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Cooperation with AEG in 1925–1928 as the first form of scientific-technical borrowings in the electric machine-building industry of the Ukrainian SSR

***Abstract.** Scientific-technical borrowings are one of those types of scientific support for the work of industrial sectors, whose role in the conditions of exiting the crisis to acquiring the particular importance. Since the mid-1920s, they have become the main how of scientific support for the organization of the development of Ukrainian electric machine-building industry in the context of large-scale electrification of the country. That was due to the need for a quick withdrawal of this industry from the previous crisis in the absence in the Ukrainian SSR of its own scientific support system for the electric machine engineering. The first form of scientific-technical borrowings for the republican segment of the Soviet Union profile industry was the agreement between the State Electrotechnical Trust and the German electrotechnical company Allgemeine Elektrizitäts Gesellschaft on scientific-technical cooperation. The main objective of this act was to achieve at the lowest possible financial cost the fastest possible increase in productivity of the Kharkiv Electromechanical Plant. To do this, it was supposed using the American technologies for the production of electrical machines but implemented them on German technological equipment. Allgemeine Elektrizitäts Gesellschaft was the company that already made such it at the beginning of the twentieth century using the technologies of the General Electric Company. Moreover, in the pre-Soviet period, it made an attempt to hold a similar act at the Kharkiv Electromechanical Plant, which it owned in this time; however it ended in failure due to the revolutionary upheavals that began in Ukraine. Thus, the agreement concluded with the German company was a continuation of the same actions, what itself had begun, but, already in new historical realities. That is, the Allgemeine Elektrizitäts Gesellschaft actions were copied by the Soviet government, however, adapted to the Soviet way of organizing industrial production. Despite the fundamental difference between the latter and the working conditions of the Allgemeine Elektrizitäts Gesellschaft in Germany, the concentration of the parties precisely on the scientific and technical component of the*



project made it possible to achieve the expected result in full. However, at the same time, Ukrainian electric machine builders focused specifically on the speed of duplication of scientific-technical knowledge missed the opportunity to study the methodology for obtaining them. This became the reason that these scientific-technical borrowings did not become the proper basis for the formation of the scientific component of the scientific-technical potential of the domestic electric machine-building industry.

Keywords: *scientific support; construction; technologies; scientific and technical potential; electrical engineering*

Introduction

Scientific and technical borrowings in the industry is a fairly common way to improve the technical level of products and the productivity of enterprises, since they do not require significant time for the necessary preliminary research and development work (R&D). Scientific and technical borrowings have different forms of implementation and their role becomes very important in conditions when progress in the product range and production technologies must be achieved very quickly. The conditions of the large-scale electrification that has been carried out in the Ukrainian Soviet Socialist Republic (UkSSR) since the mid-1920s were just these for domestic electric machine-building, which at that time take the scientific-technical assistance from the German Allgemeine Elektrizitäts Gesellschaft (AEG). This assistance can be considered as a form of scientific and technical borrowings implementation by the Ukrainian segment of the Soviet specialized industry, the reasons, essence and results of which require special study in the context of summarizing the historical experience of using scientific and technical borrowings.

Despite the indicated importance of scientific and technical borrowings, in Soviet historical studies, which in one way or another cover the development of Ukrainian electric machine engineering during the selected period, the question of their implementation is either ignored altogether or considered superficially. So, in the multivolume monograph “History of the Energy Technology of the USSR”, the talk is about updating the product range in the electric machine engineering of the Ukrainian SSR while simultaneously mentioning the receipt of scientific and technical assistance by the Soviet industry from the German AEG and the American General Electric Company (GEC) (Aleksandrov et al., 1957). However, the relationship between these two phenomena is not made by the authors, which makes it impossible to conclude on the degree of influence of the received foreign scientific and technical assistance on the development of Ukrainian electric machine building, especially - the determination of the types of scientific-technical borrowings, which was implementation. In the collective scientific work “An outline of the history of the Kharkiv Electromechanical Plant”, cooperation with foreign electrical engineering companies is not mentioned at all, although it is indicated that in 1926/1927 (the time when such full-scale cooperation began) the enterprise experienced sudden

significant qualitative and quantitative changes in the range of products (Suzdal'cev et al., 1965a). In foreign studies of the period of the existence of the USSR, the scientific-technical borrowings issue in Ukrainian electric machine-building is also mostly considered superficially, although the scientific-technical cooperation with foreign companies is – more complete than in the works of Soviet historians. So, the fundamental role of Western electrical engineering firms in the development of republican electric machine engineering is noted in the monographs “Foundations of a Planned Economy 1926–1929” (Carr & Davies, 1978) and “The Structural Origins of Soviet Industrial Expansion” (Hutchings, 1984). However, these studies are filled only with a statement of the facts of scientific and technical cooperation, as well as a listing (often incomplete) of the types of electric machines with production which this cooperation was related. Only in the first volume of the monograph “Western Technology and Soviet Economic Development” (Sutton, 1968) is the question of the scientific-technical borrowings by Soviet electric machine engineering considered in more detail. At the same time, detailing the scientific-technical borrowings issue in this work relates mainly to the political-economic part, which, together with the limited information on the Ukrainian segment of this industry, does not make it possible to consider it quite informative on the topic of this publication. In addition, A. C. Sutton does not adequately cover the background to the conclusion of an agreement on scientific-technical assistance with AEG, which makes it impossible to objectively establish the reasons for this event.

In post-Soviet Ukrainian studies of the development of domestic electrical engineering, the only work that mentions the dependence of Ukrainian electric machine engineering in the 1920s and 1930s on foreign aid is the PhD dissertation “Contribution of scientists from Kharkiv Technological and Electrotechnical Institutes to the development of the electrotechnical industry in Ukraine (1885–1950 years)” (Tverytnykova, 2009). However, what exactly was this dependence, the author of this thesis does not specify, nor does he focus on its influence on the development of Ukrainian electric machine-building. In the post-Soviet Russian historiography of Soviet electric machine engineering, the Ukrainian segment of this industry is considered rather fluently. In the study “The History of Electrical Engineering” (Glebov ed., 1999), Ukrainian electric machine engineering of the 1920s is mentioned fragmentarily and scientific-technical borrowings produced by it during this period are not mentioned at all. At the same time, it should be noted that for other regional sectors of Soviet electric machine engineering, the issue of scientific-technical borrowings in this work is also rarely raised – the facts of scientific-technical cooperation with leading foreign electrical companies only fixed. The PhD dissertation “Foreign Capital in the Soviet Electrotechnical Industry of Strong Currents: Forms of Attraction and Use Results” (Novikov, 2006), in contrast to the previous work, discusses scientific-technical borrowings in Soviet electrical engineering more deeply, although mainly in the organizational-financial context. Despite this, some aspects of this dissertation can serve as a basis for determining the

objective reasons for using certain types of scientific-technical borrowings in the Soviet specialized industry, and indirectly in its Ukrainian sector. Direct projection of the corresponding material of this dissertation on Ukrainian electric machine engineering is rather difficult due to its infrequent mention by the author in the context of the topic being studied.

Thus, the results of the historiography analysis of scientific-technical borrowings problem in Ukrainian electric machine-building show that its scientific and technical cooperation with AEG in this context has not yet been investigated and the topic of this article is relevant in terms of restoring the historical picture of this industry. However, in addition to historical science, studying the topic of the article is important for the economy, since it is part of the process of awareness the previous experience of urgent and large-scale quantitative and qualitative improvement of the scientific support of those high-tech industries, the current level of development of which determines the prospects for the scientific-technical development of a country generally. Therefore, the purpose of this scientific work is to analyze the scientific-technical assistance of AEG to Ukrainian electric machine engineering in the mid-1920s as one of the types of industry-specific scientific support. To achieve this goal, objective and subjective reasons, the essence and general results of the scientific-technical cooperation for the domestic profile industry are determined.

Research methods

The study is based on the principles of historicism, objectivity and systemicity, that allowed to consider the electric machine building of the Ukrainian SSR as a structural element of the all-Union profile industry, which is in the conditions of the need for a rapid transition from a crisis to that phase of its development, which would determine its further self-sufficient functioning with the necessary productivity of techniques of the scientific-technical level which be corresponding of world. At the same time, problem-chronological and comparative-historical methods were widely used, as well as the method of periodization, as a result of that was identify the stages of the formation of the way of scientific-technical cooperation between AEG and Ukrainian electric machine building, the causes of their occurrence and subsequent transformations, objective results of scientific-technical borrowings carried out in whole.

Results and discussion

The absence in the Ukrainian SSR at the beginning of the 1920s of specialists in the field of designing electric machines, as well as those competent in the technologies for their production, as well as the shortage of specialized R&D centers, were caused by the fact that in the pre-Soviet period of development of the industry, due to the industrial policy pursued by the tsarist government, electric machine engineering was concentrated in the Russian branches of foreign firms. As a result of the fact that domestic specialized enterprises were, in fact, only the production

capacities of foreign concerns, the scientific support of the industrial production of electric machines throughout the Russian Empire was almost completely carried out from its borders (Annikov, 2014). For this reason, and also because of the low level of electrification of the country, which did not require significant efforts of the electric machine-building industry, the issue of preparing specialized qualified designers and technologists in the pre-Soviet period did not arise on the territory of the future USSR. These factors also influenced that the need for R&D in the field of electrical engineering in the empire was not properly recognized, and they did not have significant support either from domestic business or from the state. Theoretical studies conducted at Ukrainian technical institutes under the guidance of G. E. Evreinova at the Ekaterinoslav Jewish Polytechnic and Ekaterinoslav Mining Institute (Savchuck & Siukh, 2012); A. A. Skomorokhov at the Kyiv Polytechnic (Vydolob & Sen'ko, 1998); P. P. Kopnyaev at Kharkiv Technological Institute (Tkachenko, 2006), were not supported by proper funding. This moment did not allow reaching the volume and depth of fundamental research work that would allow, based on its results, to develop broad R&D of a practical nature, ending with specific design and technological solutions.

The establishment of Soviet power with its program of electrification of the country gave reasonable hope for the imminent increase in the demand for specialists in the field of electrical engineering, which prompted all higher education institutions of the Ukrainian SSR without exception to introduce into their programs disciplines on the basics of designing electric machines (Savchuck & Siukh, 2012; The State Archive of Odesa Region, File (F.) r-126. Description (D.) 1. Case (C.) 147. 93 sheets (s); The State Archive of Kyiv City (SAKC), F. r-308. D. 1. C. 48. 129 s.; The State Archive of Kharkiv Region (SAKR), F. r-1682. D. 1. C. 83. 23 s.). The validity of this hope was ensured by the presence in the republic of 38 electrotechnical enterprises, of which 10 were factories with an electromechanical profile of production (Vasil'ev, Potresov & Tejtell, 1922). True, among them were: the Yekaterinoslavsky Vickers plant, which only was started by construction, and the Temvod plant in Mykolaiv, which was built but not yet fully equipped, and four factories, in the product range of which, along with electric machines, were present means of communications (Annikov, 2015). Besides also small (about 40 people) was the production enterprise of the Kharkiv Installation and Construction Bureau (MSB) of the former Vseobshchaja Electrichestskaya Kompaniya (VEK) [*until summer 1917, the VEK was called the Vseobshchaja Kompaniya Electrichestva (VKE) and was a subsidiary of AEG*] (SAKR, F. 349. D. 1. C. 196. 50 s.). Thus, only three enterprises – Kharkiv Siemens-Schuckert Electric Plant and the production unit of the Mykolaiv MSB of the former WEC, which together was the medium-sized, as well as the country's largest Kharkiv electromechanical plant (KhEMZ) VEK represented the main production potential of Ukrainian electric machine-building industry (SAKR, F. 349. D. 1. C. 184. 583 s.). However, the development of a large-scale plan for the electrification of the country left no doubt that all the available electric machine-

building capacities in the Ukrainian SSR would be used with the prospect of their expansion.

Meanwhile, the industrial crisis in Ukraine caused by the revolutionary events and the ensuing civil war did not favor the growth of demand for electric machines in the early 1920s, as a result of which it amounted to about 4% of the pre-war [*First World War*] (Annienkov, 2014). The situation was complicated by the electrification policy pursued by the central government in Moscow, according to which the “old” industrial areas of the Center and North-West of Russia has electrified in the first place. As a result, a further drop in demand for electric machines in the UkSSR led to the closure or reprofiling of all electromechanical plants in the republic, except for the KhEMZ VEK, which had new calling Elektrosila No. 1. But the situation with the provision of orders for this plant, subordinate to the Board of the Electrotechnical Trust of the Central Region (ETCR) in Moscow was very difficult too, and therefore in 1923 the question arose of its closure (SAKR, F. p-1. In. 1. D. 896. 44 s.). However, the liquidation of such a large plant on the eve of the planned large-scale measures for the electrification of Ukraine was a rather risky step, all the more so – contrary to the government’s concept of concentration of mass production organized at giant enterprises. For these reasons, the plant was not completely stopped and continued to function partly due to state subsidies, and partly thanks to targeted government directives requiring consumers to place a certain part of their orders, from among those that can be executed at Elektrosila No. 1, at this enterprise (Suzdal'cev et al., 1965a).

It goes without saying that the state of the electric machine-building industry in Ukraine, which existed until the mid-1920s, did not favor any significant increase in R&D in the republic, despite the opening in 1921 at the Kharkiv Technological Institute (KhTI) of the Electric Machines Cathedra under the direction of P. P. Kopnyaeva (Tverytnykova, 2008). The profile material and technical and personnel bases of the KhTI were significantly inferior to the electrical research centers concentrated in Moscow and Leningrad. In addition, unlike Elektrosila No.1, the electromechanical plants of these cities were already operating at full capacity and began the process of expanding production, which significantly expanded the innovative capabilities of local researchers. Thus, in spite of the individual R&D results of the Cathedra of Electrical Machines of KhTI, which were introduced in the Soviet electric machine building, as a whole, its research work during the 1920s was more concerned with testing electric machines purchased by consumers or planned by them for purchase (Kamienieva, 1959). In other higher technical educational institutions of Ukraine, due to the concentration of the corresponding production in Kharkiv, research activities in the field of electric machine engineering were carried out on an even smaller scale. This factor of concentration of production influenced the centralization in Kharkiv training of Ukrainian specialists – designers of electric machines and technologists in the field of their production, although in view of the practical stagnation of their main consumer – Elektrosila No. 1, until the second half

of the 1920s there were isolated cases graduation of such specialists (SAKR, F. r-1682. D. 1. C. 191. 22 s.). In contrast to the KhTI at the same time, for example, in Moscow, at the Higher Technical School, the Lomonosov Institute and the Kagan-Shabshay Institute, the training of specialists in the field of electrical engineering was carried out extensively and on a system basis (SAKR, F. r-1682. D. 1. C. 191. 22 s.).

Thus, by the mid-1920s, a situation had developed where the scientific component of the scientific-technical potential of Soviet electric machine-building was mainly concentrated in Moscow and Leningrad. Its sector in Kharkiv was not sufficiently developed in order to independently carry out the necessary scientific support for the processes of creating electric machines at republican production facilities. Considering the conditions of information exchange that existed in the period under review, this moment has significantly weakened the scientific support of the Ukrainian segment of the Union branch of electric machine production. It is also necessary to take into account the fact that based on the condition of electric machine-building production in Russia in the pre-Soviet period mentioned at the beginning of this article, the formation of the scientific component of the sectoral scientific and technical potential in Moscow and Leningrad began only in the first half of the 1920s. Therefore, by the middle of this decade, neither the research centers located in them nor the scientific and technical specialists trained by the educational institutions of these cities had gained sufficient experience in creating electric machines. That is, by the mid-1920s in Moscow and Leningrad, a sectoral scientific-technical resource was already sufficient to provide effective assistance to manufacturers of electric machines in mastering new designs and technologies which was borrowed, but still not sufficient to create such designs and technologies independently, at least – in the required quality and quantity. At the same time, the volumes of specialists trained in these centers by the second half of the 1920s have not yet reached the mass that would allow creating the appropriate reserve for use him in other regions. As a result, by the mid-1920s, Ukrainian electric machine industry turned out to be almost completely devoid of not only current scientific support, but also the minimum level of scientific service necessary for it in the near future.

Meanwhile, the electrification process in the USSR became more and more intensive according to the plans of the Soviet government for industrialization of the country. According to the same plans, from the 1924/25 operational year, measures were launched to widely electrify the industrial regions of the Ukrainian SSR, which led to the intensification of the work of Elektrosila No. 1. However, despite the increase in the fixed assets of this plant by their alienation from the canned enterprises, as well as a significant increase in the main industrial-production personnel, Elektrosila No. 1, renamed the State Elektrozavod (GEZ) in 1925, was unable to satisfy the rapidly growing demand on electric machines (SAKR, F. p-1. D. 1. C. 1180. 96 s.). Resuming operation of the former Siemens-Schuckert factory in Kharkiv, known as the Kharkiv Elektrozavod (KhEZ), and restoring the production of

electric machines at the former MSB VEK in Mykolaiv, renamed the Nikolayev Naval Construction Bureau (NVMSB) for the increase capacities of Ukrainian electric machine-building in needed scale it turned out also insufficient (Annikov, 2015). According to the information provided to the Central Committee of the Communist Party of Ukraine by the State Electrotechnical Trust (GET), which replaced the ETCR in 1925, the total productivity of these enterprises for the 1925/26 operational year covered only 2/3 of the domestic demand on electric machines of all types manufactured by them (The Central State Archive of the Public Unions of Ukraine, F. 1. D. 20. C. 2506. 43 s.). That is, it became obvious to the GET and party-government circles that by simply increasing the number of industrial capacities it is no longer possible to achieve such an increase in the productivity of Ukrainian electromechanical plants which it would satisfy the growth rate of consuming their products, and necessary a radical change in production technologies to more productive ones is required (The Central State Archive of the Public Unions of Ukraine, F. 1. D. 20. C. 2506. 43 s.). In addition, the technical level of electric machines produced by Ukrainian GET plants according to pre-war technical documentation did not correspond to modern trends in the development of electric mechanic, which did not allow counting on their long-term operation. At the same time, the existing scientific component of the domestic sectoral scientific-technical potential, as mentioned above, did not allow making the required changes on its own, so the question of ask for help for a comprehensive focused on the Ukrainian segment of the Soviet electric machine engineering, foreign scientific-technical assistance by 1925 acquired objective inevitability.

Thus, based on the fact that the GET primarily raised the issue of increasing the productivity of Ukrainian electromechanical enterprises, we cannot agree with the position of A. Sutton, who argues that when the agreement about scientific-technical cooperation was concluded between the GET and AEG for USSR was of paramount importance access to information on modern designs of electric machines. More consistent with real historical reality are the claims of M. Novikov that USSR in 1925 it was extremely necessary to obtain highly productive technologies for the production of electric machines (Novikov, 2006). However, this author inaccurately assesses the situation in Soviet electric machine engineering in the mid-1920s, insisting too, like A. Sutton, that the entire industry was needed scientific-technical cooperation with AEG, and not just its Ukrainian segment alone. This, strictly speaking, contradicts the facts cited by themselves about the rather successful results of scientific and technical cooperation between electromechanical plants in the Central and North-Western regions of Russia with, for example, firms such as Siemens-Schuckert, Vickers, Allmänna Svenska Elektriska Aktiebolaget (ASEA), both before and after the chronological period considered here. However, when we are faced with A. Sutton arguments about why all Soviet electric machine building needed scientific and technical cooperation with AEG in the mid-1920s this contradiction becomes understandable.

So, according to A. Sutton, herself received scientific-technical assistance from GEC during the study period, AEG, working with the GET, thereby transmitted the latest achievements of American electric machine engineering to the latter. The direct non-conclusion of a similar agreement between the GET and the GEC in 1925 is explained by the author mainly with arguments based on the fact of the fierce competition between the GEC and Westinghouse at that time, although the author never indicates this directly. Indeed, if you look at the successful opposition of Westinghouse AEG in litigation regarding the priority of intellectual property for multiphase current technique, the argument about the GEC's large-scale support for the latter, including the provision of mediation rights she in cooperation with the USSR, seems entirely justified. Moreover, already in 1929, GEC became the co-owner of AEG, having acquired an appropriate stake in this German concern in 27.5%. It also seems justified, based on the meaning of the material presented, to clarification GEC's reluctance to work directly with the Soviet government at that time for anxiety of creating in the USSR an electrical giant equipped with the latest technology and projects, similar to the GEC factory in Schenectady. In the future, in the event of closer cooperation between the USSR and Westinghouse, this been could significantly weaken the position of the GEC in the world electrical market. The non-direct transfer of knowledge left the GEC an opportunity to maneuver in the issue of the degree of novelty of the designs and technologies, which be transferred. This line of thought, given the change in the direction of the USSR's vector of cooperation in the field of electrical engineering from GEC to Westinghouse in the early 1930s, may also seem correct, if one does not take into account the deeper background of the conclusion of an agreement on scientific and technical cooperation between GET and AEG.

It should be recognized that all the reasons given could take place in history and be laying the foundation of the theses of A. Sutton, emphasizing the GEC initiative in indirect participation in the development of Soviet electric machine engineering. So, the Soviet Union did want to create a plant similar in Kharkiv to the previously mentioned enterprise, what it did not hide no in the mid-1920s or later, but what, however, did not prevent the GEC from concluding a direct agreement on scientific-technical cooperation with him in 1928 (Lisin & Zuck eds., 1935). Moreover, the possibility of creating an enterprise in Kharkiv, similar to that located in Schenectady, was considered back in the summer of 1917, after the confiscation of HEMZ in AEG and the transfer of 1/6 of the shares VEK to GEC (The State Archive of Mykolaiv Region, F. 301. D. 1. C. 39. 8 s.). And direct scientific and technical assistance from GEC to KhEMZ, as well as SMB in Kharkiv and Mykolaiv, were received during the entire World War I, according to the corresponding agreement concluded between this company and AEG in 1914 (Suzdal'cev et al., 1965b). Thus, the entire background of the conclusion of an agreement on cooperation between the GET and AEG testifies to the initial desire: first, German entrepreneurs, and then the Russian and, after them, Soviet governments, to create in Kharkiv, on the basis of KHEMZ, one of the largest electromechanical enterprises in the world, in than the

GEC took the most active and direct part in the pre-Soviet period. Nevertheless, in 1925 the corresponding direct agreement between the GET and the GEC was not concluded, which, as we can be convinced, could not have significant obstacles from the GEC. Consequently, the reasons of the implementation of scientific-technical borrowings from GEC to Ukrainian electric machine engineering in 1926–1928 through the mediation of AEG, lies in the plane of Soviet industrial policy, and not in the strategy and tactics of the American manufacturer.

Returning to the thesis about the urgent need for the Soviet government in 1925 to increase the productivity of Ukrainian electrical engineering, we note that for the successful implementation of this event, in principle, it is necessary not only to have the appropriate knowledge but also the equipment with which this knowledge gets its materialized expression. Meanwhile, during the economic downturn, the replenishment of the active part of KHEMZ's fixed assets took place due to the transfer of the morally and physically obsolete equipment from the conserved enterprises same as that was already having at this plant. In addition, it should be borne in mind that the park of metalworking machines at KHEMZ, in its predominant part, was not at all adapted to work by flow methods and to mass production. In other words, the Soviet government was faced with the task not so much of introducing large-scale scientific-technical borrowings into the range of products, as, first of all, of making quantitative and qualitative changes in the active part of the fixed assets of the enterprise, which would allow introducing large-scale scientific-technical borrowings into the technology of electric machine-building production. For these purposes, it was necessary to purchase a considerable amount of appropriate equipment, which for the most part was not produced by Soviet industry, and the best conditions for its import of the USSR in all the necessary assortment in the mid-1920s were provided by Germany (The Central State Archive of the Supreme Authority and Administration of Ukraine, F. r-143. In. 1. D. 161. 489 s.). Thus, the best option that allows the Soviet Union to create a modern, highly productive center for electrical engineering, aimed at the production of machine and apparatus designs borrowed mainly from American electrical companies, was the one according to which the corresponding specialized American knowledge would be embodied on German equipment. However, such an option for the organization of electric machine-building production has already been implemented in Germany at AEG, and with a positive result. This was the reason that the agreement on scientific and technical cooperation was concluded precisely with AEG, and cooperation, in essence, was duplication under the German and American specialists the acts that were once done by this company.

The orientation of the tasks facing Ukrainian electric machine building in the mid-1920s, namely to the transition to American production technologies, is also confirmed by the fact that out of all metalworking equipment for the production of electric machines delivered to KHEMZ from 1920 to 1939, more than 73 % accounted for the period of its direct or indirect (through AEG) cooperation with the GEC in 1926-1932.

(Annikov & Annikova, 2015). And according to the “HEMZ Census of Metalworking Equipment” of this amount, qualified equipment amounted to 85%, 80% of which was imported, and more than $\frac{3}{4}$ of volume in the import was German equipment (SAKR, F. r-4217. In. 2. D. 376. 66 s.). If we take into account that during the period under review, the Soviet machine-tool industry specialized mainly in the production of duplicates, and mainly of German machine tools, then the remaining 20% of the domestic qualified equipment supplied to the GEZ can also be considered, at least in design, as German ones (Annikova, 2019). Thus, the data presented testify to the correctness of the thesis that the task set for the Ukrainian electric machine was to switch to American technology with German technological equipment.

It should be recognized that the results of the cooperation between the GET and AEG fully met expectations for increasing the productivity of Ukrainian electric machine-building industry. By 1929, the GEZ already produced a third of the electric machines manufactured in the USSR (Suzdal'cev et al., 1965a), which allowed the KhEZ to be transferred to the production of military radio communications, and the industrial capacities of the NVMSB organized on assembling naval electrical products based on complete electric machines. However, while in the industrial-innovative plan AEG was one of the authors of the transferred knowledge, in the scientific-innovative plan it was only an intermediary. Therefore, in the implementation of this type of scientific-technical borrowings, there was no achieved significant increase in the scientific and technical level of products manufactured by the GEZ, as a result of which until the end of the 1920s there was not a tendency to a decrease in the volume of imports of electric machines in the USSR (The Central State Archive of the Public Unions of Ukraine, F. 1. D. 20. C. 2506. 43 s.). The fast pace of electrification of the Soviet Union led to a change in consumer demand for electric machines not only quantitatively, but also qualitatively, and the domestic scientific support of the industry, as we have seen, could not provide the latter. Therefore, the need for electric machines of a higher technical level or structurally different from those that were manufactured as a result of foreign scientific and technical assistance was still covered by import at the turn of the 1920 s and 1930 s.

Conclusions

The implementation of large-scale scientific-technical borrowings from abroad in the field of electric machine engineering in the mid-1920s in Ukraine became an objective necessity, caused by the lack of domestic scientific support for the industry, sufficient to organize, first of all, its productivity at least at the minimum level required by the country's electrification process. Scientific and technical cooperation with AEG was based on the principle of introducing in Ukrainian electric machine-building American manufacturing technologies adapted to German equipment. This was the first form of scientific-technical borrowings implementation that was most acceptable for the USSR, which made it possible to increase the current productivity of Ukrainian electric machine building at minimal cost, while providing it with the

ability to maintain or even independently increase its productivity in the future, with switching to the production of a more technically advanced product range. Itself this form of scientific-technical borrowings itself was not invented by the Soviet government but was a copy of similar acts conducted by AEG in the early twentieth century, which this company tried to implement at its factory in Kharkiv in the same period too, but the copy was new conditions adapted. Despite the certainly positive overall outcome of cooperation with AEG, its significant drawback was the superficial mastering by domestic scientific, technical and industrial personnel of the methodological foundations of the design and manufacture of electrical machines used by German and American specialists. This moment was caused by the rush with which the Soviet government carried out the measures for the scientific-technical borrowings considered here, and which led to the fact that their implementation acquired the character of predominantly unthinking duplication. The consequence of this was both the continuation of the unrelenting dependence of the domestic electric machine building on foreign scientific-technical borrowings in the aspect of the product range and the high probability of making mistakes with the further independent adaptation of the technologies in worsening conditions of their application.

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Співробітництво з АЕГ у 1925–1928 рр. як перша форма науково-технічних запозичень в електромашинобудуванні Української РСР

***Анотація.** Науково-технічні запозичення є одним з тих видів наукового забезпечення роботи промислових галузей, чия роль в умовах виходу з кризи набуває особливої значущості. З середини 1920-х років вони стали основним способом наукового супроводу організації розвитку українського електромашинобудування в умовах масштабної електрифікації країни. Це обумовлювалося необхідністю швидкого виведення галузі з попереднього кризового стану за відсутності в УСРР власної системи наукового забезпечення електромашинобудівної індустрії. Першою формою здійснення науково-технічних запозичень для українського сегменту союзної галузі став договір між Державним Електротехнічним трестом та німецькою електротехнічною фірмою Allgemeine Elektrizitäts Gesellschaft про науково-технічне співробітництво. Головною метою даного заходу стояло досягнення якомога більш швидкого збільшення продуктивності Харківського електромеханічного заводу за мінімальних фінансових витрат. Для цього передбачалося використати американські технології виробництва*

електричних машин, що втілювалися б на німецькому технологічному оснащенні. *Allgemeine Elektrizitäts Gesellschaft* була тією компанією, що вже втілила в себе такий прийом на початку ХХ ст., використовуючи технології *General Electric company*. Більше того, нею було здійснено спробу здійснити аналогічний захід на Харківському електромеханічному заводі, що належав їй у дорадянські часи. Однак вона завершилася невдачею через розпочаті на українських теренах революційні потрясіння. Таким чином, укладений з німецькою фірмою договір став продовженням нею ж розпочатих дій, проте в уже нових історичних реаліях. Тобто, радянським урядом було скопійовано заходи *Allgemeine Elektrizitäts Gesellschaft*, але адаптовані до радянського способу організації промислового виробництва. Не зважаючи на докорінну відміну останнього від умов роботи *Allgemeine Elektrizitäts Gesellschaft* у Німеччині, зосередження сторін саме на науково-технічній складовій проекту дозволило домогтися очікуваного результату в повному обсязі. Проте при цьому українськими електромашинобудівниками, зосередженими на швидкості дублювання науково-технічних знань, було упущено можливість вивчення методології їх отримання. Це стало причиною тому, що проведені науково-технічні запозичення не стали належним ґрунтом формування наукової складової науково-технічного потенціалу вітчизняного електромашинобудування.

Ключові слова: наукове забезпечення; конструкції; технології; науково-технічний потенціал; електротехніка.

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Сотрудничество с АЕГ в 1925–1928 гг. как первая форма научно-технических заимствований в электромашиностроении Украинской ССР

Аннотация. Научно-технические заимствования являются одним из тех видов научного обеспечения работы промышленных отраслей, чья роль в условиях выхода из кризиса приобретает особую значимость. С середины 1920-х годов они стали основным способом научного сопровождения организации развития украинского электромашиностроения в условиях масштабной электрификации страны. Это обуславливалось необходимостью быстрого вывода отрасли из предыдущего кризисного состояния при отсутствии в УССР собственной системы научного обеспечения электромашиностроительной индустрии. Первой формой осуществления научно-технических заимствований для республиканского сегмента союзной отрасли стал договор между Государственным Электротехническим трестом и немецкой электротехнической фирмой *Allgemeine Elektrizitäts*

Gesellschaft о научно-техническом сотрудничестве. Главной целью данного мероприятия было достижение при минимальных финансовых затратах как можно более быстрого увеличения продуктивности Харьковского электромеханического завода. Для этого предполагалось использовать американские технологии производства электрических машин, реализуемые на немецком технологическом оборудовании. Allgemeine Elektrizitäts Gesellschaft была той компанией, которая уже осуществила у себя такой прием в начале XX века, используя технологии General Electric company. Более того, ею была сделана попытка проведения аналогичного мероприятия на принадлежавшем ей в досоветский период Харьковском электромеханическом заводе, которая закончилась неудачей из-за начавшихся на территории Украины революционных потрясений. Таким образом, заключенный с немецкой фирмой договор стал продолжением ею же начатых действий, однако уже в новых исторических реалиях. То есть, советским правительством были скопированы мероприятия Allgemeine Elektrizitäts Gesellschaft, адаптированные, однако, к советскому способу организации промышленного производства. Несмотря на коренное отличие последнего от условий работы Allgemeine Elektrizitäts Gesellschaft в Германии, сосредоточение сторон именно на научно-технической составляющей проекта позволило добиться ожидаемого результата в полном объеме. Однако при этом украинскими электромашиностроителями, сосредоточенными именно на скорости дублирования научно-технических знаний, была упущена возможность изучения методологии их получения. Это стало причиной тому, что проведенные научно-технические заимствования не стали должной основой формирования научной составляющей научно-технического потенциала отечественного электромашиностроения.

Ключевые слова: научное обеспечение; конструкции; технологии; научно-технический потенциал; электротехника

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