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Saving Energy with Depot of Idle Locomotives and Waiting for the Work of ARF by Introducing an Additional Installation of a Transformer and Compressor

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Abstract: Currently the world economy is quite noticeably suffering from financial crisis, and this applies railway transport. So you need to decide on re-source saving and means rail. Reducing energy costs traction trains is an urgent task, the suc-cessful solution of which contributes to the prop-er understanding the factors that affect con-sumption electricity and possibilities of influence on them to reduce energy consumption. Complete and a comprehensive understanding of the energy it gives balance of the movement (Aibre) trains, resulting in Based on the law of conserva-tion and transformation Energy and described linear system algebraic equations, each term of which is largest integrated.

Key words: Rolling stock · Idle locomotives · Saving energy · Electric transformer overhead

INTRODUCTION

Kazakhstan of the 21st century is a country cre-ated from scratch in just two decades by a talented, hard-working, tolerant people! This is our common child, which we are proud of! This is our great creation, which we love unselfishly!

There have been adopted the Strategy-2050 so that the people of Kazakhstan firmly hold the helm of the future country in their hands. Today, many successful countries - China, Malaysia and Turkey - are working on long-term plans. Strategic planning in the twenty-first century is the number one rule. For no wind will be a passing, if the country does not know the route and the harbor of arrival. Strat-egy-2050, as a guiding light, allows us to solve the problems of daily life of people, without losing sight of our main goal. This means that every year, and not after 30-50 years, we will improve the lives of people.

The strategy is a program of concrete practical cases, which day after day, from year to year, the country and the life of Kazakhstanis will do better. But everyone should understand and know that in market conditions one does not have to wait for the manna of heaven, but to work effectively. The task of the state is to create all conditions for this. I am convinced that the worthy Future of our Motherland among the advanced countries of the world is exactly what will unite all Kazakhstan people forever.

It is necessary to develop the logistics services sector. First of all, we are talking about the maxi-mum use of the territory of the Customs Union for the transport of our goods. The construction of the corridor "Western Europe - Western China" is near-ing completion, the railway to Turkmenistan and Iran is built, with access to the Persian Gulf. In the future, Kazakhstan should invest in the creation of logistics centers in the countries with access to the sea. It is necessary to reduce the terms of customs processing of goods, increase the throughput of border crossings, strengthen the capacity of the port of Aktau, and simplify the procedures for ex-port-import operations [1].

The developments of the railway, as well as the development of energy and energy conservation are closely linked in the "Kazakhstan-2050" Strategy.

Energy saving is the organizational, scientific, practical, informational activity of state bodies, le-gal entities and individuals aimed at reducing the costs and

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losses of fuel and energy resources in the process of their extraction, processing, transporta-tion, storage, production, use and disposal.

Fuel and energy resources are the aggregate of all natural and fuel resources and energy.

Secondary energy resources are the energy re-ceived in the course of any technological process as a result of underutilization of primary energy or as a by-product of the main production and not used in this technological process.

Effective use of fuel and energy resources is the use of all types of energy in economically justified, progressive ways at the current level of technology and technology development and compliance with legislation.

This article describes the design of the rolling stock of electric transformer overhead 80c. It pre-sents the development of a modern tool to use an additional low power transformer to increase eco-nomic efficiency through the development of ener-gy-saving techniques with the use of modern in-formation technologies and means.

Rational use of fuel and energy resources is achieving maximum efficiency in the use of fuel and energy resources at the current level of tech-nology and technology development and compli-ance with legislation.

The main indicator of energy efficiency is the specific amount of consumption of fuel and energy resources for the production of a unit of products for any purpose.

Unconventional and renewable sources of ener-gy are sources of electrical and thermal energy us-ing the energy resources of rivers, reservoirs and industrial drains, wind, solar energy, biomass (in-cluding wood waste), sewage and solid household waste.

Users of fuel and energy resources - business en-tities regardless of the form of ownership, regis-tered as legal entities or entrepreneurs that carry out their activities without the formation of a legal enti-ty, as well as other persons who, according to the law, have the right to enter into economic con-tracts, and citizens using fuel -energetic resources.

One of the effective ways to reduce a person's influence on nature is to increase energy efficiency. In fact, modern energy, based primarily on the use of fossil fuels (oil, gas, coal), has a significant im-pact on the environment. Starting from the extrac-tion, processing and transportation of energy re-sources and ending with their burning to produce heat and electricity - all this is very detrimental to the ecological balance of the planet. Finally, it is the "fossil" energy that is responsible for the prob-lem of climate change associated with an increase in the concentration of greenhouse gases. That is, the issue of increasing the energy efficiency of the economy is now one of the most vital for all coun-tries without exception.

Energy conservation now becomes one of the priorities of the policy of any company operating in the production or service sector. And the point here is not so much in environmental requirements as in a completely pragmatic economic factor. This is due to the fact that the specific energy consump-tion for the production of the main types of prod-ucts in Ukraine is much higher than in Western Eu-ropean countries. One of the main reasons for this situation is obsolete energy-saving technologies, equipment and devices.

World experience in planning and implementing energy-saving policies has more than a quarter cen-tury of history. Being the answer to the sharp rise in prices on world fuel markets in the 1970s, energy saving remains today a major direction of the energy policy of many countries and international or-ganizations and unions of fuel and energy.

Rational use and economical use of fossil fuel resources (coal, oil, natural gas), increasing the effi-ciency of final energy consumption in all sectors of the economy, development of renewable energy sources (biomass, hydroelectric power, solar ener-gy, wind and geothermal energy and other sources) This, taken together, can meet the needs of man-kind for energy and, consequently, its sustainable development on a global scale.

Energy saving is a factor of economic develop-ment in practice, which has shown that in many cases it is cheaper to implement measures to save energy or even avoid using it, rather than increasing its production. This means that financial resources intended to expand energy production could be channeled to other activities to improve the living standards of people. In addition to such a global effect on the release of significant financial re-sources, the direct impact of increasing energy effi-ciency on production activities in terms of increas-ing the productivity and competitiveness of indus-try is also very large. One should also take into ac-count the fact that the development of the national production of advanced energy-efficient equipment will enable such equipment to be exported to for-eign markets.

However, only an understanding of the need and desire to implement energy-saving measures to achieve the overall success of energy-saving poli-cies in the country is clearly not enough. To do this, at the level of the end user, you first need to know how to do this and what the most optimal way is for it, and also to have the

necessary components of technical, financial and organizational means. On a broader scale, as evidenced by the experience of the leading industrialized countries of the world, which have made significant progress in improving the energy efficiency of their economies, it is nec-essary to develop a complex set of measures for organizational, institutional, regulatory, financial and economic, scientific, technical and infor-mation-Educational directions of energy saving policy. It is necessary to know the range of availa-ble energy saving opportunities in each specific branch of the economy, the ability to choose the most suitable for the various categories of energy consumers according to the technical and economic criteria and to determine the sequence of their im-plementation.

Fuel is a substance or a mixture of substances capable of exothermic chemical reactions with an external oxidant or contained in the fuel itself, used to release energy, initially thermal.

Fuel, which does not contain an oxidant in its composition, is often called fuel. The concept of fuel is more general than fuel or fossil fuels, be-cause it includes wood and various fuel mixtures.

The chemical or nuclear energy of the fuel is converted into various types of energy, and most often through the conversion of heat released by the reactions of heat [2].

Energy saving is an absolute necessity. The del-egation of JSC "Lokomotiv" visited the company "SlovakCargo" and got acquainted with the ad-vantages and featuresn of operation of the Slovak automated energy management system.

The issues of energy efficiency in Lokomotiv JSC are paid special attention. The renewal of the locomotive fleet by the modernized locomotives and locomotives of the TE33A Evolution series made it possible to significantly reduce the specific fuel consumption. However, this process cannot be continued without the introduction of innovative technologies and automation in various fields of activity.

Actual Problems: Rail transport plays an im-portant role in the economic development of the Republic of Kazakhstan, which is the foundation of the country's transportation system, carrying out the bulk of cargo and passengers. The infrastructure of Kazakhstan railway network connects all regions of the country and has 15 points of the stop with the railway networks of neighboring countries, in-cluding 11 - with the Russian network.

Transport is one of the industries that form the infrastructure of the economy. Kazakhstan has a well-developed transport system, including rail, road, air, inland waterway and pipeline transport. The transport of Kazakhstan developed taking into account the formation of the sectorial complexes of the national economy of the republic (agro-industrial, fuel-energy, mining-metallurgical, con-struction, etc.), ensuring the interrelationship of not only the branches of the economy and types of production, but also territorial complexes. The most dynamic development of all types of transport in the republic occurred in the 70-80-ies. The econom-ic recession in the CIS countries, which began in the 1990s, led to a general drop in traffic for all modes of transport. Stabilization and growth of volumes began at the end of 1999.

Due to the raw material orientation of Kazakh-stan's economy, rail transport plays a key role in the transport and communication complex of the Re-public of Kazakhstan. According to the Agency of the Republic of Kazakhstan on Statistics in 2004, in the turnover of all types of transport, its share is 63%.

MATERIALS AND METHODS

In the development of rational modes of driving trains of great importance to research and summarize experience the best drivers. The growth loco-motive crew training, quality improvement and repair maintenance of locomotives required for effec-tive use of traction features and power.

Great influence on capacity utilization also causes locomotives operating system locomotives. The important role played by the schedule of trains, which is to provide the best conditions crossing on their areas.

RESULTS AND DISCUSSION

The sharp competition of railways with other modes of transport, primarily with the automobile, the rapid growth of current costs, fueled by inflation, leads to the need to perform works on the modernization of the railway network and increase its equipment with new types of locomotives and wagons, Perfected devices, means of automation and specialization of the transportation process and. First of all, container-like type.

According to the main indicators of the technical equipment of railways (operating length, length of electric lines, working fleet of freight cars) and trans-shipment work (freight turnover, passenger turnover, loading of

cargoes), Kazakh-stan ranks third among the former Soviet republics, behind Russia And Ukraine.

It should be noted that the physical and moral wear of the basic funds of JSC "NC Kazakhstan Temir Zholy" is significant, because due to objective economic reasons after 1991, the rate of their renewal was low. The average fixed assets ratio is 60%.

In the current situation, the park of diesel locomotives is sufficient to increase cargo turnover by 36.3% (and it takes 24% for ten years). It must be assumed that the new locomotives will not require the same base of current repairs, which is necessary for existing locomotives, they will pass only maintenance and overhaul at locomotive repair facilities. The given data on the required quantity is overestimated because of the large percentage of locomotives under repair (by locomotives it is 32%). In fact, in 2000, 186 locomotives and 140 electric locomotives were used daily in freight trains. When restructuring the repair of locomotives, the percentage of those under repair should be reduced to the standard, that is, 10% for locomotives and 8% for electric locomotives from the exploited quantity.

The required number of locomotives will be (227 + 146) x 1,10 = 410 diesel locomotives. In 2004, JSC "NC" Kazakhstan Temir Zholy "had 552 2TE10 diesel locomotives that had not reached their service life, therefore, for the next three years, there is no need to replenish the diesel locomotive fleet while maintaining the existing system for their maintenance of the repair.

It is necessary to set before the services operating diesel locomotives the task of improving the indicators of their use. Based on the results of the operating activity of JSC NC Kazakhstan Temir Zholy in 2004, the linear run of locomotives was 37972521 locomotives/km, and the linear run at the head of the trains, that is, the run that brings the railway revenue, was 32116205 locomotive/km. Thus, the "idle" run was 18% (37972521/32116205 = 1.18), which cannot be considered admissible.

The ordering of the repair quality (reduction of idle mileage up to 5%) allows increasing the fleet of locomotives used by (32-10) + (18-5) = 35%, that is, the planned annual increase in traffic (24% over 10 years) Is covered by the quality of repair and operation for the next 10 years.

Technical normalization of the operational work of the railway is one of the most important tools for managing the rational organization of the transportation process for the fulfillment of the order for transportation and services with minimal expenditure of material, labor, and financial resources.

At present, “Lokomotiv” JSC has an excess fleet of locomotives, the technical resource of which is not exhausted. At the same time, it is necessary to update the locomotive fleet, which should be carried out using international experience. Modern achievements in the field of locomotive building and diesel construction allow making effective modernization of locomotives, primarily of main diesel locomotives.

The upgraded diesel locomotive can replace 1.5 units of existing diesel locomotives in its technical and economic characteristics, significantly reduce the cost of diesel fuel and maintenance, and increase the reliability of locomotives. For the most loaded directions, it is advisable to purchase new diesel locomotives. A new locomotive can replace two existing ones with a significant reduction in fuel and maintenance costs.

When investing in repair production, the quality of repair improves, which makes it possible to change the areas of circulation of locomotives and improve their performance.

In the world practice, when developing a technical specification for the design of a diesel locomotive, modes are set: 25% of the time - work at full (nominal) load; 50% - idling (no load) and 25% of the time - at partial loads, most often an average 50% load is taken from the design capacity of the diesel.

In fact, our locomotives operate at full power 10-12% of the time, so it is very important to have a high economy (the lowest specific fuel consumption) when working at partial loads. The best characteristics are the diesel G3 of General Motors. The best is the "simplified" characteristic when the lowest specific fuel consumption (economy of the diesel engine) in the mode of nominal load.

The conditions of railways are characterized by a flat-hilly profile, which forces the machinist to frequently change the mode of operation of the diesel engine and to work most of the time on partial load regimes.

Thus, when choosing a diesel engine and for up-grading old diesel locomotives, and for a new locomotive, it is necessary to determine the specific conditions for their operation in terms of the use of passport power and only then choose the type of diesel by the criterion of economy.

After the end of the resource of the old diesel locomotives, it is economically more profitable to replenish their fleet at the expense of the newest modern locomotives.

When choosing a diesel engine for the modernization of old diesel locomotives and when choosing a new diesel locomotive it is necessary to take into account the economy of the diesel at partial loads.

By the criterion of traction, the best are locomotives with AC traction motors of an asynchronous short-circuit type.

Analysis of the statistical data of the work of railways with electric and diesel traction shows that on electrified routes the cost of transportation is 1.5-2 times lower than for diesel locomotives. Such a decrease in the cost price integrally reflects a higher (in 1.4-1.6 times) energy efficiency of electric traction, increased weight (in 1.2-1.3 times) the weight norms of trains, district speeds and average daily runs of locomotives. Repair and maintenance costs of diesel locomotives are 2-2.5 times higher than for locomotives (especially with a high degree of deterioration of locomotives).

State railway transport that meets the requirements of economic security, must be characterized by a set of identified key resource indicators and the resulting indicator rail system stability, outside the threshold values which the system loses the ability to reproduction, and the cost of maintenance in operational condition are increasing exponentially. Without the huge financial costs of the system becomes unable to self-preservation and converted into economically inefficient.

Locomotive farming is an integral part of the process of passenger and cargo transportation and today it becomes the only owner of traction rolling stock and accompanying operating base in the republic. Therefore, the technical armament of loco-motive facilities is crucial for improving the efficiency of the main activities of JSC NC KTZh, which today performs the functions of providing the locomotive, maintaining, organizing depot repairs and equipment.

Currently, a number of factors impede the implementation of the above-stated activities at the proper level:

- The source of the data of the automated system for centralized processing of the operator's routes (JCOMM) are the drivers' routes, where only information on the total consumption and return of electricity is indicated on the trip, which limits the conduct of a more detailed analysis of the EPS energy consumption, prevents the determination of the actual values of unproductive energy losses and attribution On the participants of the transportation process and the search for reserves of saving fuel and energy resources.
- With the existing system of electricity metering, there are cases of late delivery of routing sheets to the center of operational and technical records, which leads to a violation of the control of the flow and return of electricity, prevents rational planning of technical and economic performance of locomotives and locomotive teams, Information on the efficiency of the use of EPS energy at the end of the day for the purpose of prompt response.
- The JCOMM system assumes manual input of information from the driver's route, which leads to numerous mistakes in statistical reporting and, as a result, unreliable organization of electricity metering, the appearance of the commercial component of unbalance, defined as the difference in unbalance and technological losses of electricity in the traction network and inadequate Normalization of FER.

The project "Reduction of electricity costs during the time of sludge (place waiting for work) of electric locomotives in the depot" is aimed at saving electricity. The author of the development is the former head of the production technical department of the branch of JSC Lokomotiv - Karaganda operational locomotive depot, now pensioner Vladimir Petrenko, the press service of the enterprise reports.

“According to statistics, on average 65 electric locomotives are idle per month in the depot, the average idle time of one locomotive is 28 hours. Each locomotive within one hour should include compressors seven times for 37 seconds to maintain. The rationalizer proposed: the electric locomotives in the sludge, grouped into 5 units, thus 13 groups will be created, and the group will include only 2 electric locomotives, which are at the beginning and at the end of the group. Due to them, the remaining ones will be heated,” says Lyubov Pakhomova, the metrological engineer of the depot.

According to the calculations of specialists, the energy saving will make over 9 thousand kW / h per month. The annual energy savings will be over 116 thousand kW / h. With an average cost of 1 kW / hour 9, 56 tenges, the annual economic effect will be over 980 thousand tenges.

"The technical solution consists in combining the pneumatic feed lines of electric locomotives into one common network, with some of the compressors being excluded from the operation, which provides the conditions for saving electricity when locomotives are slackened," Pakhomova said [3].

Situation: As a result of the adoption of the Law "On railway transport" in the rail industry, JSC was restructure "National Company Kazakh-stan Temir Zholy" (JSC "NC "KTZ") with the appearance of several business units in it:"Kaztranservice", JSC "Passenger transportation", "JSC

Locomotive". Ongoing changes in the structure of the industry, for a revision of financial and economic relations in the market, including pricing policy for services in the transportation process.

The reform of the railway industry coincided with the reform of the country's electricity; this sets new stringent market requirements for electricity consumers. Not being a producer of energy, rail transport had to blend well with the new terms of the relationship with the energy with minimal negative effects.

The stable operation of rail transport is a prerequisite for Kazakhstan's sustainable economic growth. Railway transport, carrying out the bulk of the transportation of goods and passengers, is the basis of the transport system of Kazakhstan. The infrastructure of the railway network connects all regions of Kazakhstan and has 15 border points with the railway networks of neighboring countries, including 11 with the network of the Russian Federation. Due to the vastness of the territory of the country, low tariffs in comparison with other types of transport, rail transport has no real alternative in the transportation of such bulk commodities as coal, ore, metals, grain.

The operating length of the railway lines is 13.6 thousand km. The length of electrified lines is currently about 27% of the operational length, and lines equipped with auto-locking - more than 75%. Of the total length of railways, JSC "NC Kazakh-stan Temir Zholy" 97.5% is located on the territory of Kazakhstan, and 2.5% - on the territory of the border areas of Russia and Kyrgyzstan.

Analysis of Work Electric Locomotives: Rail transport is one of the most energy-intensive means of transportation. With the implementation of electric drive, there has been a reduction of about three-quarters of the total traffic with about 5% of the electricity consumed in the country. The traffic downturn and rising prices for electricity is one way to improve the efficiency of the railway transport system and to reduce the energy consumption for train traction.

On the energy consumption by rail across all channels of their spending affected by a combination of many factors, defined as the energy parameters of the devices involved in the energy consumption (efficiency, physical and moral deterioration of IT) and their external operating conditions (operating conditions, the degree of loading and etc).

In the main type of energy - drawn train - improves energy efficiency, i.e., reduction of specific consumption of fuel and energy resources (FER), influenced by the following factors are the most significant:

- Improving the design and operational efficiency of locomotives;
- Increase the utilization rate of power locomotives;
- Reduction of time "hot" and run idle locomotives reserve;
- Increase energy recovery volume while improving its quality;
- Optimizing train driving modes for power inputs;
- Increasing the axle loads of freight cars;
- Increasing the precinct speed trains;
- Increase of weighted norms of trains;
- The preferential use of continuous welded rail, reducing the number of curves, the use of lubrication;
- Improving the technical condition of locomotives fleet.

If you carefully approach the issue of energy savings, it may be that small extra effort will eventually lead to a significant reduction in total energy consumption. Swiss Federal Railways (SFR), being the largest consumer of electricity in the country, seeking to optimize energy use and improve the environmental friendliness of railways by implementing appropriate measures for saving energy in all areas of industry.

Rolling stock - SBB seeks to save energy, primarily through the implementation of technical measures to optimize the components of traction rolling stock and trailer cars. These activities are aimed primarily at optimizing the drive control and to increase the braking power of the existing locomotives. Furthermore, it should also be adjusted with a maximum efficiency of energy consumption of passenger cars, particularly in the sludge. Criteria of efficiency of energy consumption are given great importance in the purchase and modernization of rolling stock;

At the same locomotives must always be ready. For this load is the main switch, traction transformer, phase splitter, the compressor. On the maintenance of their efficiency, a significant amount of electricity is spent. The traction transformer, although it has a high degree of efficiency, it relates to thrust mode. When sludge locomotive is activated only its own needs winding, the magnetic core of the system is still completely saturated and therefore consumes a lot of extra energy. This can be represented like this, if the boiler plant, designed for a quarter would be a heated one small house. After all, we have to heat the house would be warm in the very first huge boiling plant.

Also during the sludge that has worked powerful compressor, necessary work phase splitter. He current conversion process using phase splitter is not effective and it does not apply to the modern electric locomotives and the compressor designed for rapid pumping of the air for the entire structure consumes large amounts of energy.

FAQ electricity consumption at idle at the depot, waiting for work in the ARF for 2014god and Q1 2015

		Idle hours					Consumption thousand kW / hour			Consumption tenge
Period	Expo. park units.	Waiting. work	day	ARF	day	only	Waiting. work	ARF	only	only
Year 2012	274	423551	48	406761	46	830312	3883	10825	14708	124574
1 quarter of 2013	248	76754	36	10063	5	86817	704	3823	4527	42846
Total:	522	500305	84	416824	51	917129	4586	14648	19234	167420

Calculation table for power consumption when using the pre-executive transformer

		Idle hours					Consumption thousand kW / hour			Consumption tenge
Period	Expo. park units.	Waiting. work	day	ARF	day	only	Waiting. work	ARF	only	only
Year 2014	274	423551	48	406761	46	830312	3456	3312	6768	57257,28
Year 2015	248	76754	36	10063	5	86817	2592	360	2952	27925,92

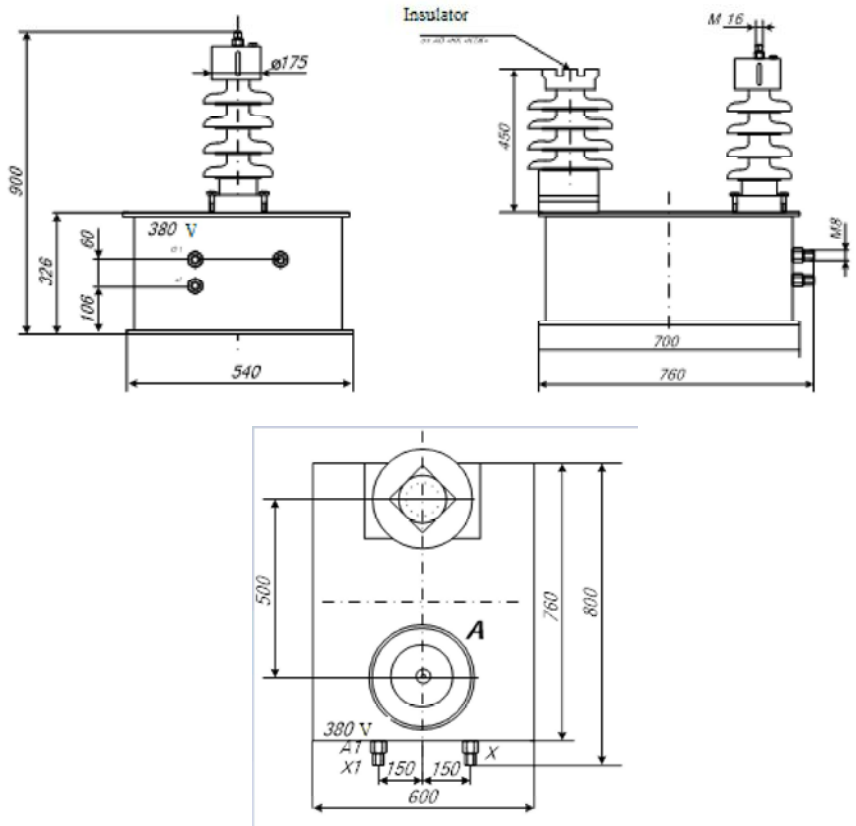

Fig. 1: Outline drawing of the transformer

1. One three-phase winding railway transformer
2. Power transformer 8 kW
3. Power hand 0.23 kW - 2.3 kW
4. Power hand 0,054 kW - 5.0 kW
5. Voltage BH - 27,5 kW
6. Voltage CH - 0.23 kW
7. Voltage LV - 0,054 kW
8. The connection scheme of the 1-0 / 1-0 / 1-0

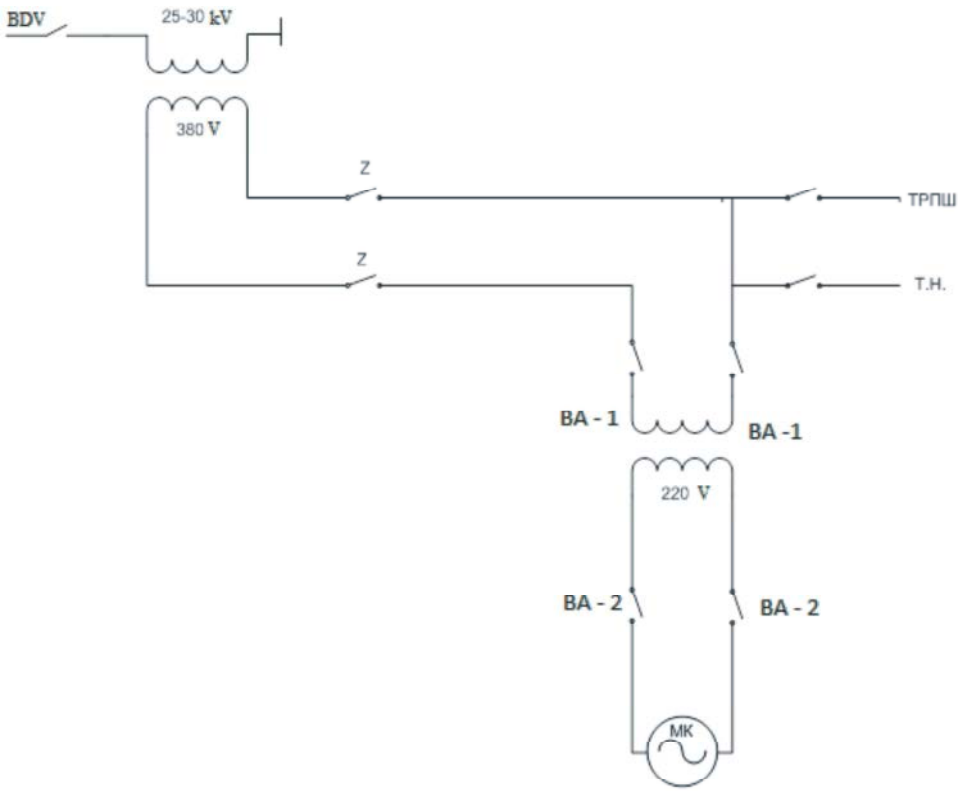

Fig. 2: Schematic diagram of the device

Estimated energy savings for 2014 with optional transformer was 67316.72 tenge.
Estimated energy savings for 2015 when using the optional transformer was 14920.08 tenge.

Additional features transformer: To solve this problem we offer to use additional low power transformers. The transformer is proposed to be installed on the roof of the locomotive and nourish its signaling network management, heating and optional low-power compressor at 220 volts.

Dimensional drawing of the proposed transformer and settlement facilities for the windings shown in Figure 1. According to the submitted drawing, its dimensions allow to place it on the roof of the locomotive and power design allow for specified functions for implementing the device.

Transformers of large and medium power are usually made rod-shaped. Their design is simpler and makes it easier to isolate and repair windings. Their advantage is also the best cooling conditions, so they require a lower consumption of winding wires. Single-phase low-power transformers are most often performed by armored and toroidal ones since they have a lower mass and cost compared to rod transformers due to fewer coils and simplification of the assembly and manufacturing process. Traction transformers with voltage regulation on the low voltage side are of the rod type, and with regulation on the high voltage side - armor type.

When the BDV (speed switch) button on the operator, in a state of a disconnected electric GW, there is an inclusion of the proposed scheme. When you turn the button off HS is powered E-13 wire, and includes the power relay intermediate relay proposed additional scheme ¹1. At the same time, your contacts ¹1 relay opens the circuit to the coil Z which is your contactor (contactor Z) your contacts opens the circuit to the switching valve BDV.

It is assumed the manufacture of the transformer in the town of Kentau also helps to improve the employment of our country and about the objectives set out in the Technical Policy Strategy of JSC "NC" Kazakhstan".

CONCLUSION

The shortage of fuel lubricants, continuous growth energy prices, the issue of savings and rational use is extremely important. Locomotive is sector most energy on

rail transport, as is the cost of energy to pull trains. Reducing the power consumption can be achieved through the introduction of energy saving measures and increased control the use of fuel energy resources.

Energy conservation is a multifaceted activity, process, package of measures, accompanying all stages of the life cycle of facilities management, aimed at the rational use of energy resources. During this process of decreases the need for energy resources on unit of the final product and reduces adverse impact on the environment.

The proposed scheme will greatly reduce costs by electric power when idle at the depot, waiting for work in the ARF. It is proposed to use a separate compressor and a low-power transformer which consume much less power and at the same time allow providing all the necessary functional properties locomotives.

In view of the foregoing, I consider it appropriate implementation of the proposed device.

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