heavier and faster must invariably ride smoothly and safely, even on tracks in no good repair. All these requirements can be met by making full use of scientific work.

The railcar is distinguished from other passenger transport vehicles by its machinery. The first element of this machinery is the engine now generally of the Diesel-type. The requirement for higher driving power — owing to the special limitations of railway vehicles already mentioned — can be met by increasing the specific output of the engine which is equivalent to a reduction in its weight. This necessitates a systematic research work concerning the thermodynamical problems of the engine. An improvement of the combustion increases the mean effective pressure in the cylinder, thereby increasing the specific output at constant weight. An increase of the number of r. p. m. also improves the specific output, at the same time also reducing the dimensions of the engine

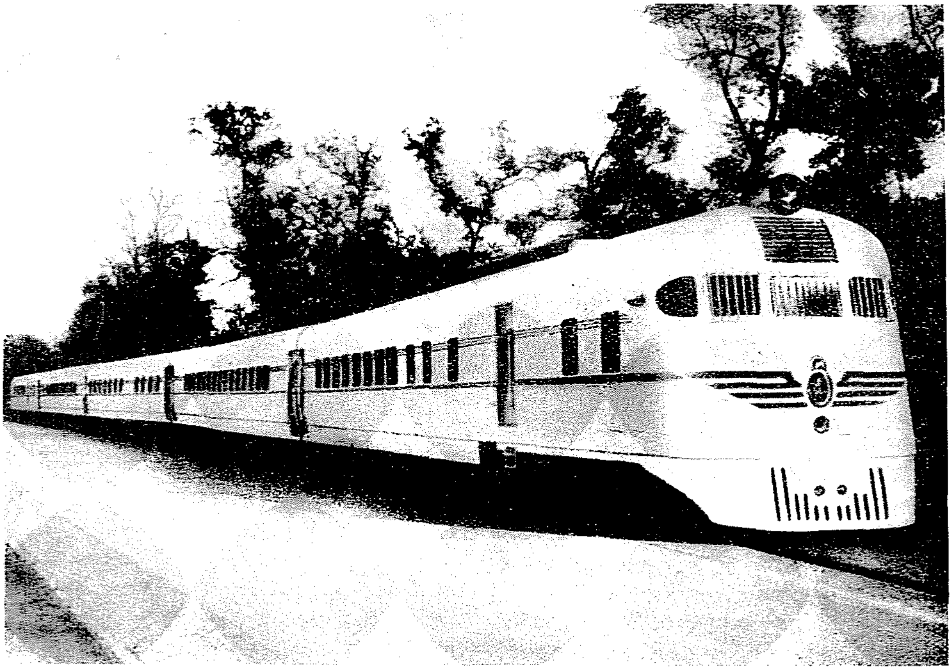

Fig. 2. Express broad-gauge five-car Diesel train set. Engine output 2×600 HP. Mechanical power transmission. Top speed 130 kms per hour. 240 seats. Air-conditioning equipment

When increasing the speed of the engine it is also necessary to study the combustion, as well as hydraulic problems. This involves technological problems concerning the bearings and the wear and tear. On account of the reduction in the weight and price of the engines the question of technology will arise in any case combined with problems of the materials employed and of their machining processes, furthermore because the railway companies require reliable wear-resistant engines which need disassembling only after many years of operation. This can be achieved only by extensive research in thermodynamics, materials and technology.

The driving power of the engine is transmitted to the driving wheels by the power transmission. The power transmission converts the Diesel-engine's torque, which is not quite suitable for traction purposes, into values that can be used in different operating conditions. The characteristics of the different transmissions have to be matched with those of the engine to make possible the full utilization of available power. All this cannot be achieved without scientific research. A study of the efficiency of the transmission for reducing the weight and increasing the over-all efficiency of the traction is also a part of the job. This is the task not of a single factory but of the Polytechnical University.

The auxiliary equipments of the engine abound in research problems : the recooling of the lubricating oil and of the cooling water requires a study of heat transfer, moreover a study of the flow conditions of the three media used : oil, water and air. The difficulties involved in cooling the lubricating oil are well-known. The control of the cooling is exceedingly important. Coolers of small dimension consuming little energy would be desirable in railcars. Among the auxiliaries we have the taking in, conducting and filtering of the air, the removal of the exhaust gases together with noise damping. These again involve hydraulic problems.

The control of the engine and the transmission is effected by means of compressed air as a working medium. This, in turn, is actuated electrically. There are, however, hydraulic control systems as well. The Diesel-engine may have a mechanical or a hydraulic regulator. In order to increase power often several railcars are combined in one train. This has necessitated the development of remote control systems, the handling of all the machinery by one man from the driver's post. In this case different oscillations are liable to arise at controlling, the elimination of which is again a scientific task.

Owing to the steadily increasing weight and speed of the trains, the brake system of the railcar needs development which calls for research in hydraulics, enquiry into friction and heat distribution problems.

The supply of electric energy for all these auxiliaries requires a small and light-weight generating set, well-protected against dirt, the characteristics of which will suit the requirements varying on a wide range.

Keeping the air in the railcar in a healthy and agreeable condition for the passengers is a task of ventilation, heating and cooling. In up-to-date railcars these three tasks are combined in the form of air-conditioning. Here thermodynamic problems (e. g. the loss of heat of the vehicle), hydraulic questions render the research necessary.

The lighting of the railway vehicles is another field for research. The intensity of illumination, the light distribution of the different luminaires used are fruitful research subjects. Today d. c. or a. c. fluorescent lamps are coming into use and experiences with those are being collected.

Our next item is the car body which not only serves as a covering but also has to withstand external horizontal forces. The economical design of the body requires a most accurate calculation of the stresses which presents also a mathematical problem. Several methods for approximate calculation have been in use the reliability of which can only be checked by tenzometric measurements.

The machinery of the railcar and its auxiliaries contain a great number of machines causing noises in addition to those arising in a simple passenger coach. The noise in the railcar must be reduced to such a level as to remain still bearable during the time of the travel. The first step is to measure the noise intensity. The place of noise-reduction and the insulating material to be used are determined by systematic scientific research. To this is related the heat insulation problem of the car body i. e. the protection of the passengers against heat and cold. Research work is being done for a non-aging, moisture- and corrosion-resistant insulating material of low specific gravity that can easily be fitted.

The safety of operation, the securing of a long life to the vehicle and the tracks, furthermore the passengers' comfort require that the railcar as a railway vehicle often running single should, inspite of its weight higher than that of the passenger carriages, ride smoothly and quietly at all speeds even on tracks in need of repair. The running gear and the supporting structure must absorb the impacts (disturbing movements) or transmit them to the car body without causing harmful and unpleasant oscillations and resonances. The movement of the vehicle can be registered and analysed by oscillograph with the help of mathematical means.

Rubber as a noise-reducing and vibration-preventing means is increasingly coming into use in the running gear of railway vehicles. The finding of non-aging, oil-resistant rubber material of suitable quality, futhermore the determination of the proper dimensioning principles give again large opportunity of research to the chemical research workers and to those engaged in statics.

For the internal furnishing of the railcars the use of plastics is constantly spreading which is due partly to the general shortage of wood. These plastics must prove to be wear-resistant, colour-fast and often capable of resisting tropical moisture and insects. The different metals must be provided with a protective coating against the influence of the weather. The protection of the steel parts against corrosion, the durability of the weather-proof outer finish of the railcar often exposed even to the smoke of steam locomotives in case of mixed operation, are all excellent research subjects for chemical research workers and experts in technology. Among the methods here used we may include the sticking of metals to other materials, a method by which the assembly is greatly facilitated.

In the analysis of train resistance the air resistance plays an important role. Here of great help are the aerodynamic tests on small-scale (1/15—1/40) models in air tunnels carried out with a view to finding the most favourable vehicle shape by comparison. At other times it is necessary to obtain a picture of the air flow in order to find the most suitable place for the different openings.

Having come to the end of our survey we may regard as proven that the railcar is a complicated unit presenting in its many details scarcely investigated questions which render strenuous and systematic research necessary. The design requires numerous calculations calling for mathematical ability offered by the University. The variety of the research problems involves the work at many institutes, at the University and in most cases the connection with the factory is not limited to a short period but is constantly upheld because in case of railway vehicles the suitability of some constructions or materials to be used can be ascertained only by tests lasting for years. This fact ensures an unbroken cooperation between University and factory by which both parties accumulate experiences and raise their scientific level.