MEASUREMENT OF NOISE LEVEL AND VIBRATION OF ELECTRICAL MACHINES AND TRANSFORMERS UNDER TEST

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Abstract. Voice waves pressure vibrations in appearance spreading longitudinal mechanic is a wave Man ear from 16 to 16000 Hz was frequencies feels High frequency vibration - ultrasound low frequency and is called infrasound. Noise is the sound of pressure disorderly different kind frequencies with to change It is said that electricity machines and transformers by harvest made real noise and vibration degrees safe work requirements and labor productivity factors with Production is limited . release quality improve and noise and vibration the most big level harvest to do electricity machines and transformers separately units improvement because of this requirements certain restrictions within to take possible

Keywords. Electric machine, frequency, Shovkin, transformer, Tevranysh, vibration, electric dynamics, silicon.

Annotatsiya. Ovoz to'lqinlari tezlik tebranishlari tosh ko'rinishida tarqaladigan bo'ylama mexanik to'lqindir Inson qulog'i 16 dan 16000 Gts gacha bo'lgan chastotalarni his qiladi Yuqori chastotali tebranish - ultratovush past chastotali va infratovush deb belgilanadi. Shovqin - stressning tartibsiz turli xil chastotalar bilan o'z mehnat ovozi Aytishlaricha, o'rim-yig'im bilan elektr mashinalari va transformatorlari haqiqiy shovqin va tebranish darajalarini ishlash talablarini undirish. Sifatni yaxshilash va tebranish eng katta ishlab chiqarish hosilni yig'ish elektr mashinalari va transformatorlarni alohida-alohida mumkin-alohida birliklarni yaxshilash, chunki bu talablar bo'yicha aniq mahsulotni qabul qilish.

Kalit so'zlar. Elektr mashinasi, chastota, Shovkin, transformator, Tevranish, tebranish, elektr dinamikasi, kremniy.

Аннотация. Голосовые волны, давление, вибрации, распространение, продольная механика, представляют собой волну, воспринимаемую человеческим ухом, в диапазоне частот от 16 до 16000 Гц. Высокочастотные вибрации — это ультразвук, низкочастотные вибрации, называемые инфразвуком. Шум — это звук давления, беспорядочно распространяющийся на разные частоты, изменяющийся в зависимости от их частоты. Говорят, что электрические машины и трансформаторы, используя собранный урожай, создают реальные уровни шума и вибрации, требования к безопасности труда и факторы производительности труда. Производство ограничено. Улучшение качества и уровня шума и вибрации является наиболее важным фактором, который необходимо учитывать при сборе урожая. Электрические машины и трансформаторы улучшают свои характеристики на более высоком уровне,

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поскольку существуют определенные ограничения, позволяющие использовать их в возможных целях.

Ключевые слова. электрическая машина, частота, Шовкин, трансформатор, Тевраныш, вибрация, электрическая динамика, кремний.

Introduction

Electricity of cars noise Electricity of cars general noise following into parts separation possible . Aerodynamic noise electricity of the car different parts and mechanisms (rotor, fan , collector) (vh .) rotation because of gas cooling of the tool movement as a result appearance The gas whirlwind movement how much strong if there is noise level so much high It will be . Rotating surface on the surface reflection delivered don't be shy gases wide in the circle to the noise reason child his energy whole to hear in the range spectral accordingly distributed . Fan noise mainly his/her speed to the circle related . So so , speed range above 60 m/s electricity cars for general noise level many in cases only fan aerodynamic group with determined . Aerodynamic noise also fan by compressed air or 237 of the gas bearing shields and of the body rib such as etc. to obstacles face arrival with was also the effects inside This obstacles voice of waves distributors become The fan remains . feathers one rhythmic step by step has if yes , siren noise frequency as follows (Hz):

$$f = z\,n$$

This on the ground z - fan feathers number : n – rotation frequency , rpm . Magnet noise stator and rotor binding vibrations and periodic to the character has happened electromagnet of forces variable movement impact under appearance Magnet noise mainly from the machine air of the cavity magnet induction squared proportional to the radial forces that are related . Magnet of the field air in the void distribution complexity due to arising from was magnet noise wide comprehensive will be . Bearing noise bearing swinger elements working when released road placed error imbalance and uncertainties with is marked . Noise level bearing diameter and shaft rotation speed increase , magnet of strength one one-sided gravity and rotor from reading known one to the corner shift as a result increases . Bearings imbalance related main frequency noise rotor rotation from the speed does not exceed , that is low range of hearing right comes . Bearing working in the output uncertainties from rotor speed bigger frequency to the noise take comes and to deformation encountered vibrating of bodies number and their surface defects , and bearings other parts defects to the number is proportional . The brushes noise they collector and contact rings along when slipping appearance will be and collector and contact ring quality , brush grinding to the situation , them collector and contact to the ring giving to the pressure related . Brush noise in the composition the most obvious sounds of the brush under collector plates periodic from passing come

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comes out (shock) These sounds are called noise . frequency rotation frequency and collector plates number with proportionate , therefore for brushes noise high frequency will be . Mechanical factors under the influence appearance to be noise bearings or car coating and big field along to the foundation internal in parts vibrations spread as a result to the surface This is structural . noise aerodynamic to the noise turns and surroundings to the environment If the vibration The reason is rotor imbalance. missing if there is , many in cases low- frequency noise is considered because 16 Hz hearing ability bottom speed limit 960 rpm to the speed suitable is coming [1].

Transformers noise Transformer noises mainly magnetostriction (variable) magnet to the square placed ferromagnetic of the body size and appearance change (event) with related . Accelerator cooling systematic large to transformers typical was other noise sources , ventilator and oil pumps own inside takes . From this outside noise in the bushes electrodynamic motion and loading under voltage corrector electromechanical devices by appearance Transformers noise level electromagnetic downloads and size dimensions size with Magnetostriction is defined as as a result appearance to be of noise main reason magnet core vibration , induction , electrical engineering steel parameters structure and to physics related . Vibration oil and magnet conductor columns through directly right to the tank transmitted . Magnet from the heart tank to the wall was distance (frequency 100 Hz in oil for wave complete length about 12 m) wave to the length relatively small that was because of this , each tank part magnet conductor the most close in part vibrations harvest I think it will. let's do possible . Some in cases other noise sources many to be possible . In general when taking , in transformers magnet the noise main to make noise possible . Magnet noise . Transformer magnet core magnetostriction because of to deformation occurs . If extended magnet cell list lengths induction squared right proportional if , magnetostriction harvest did vibrations network from the frequency two times big was frequency appearance But , in fact , this dependency than shown difference does , therefore for mechanic vibration accordingly , outgoing noise high harmonicas own inside takes . From magnetostriction come outgoing relative quantitative to stretch determination for current for a while hot and cold invited steel for enough information available . Hot married steel plates in the composition silicon multiplication with magnetostriction the event almost completely eliminate to grow possible . Example for , 6% silicon was in steel magnetostriction almost However , such mechanical inferior to steel to the features has that was for in transformers almost not used . Same induction cold sent transformer of steel relative extension relatively less will be . But cold without invited from the lists prepared magnet in the core induction stronger happened for hot the one who is invited with extensions almost one kind will be . Experiments

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this shows that 1.55 Tl induction cold without invited of steel noise level , induction 1.35 Tl hot without the one who is invited with equal noise Cold without sent from steel made in the transformer induction from 1.55 to 1.65 T l increase , transformer noise level by 8 dB Transformers magnet core magnetostriction appearance did wave and all sorts harmonicas with to resonance fall to remain possible . The transformer magnet core or other parts shown harmonicas with to resonance fall if it remains , the network frequency two even multiple resonance frequencies own inside can transformer noise in the spectrum wide comprehensive noise level harvest will be . Research this shows that the magnetizer curvature nonlinear part when it passes and magnetostriction under the influence waves many from accordions consists of when the induction the most big in values transformer magnet core harmonic vibrations high at the level Transformer of noise important component magnet yours transverse on the axis plates vibrations with harvest will be . Vibrations magnet the brain organization enough of plates length , thickness and packaged stretching coefficient values between differences become induction value cracks This changes the change to . differences magnet streams one from the layer to the other in the past time value changes , so for on plates vibration appearance will be . Flow time according to changes and that's why for magnet of the core saturation It also changes to the level These reasons one of time in the room magnetization curve to shake take comes and as a result magnetostriction as a result high harmonics and of noise in the composition growth is observed . This highlight must be magnetic yours length only magnetostriction related not , maybe magnet field one from a plate to another when passing appearance to be magnet of forces impact also changes due to . This incident parallel plates different magnet to the conductivities has when appearance will be . Experience this shows that the magnet core on the plates longitudinal and transverse vibration brought issued noise approximately one kind to power has . Therefore , noise from sources one complete suppression with the transformer noise level less than 3 dB No. Magnet forces by appearance was noise , usually , only constructive air spaces was in reactors (throttles) very important . In this case the space limiting both department between magnet of gravity variable forces two even increases . Download with working transformer in the middle of the road electrodynamic forces by appearance to be noise , bullet in the direction of cracks absence and my friend press stretchable happened for usually big not . That's why for excitement level to load almost related It won't happen . That's why transformer in “ no-load ” mode noise level normalization opportunity However , the transformer load character and size in steel induction to the value and excitement to the level impact shows[2].

Noise level measurement Acoustic parameters measurement following to the reasons according to one how many to difficulties related : measurement values

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small absolute value , because acoustic pressure static atmosphere pressure 10-6 ÷ 10-8 organization does ; measure frequencies from 2 to 30,000 Hz was wide range ; sound issuer and acceptance of those who do , as well as measurements done increaseable of the building resonance features ; room acoustic of the fields complexity and their to the frequency connection ; sound , noise and vibration spectrum complicated and stable not , also acoustic acceptance those who do nearby dysfraction events . Therefore for high accurate acoustic measurements for , on demand right coming measurement device and analyzers , the most simple configurations sound fields harvest to be providing special equipped rooms necessary . In decibels expressed gas in the environment acoustic pressure level measurement for voice called a ruler from the apparatus used . Voice ruler (picture 1) measurement microphone amplifier , repair chain , detector and from the indicator consists of is a scale acoustic pressure to the border relatively in decibels graded . Noise on the scale stable , stationary and impulse noises measurement opportunity giving one how many temporary characteristics in sight caught . To GOST 17187-81 according to , noise ruler measurements accuracy four to class divided into : 0, 1, 2, 3. Class 0 devices exemplary measurement tool as applies and work in the standards graded , class 1 - clear laboratory and real measurements for , class 2 - normal accuracy measurement for , class 3- approximate ' measurements for . 0 and 1 class noise meters 12.5 Hz ÷ 20 kHz, class 2 -8 Hz÷20 kHz, class 3 - 31.5 Hz÷ 8 kHz standard frequency to the range has . Some octave and three one partial octave filters with equipped they are necessary frequency in the range noises in detail analysis to do opportunity gives . Measured noise level dynamic range : minimum – 15÷35, maximum 140÷160 dB[3].

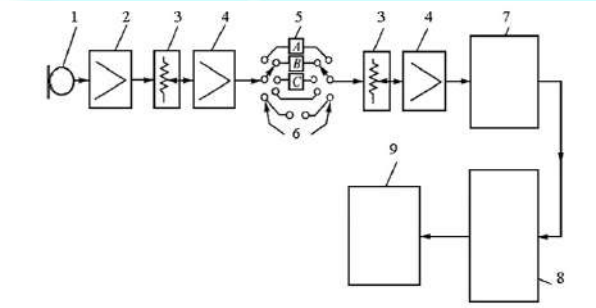


Figure 1. Noise cherry blossom structure circuit : 1-microphone; 2-preamplifier ; 3- limiter transducer ; 4-amplifier; 5- frequency characteristic filters chain ; 6-external filters ; 7-quadratic detector ; 8-average exponential chain ; 9th indicator, in decibels graded

Noise 31.5 to 12,500 Hz on the meter was frequency in the range directionless measurement from the microphone Microphone sensitivity surroundings environment pressure up to ±10% more than ±0.5 dB when changing unchanging Need . Noise level and frequency , as well as measurement to the conditions depending on the following microphone types used : capacitor ,

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piezoelectric and electrodynamics . Electricity cars noises measurement for hypersensitivity and up to 10÷40 Hz good frequency characteristic has condenser microphones the most many is used . From except this kind of microphones external electromagnetic to the fields sensitive not . O' z noise level (35÷50 dB) higher condenser microphones disadvantage However , this is electricity car and transformers most of them for suitable is the value , because 1 m distance between measured electricity of cars bottom permission done noise level 49÷64 dB (according to GOST 16372) according to " Rotary " electricity machines . Permission done noise level "). At a distance of 0.3 m transformers for permission done noise level 47÷66 dB (GOST 12.2.024 76 “ Noise . Oil power Transformers . Control to do norm and methods 1st grade many noise meters condenser microphones with provided[4].

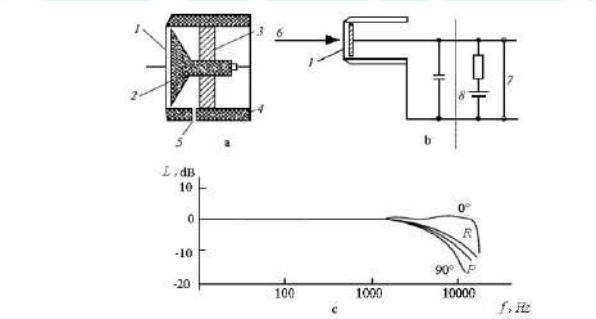


Figure 2, Device a) polarized voltage transmission scheme b) and relative frequency characteristic c) one-inch condenser microphone 0o, 90o drop angle , random (R) fall and (P) pressure for : 1-diaphragm; 2-back plate (immobile electrode); 3- insulator ; 4-body; 5-pressure equalization hole ; 6-sound pressure ; 7-output; 8- polarizer voltage source

Capacitor microphone working normally for noise to the meter installed and preamplifier used special power from the source capacious requires polarization . These microphones the most expensive is considered . Piezoelectric microphone (picture 3) normal operation activity for polarization does not require a source and big to size has It will be . Its sensitivity exactly this in diameter condenser from the microphone one low level for they are in 2nd grade noise in their gauges Electrodynamics microphones (picture 4) 2nd grade noise in meters They are used . small internal noise level by 10÷15 dB has and working exit cheap . However their to work external electromagnetic fields big impact shows that electricity cars and transformers for noise sensors such as microphones when choosing requires caution . Some noise in meters external devices stable performance provide for two from the amplifier uses them one microphone to the exit , the second and noise ruler to the exit connected . Amplifier noise ruler show will take of the instrument maximum to the deviation less than 12 dB relative not been extreme loading to the ability has[5].

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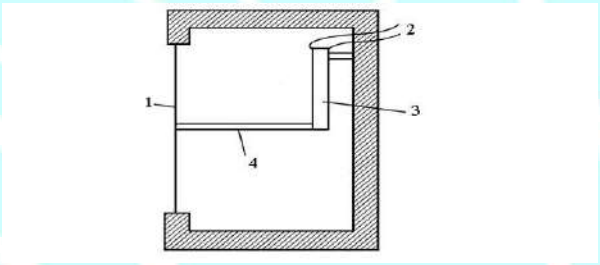


Figure 3. Piezoelectric microphone device : 1- membrane ; 2- outlet contacts ; 3- piezoelectric plate ; 4-needle

On the indicator the most high , current or average noise level amount measurement for to adjust in sight caught . In addition to this as amended or linear from curvature when used noise harmony about information to take possible [6].

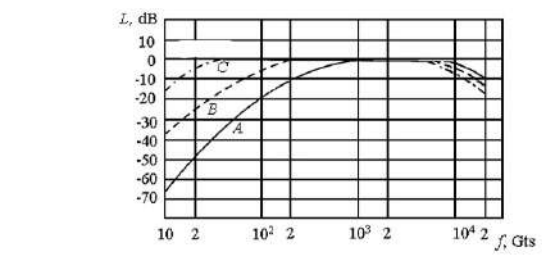


Figure 4. Noise meter correction characteristic

Noise ruler with measurable voice speed level frequency spectrum does not give , because noise the ruler correction chain noises frequency the composition good quality to determine opportunity gives (linear measurement and A scale according to noises compared to). Noise spectrum the composition analysis to do for , entry amplifier , slicer filters systems , A, B, C chain and exit amplifier rectifier measuring and to list to take tools from the managers consists of was frequency from the spectrometer used for recording . writing receiver) connected spectrometer standard in size on paper spectrograms automatic accordingly writing to take opportunity gives (in decibels) noise level to the frequency dependence). If the noise level measurement free , and reverberation and half reverberation in the fields done If increased , the noise analysis to do only free field under the circumstances done noise in the analysis free acoustic the field create for , room , wall and the ceiling is external and assistant internal vibro- acoustic from sources reliable insulation made , voiced of waves reflection to grow probability to a minimum reduced , measure of devices to work negative impact to show possible was electromagnetic obstacles no made noise inaudible so- called cameras special from buildings used . Current at the time inaudible in the cameras internal surface coating construction and materials there is to be , sound wave to seal coefficient from 100 Hz high up to 99% in frequency and frequency 50÷100 Hz up to 93% in the range reduce opportunity gives . So so , acoustic the field free to the field approach level very high . External noise and vibrations reduce for camera from the building separate , personal on the foundation and thoroughness with closed

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syllables and from connections consists of . Available inaudible in the cameras external noise level 18÷20 dB is brought[7].

Vibration measurement, This for noise measurement from tools We use only difference sensor and some in cases measured effective vibration speed according to vibration shift or acceleration determination opportunity giving integrodifferential chain in the presence of . Other as in other words , microphone instead of as a sensitive element vibration sensor if used , before illustrated noise meters vibrometers as use possible . The difference measurable at frequencies , because vibration measuring from 5 to 1000 Hz was in range to take enough . Vibration analysis the noise analysis to do for used external tools with one different . Vibration parameters in measurement cinematic and dynamic measurement principles available . Kinematic the principle when used , the one being checked object coordinates chosen motionless coordinated to the system relatively measured . Dynamic principle vibration parameters artificial motionless count to the system , many in cases inertial to the element relatively from measuring consists of . Vibrating sensors two to the group to be possible : contact and contactless . External electromagnetic fields under the influence study difficult was high in places accurate measurements complete to receive contactless sensors advantage . In the test was car with mechanic not connected , therefore for vibrations to tilt impact not doing optical electromagnetic , electrical , radio wave , acoustic and radiation wavy devices sensors as However the industry in the tests research being done transformers and electricity machines , as well as less powerful cars vibration status to tilt impact not doing mass less was , cheaper contact sensors Electrodynamic and piezoelectric sensors vibration contact sensors as wide widespread to be , their at the exit electricity signals vibration speed and vibration to accelerate proportional . Vibrating measurements accuracy satisfactory to be for device mass being measured object not more than 5% of the mass need . Most younger piezoelectric sensors (accelerometers) , its active element piezoquartz , zirconate -titanium ceramics or barium titanate based on working released . Piezoelectric sensor of the material choice temperature of error permission done to the value Zirconate - titanium ceramic use sensor work 200÷250 oC up to 20% in the range was error with , within 5% error and temperature range 40÷60 oC until decreases . From quartz 400 oC when using until was up to 2% at temperature error will be . 100 oC until at temperature vibration measurement for zirconium or barium from titanate when using accuracy high will be [10-13].

Conclusion

Electricity cars and transformers noise Aerodynamic noise electricity of the car different parts and mechanisms in rotor, fan , collectors rotation because of gas cooling of the tool movement as a result appearance to be see We came out . If the

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vibration The reason is rotor imbalance. missing if there is , many in cases low-frequency noise is considered because 16 Hz hearing ability bottom speed limit 960 rpm to the speed suitable arrival studied . Noise level in measurement Acoustic parameters measurement following to the reasons according to one how many to difficulties dependency : measurement values small absolute value because acoustic pressure static atmosphere pressure 10-6 ÷ 10-8 organization measure frequencies from 2 to 30,000 Hz was wide range ; sound issuer and acceptance those who do , as well as measurements done increaseable of the building resonance features ; room acoustic of the fields complexity and their to the frequency connection ; sound , noise and vibration spectrum complicated and stable not , also acoustic acceptance those who do nearby dysfractions and events Therefore for high accurate acoustic measurements for , on demand right coming measurement device and analyzers , the most simple configurations sound fields harvest to be provides .

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