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Hermann Kemper
NEW PERSPECTIVES FOR THE DEVELOPMENT OF TRACK-BOUND TRAFFIC

ABSTRACT

A brief hommage is rendered to Hermann Kemper (1892--1977), the inventor of the magnetic levitation tecnique for high speed transport

KEY WORDS

Kemper, Magnetic levitation

When in 1922, a student, Hermann Kemper started to concern himself with the mode of action of electromagnets at the Hanover College of Technology and, in doing so, had the idea of replacing railway wheels by the tractive power of electromagnets, what he might have had initially in mind was only a partial aspect of further development of wheel-on-rail technology. Over the years of his subsequent scientific research work, additional findings emerged which opened up new vistas of the track-bound traffic and reorganisation of the whole transport system owing to further development of automatic control engineering and discussion of transport policy starting after 1968.

Hermann Kemper was born on April 5th 1892 at Nortrup in the rural district of Osnabrueck. There he grew up in his parents' house situated neart a railway line and was thus early captivated by the fascination of wheel-on-rail technology. It has inspired him to work on further development of this technology. Unfortunately, he could begin his study of electrical engineering only after World War I. This study gave him fundamental ideas opening to him new prospects of replacing railway wheels by levitating electromagnets which appeared to him to be suitable to create a new transport system on this basis which could be operated without the noise of rolling motion. Hermann Kemper, who had a delicate ear and was not only technically but also artistically gifted, had felt the loud noise of railway to be very troublesome. However, only after 1927, was he able to study in detail this idea of contactless levitation of track-bound vehicles provided with electromagnets. After having finished the college with the degree of graduate electrical engineer and after having worked as head of the physical laboratory of the Hackethal cable company in Hanover, he was asked by his father to take over the management of the family-owned meat products factory at Nortrup. Yet, because he preferred to occupy himself with the basic research work in science and technology concerning magnetic levitation technology, he retired from managing his business and engaged in systematic research work from 1932 to 1936, for whose results patents were granted in 1933, 1934, 1935 and 1938.

The starting point of his reflections was the control of electric currents in electromagnets. According to the state of the art he could at that time use only "discharge tubes as controlling element". Consistently, he gave subsequently his special attention to the fields of application of automatic control engineering in the "magnetic levitation transport system on vehicles without wheels, which are guided along iron rails by means of magnetic fields in a levitation motion".

At the same time, he regarded the magnetic levitation transport system as a novel means of transport for the carriage of passengers and goods. Indeed, it was a novelty, because there was "no wear and tear on the maglev system's trackage" and only a relatively low energy input was to be expected. Here, new technology shows a distinct progress of the track-bound traffic, that is to say, a considerable cost reduction in the sphere of guideway maintenance due to the contactless traffic operation of the maglev system. Although the energy expenditure is more favourable than that of the wheel-on-rail technology, Hermann Kemper also looked at the energy input, because he searched for the speed limits of the magnetic levitation transport system. Under normal atmospheric conditions air resistance is ascending in square order with increasing speed of a vehicle. At a later time, this fact became the criterion determining the efficient speed range of the magnetic levitation transport system named Transrapid (TR).

However, Hermann Kemper was also aware of the possibility to change the atmospheric conditions by operating the maglev transport system as tube vehicle system in a closed tube system. At times, when there have not yet been any jet-propelled aircraft, he already thought of speed limits between 1,000 and 3,000 km/h in a nearly evacuated tube. For that time, this was part of fantastic imagination. Today, issues concerning energy input and cost reduction, in particular related to railway line maintenance, have the highest priority.

After having obtained patents for his ideas, he continued to search for opportunities of further research and development of the magnetic levitation transport system. However, for the time being these efforts were not crowned with success. Thus, it happened that Hermann Kemper took an employment with the Siemens Company in 1936 and moved from Nortrup to Berlin. Then the Aerodynamic Experimental Institution at Goettingen provided him with the opportunity of continuing his research work in 1939, by preparing together with him the application of a magnetic levitation transport system under normal atmospheric conditions for the aerodynamic testing work. Due to the fact that aircraft speed would obviously increase, when jet engines are introduced into aviation, suitable aerofoil profiles needed to be developed. Unfortunately, the wind tunnel at Goettingen did not produce the required wind velocities. That's why the idea arose among the scientists to apply magnetic levitation transport system with an appropriate design using a jet engine in the experimental vehicle in order to measure aerofoil profiles and aircraft models. The test ground (20 km in length) planned to be built in the vicinity of Landsberg on the Warthe was designed for speed limits of up to 1,800 km, but it could not be constructed due to the war. After World War II, all efforts, too, initially failed to continue research and development related to the magnetic levitation technology. That's why Hermann Kemper surrendered his patents and thus could not derive any financial profit from his research work. As a matter of fact, the history of the magnetic levitation transport system could thus have come to its end. Yet it turned out very differently.

In the late sixties Georg Leber (Social Democratic Party of Germany) was the Minister of Transport in the German Federal Government formed by the Great Coalition (composed of CDU and SDP) and headed by the Federal Chancellor, Kurt Georg Kiesinger (Christian Democratic Union). Together with his Ministry Georg Leber had also taken over the responsibility for the German Federal Railways (GFR) which were even then in financial difficulties. In order to improve the economic basis of the total transport system and thus also the economic basis of the GFR, he charged the HSB Study Company to formulate concepts for the reorganisation of the total German transport system. In doing so, the economic efficiency of means of transport came to the foreground. Among other things, this company arrived at the conclusion to cease the short-distance air traffic and to develop high-efficiency and high-speed railway system as link between railway and long-distance air traffic. In this connection the results of Hermann Kemper's research work on the electromagnetic levitation transport system were called back to mind. Under the patronage of the Federal Minister for Research and Technology various German firms examined all possible aspects of the magnetic levitation technology, and this resulted in a decision on a definite system in 1977, in which the "attraction-type" magnetic levitation technology, as it had been elaborated by Hermann Kemper, was defined as a promising version and put into further implementation.

In the meantime, the development of electronic control proceeded from tube technology to semiconductor technology resulting in new perspectives with regard to the rapidity of electric circuits action and the space required for control units. The Transrapid development series ranging from TR 01 up to TR 08 (made by Krauss-Maffei and Thyssen Henschel) and, in parallel with them, the so called *"Prinzipfahrzeug"* (basic or typical vehicle) and the KOMET maglev vehicle, a Transrapid component carrier for measuring and testing (made by Messerschmitt-Bölkow-Blohm), as well as the maglev vehicles HMB 1 and HMB 2 equipped with long-stator linear motor (made by Thyssen Henschel) represent the way leading from analogue technique to digital technique in the field of electronics. The application of digital technique resulted in manufacturing of the maglev test vehicle TR 07 and the prototype of the application vehicle TR 08 on the Transrapid test ground in Emsland. The costs of the magnetic levitation technology development in the period from 1969 to 1999 have been lower than the development costs of a new car type.

Is this development trendsetting, as often the argument goes? Those who work for the future, time and again face the question, whether decisions aimed at future development are right. A look backwards may help to answer this question, because trends have in the past come into existence, by which we can be well guided. The engineering development shows this trend as follows: mechanics – electrical engineering – electronics. This development is evident in the track-bound traffic as well: steam locomotive / diesel locomotive – electric locomotive – ICE (electronically controlled propulsion system, but still mechanical contact of wheels on rails). The magnetic levitation transport system is electronically controlled both in the propulsion (control engineering) and in the vehicle (supporting, guiding, linear electric generator) and is thus the final product in this indicated line of development.

What will be the useful effect and benefit of the fully electronic magnetic levitation transport system that is known under the name Transrapid as well?

The vehicle has no wheels for supporting, guiding and driving, but it has controlled electromagnets providing constant spacing of about 1 cm between the vehicle and the guideway without vehicle-on-guideway contact and, at the same time, compensating various loads. In contrast to a railway carriage, which is passive and cannot react by itself, the maglev vehicle can actively react to excessive speed in curves, to storm loadings or to effects of uneven (irregular) loading of vehicle sections by the aid of control engineering equipment. Therefrom results a considerable improvement of operational reliability.

The contactless levitation function results in another type of guideway load than in wheel-on-rail systems. Due to the mechanical contact of wheels on rails it is possible that concentrated loads of up to 5000 bar arise which cause damages to wheels, rails and the track bed. In the magnetic levitation technology the guideway is stressed by the belt-type weight of the vehicle to the extent of merely 1 bar or so, that is to say it is stressed by no more than a load which equals the ambient atmospheric pressure. Consequently, there is no wear and tear in the high-speed maglev system and thus the operating costs will be significantly lower. Hermann Kemper was already at that time aware of the advantage, too, when he wrote down: "If it will be manageable to protect the guideway from rust, the trackage of a high-speed railway will endure for ever, so to speak."

Since the motor of the magnetic levitation transport system may also be placed in the quideway, as, for example, in the maglev systems Transrapid 05 up to 08, it is feasible to provide a fully electronic system control from a traffic control room in a traction substation. It allows an automatic operation of the Transrapid, which may be based on centralised and decentralised safety and security systems.

The progress of the safety philosophy is also associated with this engineering development. So far in engineering the saying goes "There may be equipment and human failures, but nobody is allowed to commit an error, because otherwise there may be problems". But now, the advanced safety philosophy relating to the magnetic levitation transport system reads as follows: "There may be equipment and human failures, such failures are even tolerable, because still there will be no problems".

That's why the magnetic levitation technology is provided with redundant systems and fault-tolerant systems. Redundant systems are multiply safeguarded so as to substitute one system by another in case of a system outage. Fault-tolerant systems are designed for automatic detection of a technical malfunction (which may occur) by the system and its automatic elimination by the system without human assistance. This is the technology of the future, which has already been implemented in the TRANSRAPID system!

Hermann Kemper, who passed away on July 13th 1977 at Nortrup, had the chance to watch the course of events after 1969 until his death. He lived to see the acknowledgement, that his research work was future-related and fundamental contribution to the progress of track-bound traffic, as he had desired it. In recognition of his merits and scientific work Hermann Kemper was honoured as "Nestor of the magnetic field transport engineering" at the "International Congress of Electric Railways" in 1971 and, on the occasion of his 80th birthday in 1972, he was awarded the "Great Order of Merit of the Federal Republic of Germany".

Hermann Kemper
5 April 1892 – 13 Juli 1977
Pioneer of the Magnetic Driving Technology

LITERATURE

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