HE WAS SUPPOSED TO «INCLINE FIRE AS A SERVANT TO MACHINES»

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ABSTRACT

The published article about Ivan Ivanovich Polzunov was retrieved from the journal Nauka i zhizn (Science and Life – in English), 1953, Iss. 12. That is, it came out 65 years ago and was dedicated to the 225th anniversary of the birth of the remarkable Russian mechanic, heating engineer, the creator of the universal steam engine, the world's first two-cylinder machine. In the archives of the press, of course, a lot of other research work on a man of such a bright and extraordinary, even dramatic fate, has accumulated. To continue the topic dedicated to Ivan Polzunov, the editorial board of World of Transport and Transportation suggests an article of Alexey D. Sergeev, the leading researcher of the Polzunov's engineering heritage. The article was published in Polzunovsky Almanac, the yearly edition which by itself is a living testimony of the recognition of the merits of our famous compatriot.

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225 (now already 290 – ed.) years ago, Ivan Ivanovich Polzunov was born who later became the creator of the world's first universal heat engine, striving with his selfless work «…to achieve the glory of the Fatherland and to facilitate work for us to come…». It is difficult to overestimate the importance of the outstanding invention of Polzunov. The «fire-fighting machine» designed by him marked a new stage in the history of development of world technology – the transition of industrial energy to a new, higher stage.

In 16th–17th centuries, in order to activate various mechanisms, only windmills were used, using extremely unstable wind energy, and water wheels driven by water, which tied the industrial enterprises to certain geographic points. With development of industry and expansion of production, an ever greater universality of the engine – the possibility of using it in any conditions – was required.

At the beginning of 18th century, an industrial plant was built, transforming thermal energy into a mechanical one. However, this first engine was still extremely imperfect. True, it did not depend on local conditions to the extent that, for example, the water wheel, but still was not able to drive the factory equipment and was used, basically, as a pump for pumping out water. A machine was needed that could bring any factory mechanism into operation.

The need to create a universal engine led Western European technology to a compromise solution – to a combination of a steam pump and a water pump. In this machine, the steam pump, fed by steam from the boiler, lifted water from the tank to the water wheel, which brought the factory equipment into motion. In such an engine, almost three quarters of the energy received from burning fuel was uselessly lost. Nevertheless, for eighty years, world technology has not been able to find a better solution to the problem of a universal engine. This task was brilliantly solved by our compatriot, mine foreman I. I. Polzunov.

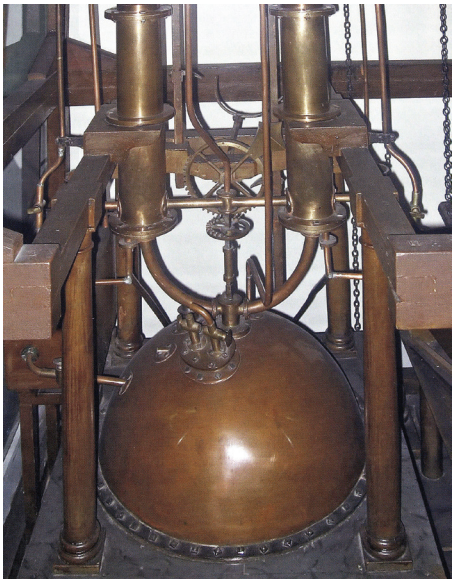
Ivan Ivanovich Polzunov was born in 1728 in the Urals, in a poor soldier's family. He successfully studied at the first Russian mining school, but did not finish it. At that time, a mining development in Russia needed specialists, and a talented young man who knew this production well, was sent to Yekaterinburg plant as a «mechanical student». In 1748 Polzunov was sent to Altai, to the system of Kolyvan-Voskresensky plants, where he in practice studied the technique of the mining business. Everywhere, in any business that he was engaged in, a wonderful mechanic sought to introduce some improvement. So, in 1754 in Zmeinogorsk he created one of the first hydropower plants in Russia, in which water, which drives the wheels, was fed from a dam located far away, along a special canal.

In his spare time, Polzunov studied hard. He accumulated extensive knowledge in the field of physics and mathematics, mining, and factory mechanics. Of great importance to him was the foremost views of Lomonosov, who considered heat as a consequence of molecular motion. These ideas of the great Russian scientist determined the direction of creative plans of Polzunov. Having studied the state of West-European factory energy, he decided to abandon the water wheel as an indispensable component of the engine and create such a «fiery machine» that would be capable to «execute, at our will, what will be needed». «I must», he wrote, «let all the possible works and forces meet in this manner, by which means the fire as a servant should be inclined to the machines».

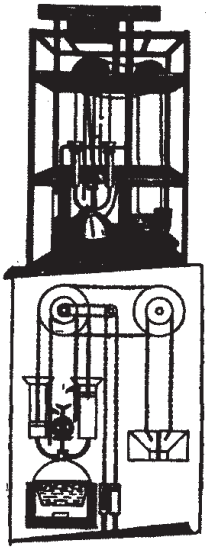
Polzunov had spent many months in the painstaking work on drawings and calculations, until he solved this problem. In April 1763 he gave the chief of Kolyvan-Voskresensky factories his project of the world's first universal thermal engine of continuous action. In a memorandum attached to the draft, Polzunov showed a deep understanding of the tasks that the growing industry confronted. Resolutely posing the question of introducing new energy, he sought to introduce his invention «for the whole nation».

Continuity of the engine of Polzunov was based on the use of two cylinders, the pistons of which were connected to each other and alternately transferred work on one common shaft. The machine was arranged as follows. In a copper cauldron, water was brought to a boil. Through special distribution devices, the steam was supplied to the cylinders. Under its action, one of the pistons went down, rotating shaft and simultaneously lifting the piston of another cylinder. When the second piston was lowered, the reverse distribution of work occurred. Thus, the shaft moved continuously, which ensured the uninterrupted operation of the machine. From the shaft, the movement was transferred to pulleys, which were connected with bellows, which pumped air into the ore smelting furnaces. This invention was to displace the water wheels that formerly dominated the mining industry, and open up wide opportunities for many industries. When developing his project, Polzunov also solved many private, but important tasks. He created the original steam and water distribution, the rotating parts of the transmission mechanism, and so on.

The project of Polzunov was sent to St. Petersburg to the President of the Berg-College Schlatter. Nine



Steam engine.



General view and diagram of a steam engine of I. I. Polzunov.

months the inventor waited for the decision of the destiny of his machine. Finally, in January 1764, an answer came in which it was reported that «this fiction for a new invention should be honored». However, Schlatter did not understand the main thing in Polzunov's project and offered him to build a machine with a steam pump and a water wheel instead of a steam engine.

Firmly believing in the progressiveness of his idea, Polzunov could not agree with this proposal. He developed a new project of the most powerful engine in the world, capable of supplying twelve copper-smelting furnaces with air. In this installation for the first time was introduced a device for automatic water supply to the boiler, the first compressed air battery.

In March 1764, Polzunov began to build his engine. The construction of the machine was associated with enormous difficulties. At Barnaul plant there were only melting furnaces, and Polzunov had to build special machines for preparation of various parts. There were no masters who knew the foundry business, and the inventor had to teach people himself. Of 19 workers he asked, only two were given to him. Polzunov was completely alone. In St. Petersburg, his project was recognized, but he received no assistance in building the engine. The Barnaul Mountain Chancellery did not oppose the new invention, but was afraid to spend an extra penny on it, while Polzunov himself, a soldier's son and a native of people, did not consider him a real mechanic.

Anticipating all the complexity of the work ahead, Polzunov wanted to first build a small pilot installation, on which he could check his calculations, prepare the masters for building a large engine. However, this was denied to him. The factory bosses forced the inventor to start the construction of a huge eleven-meter machine. The construction of the engine was slow. Only two years after the permission was received, in December 1765, the assembly of the machine was completed and a test run was carried out. By this time, the bellows and furnaces had not even begun to be built for fear of wasting. It was necessary to carry out tests «instead of bellow burdens on hanging up logs». The ease with which the engine raised and lowered heavy logs, confirmed the correctness of the designer's calculations. However, during these tests it was found that a boiler made of thin copper sheets does not have the necessary strength. Polzunov filed a report, in which he insisted on the need to replace this boiler with a cast. But even this was not done.

After the trial launch of the machine, the inventor did not even have a brief respite. He immediately began to calculate the new boiler, improved the design of compaction of pistons, taught students, supervised the construction of blowing machines and the laying of furnaces. As a result of this hard work, Polzunov's body could not stand it: sleepless nights, the smell of copper and lead melting, the unrest caused by construction of the car affected. In the spring of 1766, Polzunov fell ill with short-term consumption. Realizing the inevitability of close death, he worked until the last day to improve his project, gave instructions on construction of furnaces and bellows, took care that his students would be given the opportunity to complete the business to which he devoted his whole life. At the beginning of May 1766, huge bellows were finally built. But the talented inventor did not have to live to start the engine. On May 27, 1766, Polzunov died.

The thermal installation did not last long after the death of its designer. Insufficient strength of the boiler, which Polzunov warned in due time, was confirmed. Thin walls could not stand it, the boiler let it flow, and the machine was stopped. Over forty days of work, supplying air to only three furnaces at the rate of twelve, the Polzunov's engine, which required three times less fuel than the steam unit with water wheels, fully paid back all the construction costs and gave more than 12,000 rubles of net profit. Despite these figures, the machine was not repaired, and after 14 years it was dismantled.

The greatness of the scientific and technical feat of Polzunov is not only that he created the world's first universal heat engine, but also in that he developed the principle of combining the work of several cylinders on one shaft, which was widely used both in steam engines, and in modern internal combustion engines. ●

(*Nauka i zhizn.* – 1953. – No. 12. – pp. 33–34)