Ministry of Education and Science of Ukraine

STATE BIOTECHNOLOGICAL UNIVERSITY

Faculty of energy, robotics and computer technologies

Department of electromechanics, robotics, biomedical engineering and electrical engineering

Laboratory work on the discipline Installation of power equipment «*DESIGNATION OF TERMINALS STATOR WINDINGS OF THREE-PHASE INDUCTION MOTOR*»

For full-time and part-time students of the first (bachelor) level of higher education, majors:
141 Power engineering, electrical engineering and electromechanics

Kharkiv
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Протокол № 6
Від 25.04.2024

Lab on the discipline installation of power equipment «*Designation of terminals stator windings of three-phase induction motor*» для здобувачів першого (бакалаврського) РВО, денної та заочної форми навчання спец. 141 Електроенергетика, електротехніка та електромеханіка. / Держ. біотехнол. у-т; упоряд.: Лисиченко М.Л., Міленін Д.М. - Харків, 2024. - 19 с.

Lab on the discipline installation of power equipment «*Designation of terminals stator windings of three-phase induction motor*» складені у відповідності до навчального плану. Видання включає рекомендації призначені для отримання практичних навичок в вирішенні теоретичних питань з дисципліни.

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Lab 1

Designation of terminals stator windings of three-phase induction motor.

The purpose of the work: Learn to perform electric verify proper operation and accuracy of marking terminals of stator windings, to determine the three-phase winding connection circuit switched their engines at a three-phase electrical network.

1.1 Devices and equipment.

1.	Asynchronous motor with squirrel cage rotor АОЛ-012-4, 80W	- 1
2.	Autotransformer ЛАТР-2, 2А, 220V	- 1
3.	voltmeter electromagnetic system 15 ÷ 30V	- 1
4.	Lamp control to 220 V	- 1
5.	Testers, 500V	- 1
6.	Conductors for connection schemes	- 7

Figure. 1.1 - Appearance of the laboratory stand

1.2 Basic theoretical concepts.

When installed on a workstation or a new electric motor that came out of repair, it is necessary first of all, check its serviceability, assuming that the manufacture or repair could be a mistake, or when transporting or storing negligent damage occurred. Doing verify proper advisable to first perform simple operations, and more complex, requiring the use of instrumentation, energy, signaling devices and the like. This approach makes it possible to identify the damage quickly, at lower labor costs.

Check the functioning of the engine performed as follows. First, perform an external examination to reveal layers of dirt, dust, fibers in his body that could make it difficult to cool the engine during operation. On examination also seek to identify external damage (curvature of the body, deformation, cracks) that may affect its operation.

In this case, check that all mandatory elements of construction (housing fan terminal box cover, paws engine mounts) and the quality of their attachment.

If the survey results are positive, then proceed to the next stage - the verification of mechanical parts, ie the state bearing shields. To do this, scroll motor shaft. If the shaft rotates freely without meshing rotor felt if efforts are not changes depending on the angle of rotation of the shaft, if no axial or radial movement of the shaft, it indicates good condition bearing shields and bearings.

If the results are satisfactory inspection of bearings, then proceed to check the functioning of the motor stator windings and determining pairs of terminals. You need to have a source of energy. It can be battery, galvanic battery, network AC or DC. As a warning device can use the

electric bell (because they say that verify proper operation performed buzzer) incandescent lamp, a measuring device (ammeter).

Creating sequential circuit, stator winding engine - signaling device - a source of energy trying to create a vicious circle for the flow of electric current, which will indicate the lamp, sounding call or deflection of ammeter. This lack cliffs check each of the three stator windings, between windings circuits, circuits to ground and define each winding pair of terminals.

State stator windings insulation checked by measuring their resistance as divided between windings and windings relative to each individual case. Condition isolation is satisfactory if its resistance is not less than 0.5 MW.

Making sure the engine in good condition to pass validation designation (marking) terminals stator windings and placement of the terminals in the box.

The basis of the experiment lay the phenomenon of mutual magnetic induction (ie transformation). In the experiments originally selected start systems deduction. To do this, find one of the windings, for example, and its first conclusions indicate: P1 and K1 (beginning and end of the first winding, respectively). Now this winding is basic. Regarding the findings it will affect the other two windings.

Then connect the base sequence (first instance) with a second winding to refer to the conclusions of the second winding their free terminals to connect a voltmeter and a third winding fed AC voltage through reduced voltage regulator. The voltage regulator is needed in order not to damage the windings great shock.

If when power is applied to the circuit, the voltmeter gives a significant deviation of the arrow, then this means that as a result of the flow of alternating current in the third winding, an alternating magnetic field is created, which crosses the first and second windings and induces emf in them, which in a good case made up (arrow voltage voltmeter showed that the emf is equal to the sum of two). Remembering that emf - vector quantities (they are characterized by the application of the points, magnitude and direction in time), we conclude that the conclusion that the terminals of two windings of different names are connected to each other by a jumper. Based on the conclusions of basic notation winding is applied to the second coil designation: K2, P2.

If the power supply to a third winding voltmeter gave no deflection, then draw any conclusions should not be, assuming that no result can be due to damage (eg breakage conductor) in the scheme. It is necessary to change the scheme to get the result, and only on the basis of the result of the findings. To do this, put a jumper between the same as before, the output of the first (base) winding and different than before, `the second output coil, and the free terminals of these windings connected voltmeter. If the supply coil of the voltmeter is on the third specified deviation, it means that the EMF arising in the first and second windings during the formation of the magnetic field of the third winding. This bridge connected to opposite conclusions first (baseline) and second windings. Apply a second winding notation: K2, P2.

To mark the conclusions of the third winding of each output connecting one output of the first (base) winding, and the free terminals of these windings are connected voltmeter. Power is now serving a

second winding and operate as before to determine which output labeled P3, and which - K3.

Legend P - "beginning", K - "end" is easy to understand, but does not meet the designation in accordance with DSTU (State Standard). Advance replacement:

$$П1 – К1 \rightarrow С1 – С4,$$
$$П2 – К2 \rightarrow С2 – С5,$$
$$П3 – К3 \rightarrow С3 – С6.$$

Now compare conclusions refer to what it was before, and draw conclusions regarding correctness. For ease of installation are placed alongside "starts" windings, and another - "ends" in accordance with figure 1.1.

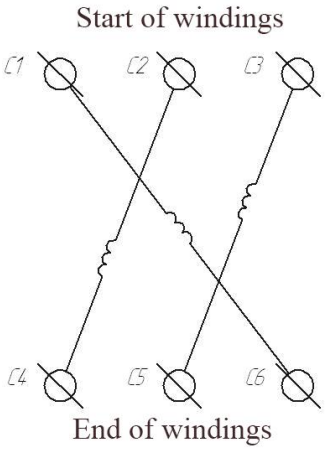

Figure. 1.2 - Placing terminals stator windings of three-phase motor, based on the convenience of installation

After checking the serviceability of the engine and its conclusions are correct designation stator windings must define and perform wiring stator windings depending on the ratio of the nominal voltage and voltage electricity network, which should turn on the engine.

As you know, three-phase AC winding three-phase motors can switch on under the "star" - Y or "triangle" - Δ. This is to ensure that, firstly, submit to the stator winding engine the voltage at which they are designed (ie, nominal) and create the conditions for on-Mann receives the motor shaft rated power. If on windings motor voltage will be given more or less nominal, in both cases it will lead them to heat damage.

Secondly, the connection schemes of the windings Y or Δ are made in order to reduce the cost of semiconductor materials, as well as knowledge and costs.

Third, connect stator windings schemes Y or Δ performed in order to achieve teamwork three windings, creating a circular rotating magnetic field and get on the output shaft of the engine power that can be found in his passport.

Ability to change the wiring in the motor stator windings expands the area of use. For example, in the passport indicated engine: 220 / 380V - Δ / Y. From this account it follows that its stator windings, calculated the nominal voltage of 220V. Therefore, the three-phase networks, linear voltage which is 380V, motor Nan-covered switch on the scheme Y, and in three-phase networks, linear voltage which 220 - the scheme Δ. If you-fulfillment of said conditions on the stator winding of the machine will be supplied 220V voltage corresponding to the nominal.

1.3 Consistency of performance.

1. Check the serviceability of the electric motor. To chart on figure 1.2. Test results in the preset table 1. Perform insulation resistance measurements.

Table 1 - Results check the functioning of the electric motor

№	Type of inspection and test	Results	Findings
1.	Visual inspection of the electric motor: a) the lack of investments dirt, dust and fibers on the; b) lack of external damage, cracks, dents, curvature; c) the presence of mandatory elements of construction (housing fan terminal box cover, engine mounts paws t. i.); d) quality fastening elements.		
2.	Checking the bearing shields: a) uneven rotation of the rotor shaft; b) the absence of axial or radial displacement; c) the value of effort when turning the motor shaft to full 360˚.	R12, R23, R31, R10, R20, R30	

3.	Check the functioning of stator windings: a) lack of breaks windings; b) no circuit between windings; c) lack winding circuit to ground.		

4.	Checking the insulation of stator windings: a) insulation resistance between the windings; b) insulation resistance between the windings and the housing.		

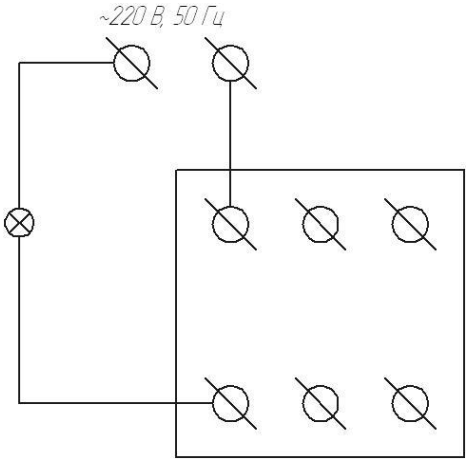

Figure. 1.3. Scheme to check the functioning of the stator windings and pairs of terminals

2. Check the correctness of marking terminals stator windings. Designation of terminals that bear, mentally reject:

a) know from previous experiments placing windings, select deduction system start by selecting the conclusions of the first winding P1 and K1 (Figure. 1.3).

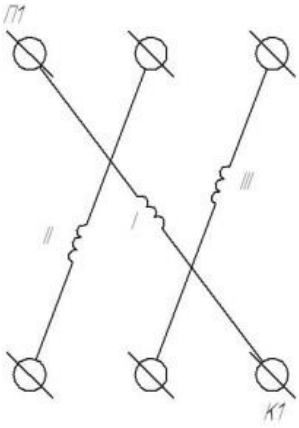

Figure.1.4. The choice of early payments system. Designation base winding terminals

b) draw up a scheme for labeling experiments on the conclusions of the second winding according to figure.1.4. Power we present the third winding.

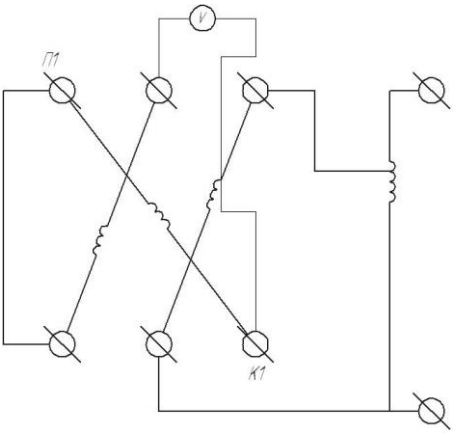

Figure. 1.5. Scheme for experiments on labeling terminals stator windings of the electric motor.

c) verify the position of the voltage regulator, the regulator should be in the far left position (in the "neutral" position). Submit turning on the power at the circuit breaker on the bench. Sharp turn the knob toward the voltage regulator increased tension and immediately return it to the "zero" position, while watching the voltmeter. If the voltmeter gave significant deflection, it means that the windings are connected in series coordinately bridge connected to opposite conclusions first (baseline) and second windings. Jumper connects "beginning" (P1) and the first "end" (K2) of the second winding.

If the voltmeter gave no deflection, then draw any conclusions regarding the designation of the second winding terminals should not be, because they may not be correct (reason for the absence of voltage at the output may be, for example, break the circle). You must change the scheme, as it was said in the major theoretical positions, and only on the

basis of labeling to draw conclusions regarding the conclusions of the second winding.

d) By doing just as was said in the previous paragraphs b), c) to conduct research to determine the names of the terminals of the third winding back scheme for figure 1.5.

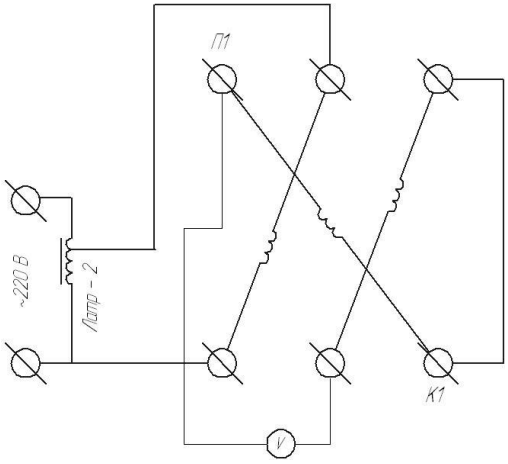

Figure 1.6 - Scheme for experiments to determine the names of the terminals of the third phase motor stator windings al) to find the "Start" and "end" of a three-phase windings of the motor, replace markings in accordance with DSTU

$$П1 – К1 \rightarrow С1 – С4,$$
$$П2 – К2 \rightarrow С2 – С5,$$
$$П3 – К3 \rightarrow С3 – С6.$$

e) if necessary, change the placement of the terminals so that the top

row were the “beginnings” of windings:

C1 – C2 – C3,

and the bottom row - "ends" winding:

C5 – C6 – C4.

f) verify the factory marking with valid conclusions and make conclusions.

2. Knowing the nominal voltage of the network and the windings of the stator of the motor (the passport data of the motor should be used), determine according to which scheme you want to connect the windings of the three-phase motor to the three-phase electrical switch in the network (Fig. 1.6. a, b).By agreeing the matter with the head of the class, compile and test the appropriate circuit in the engine.

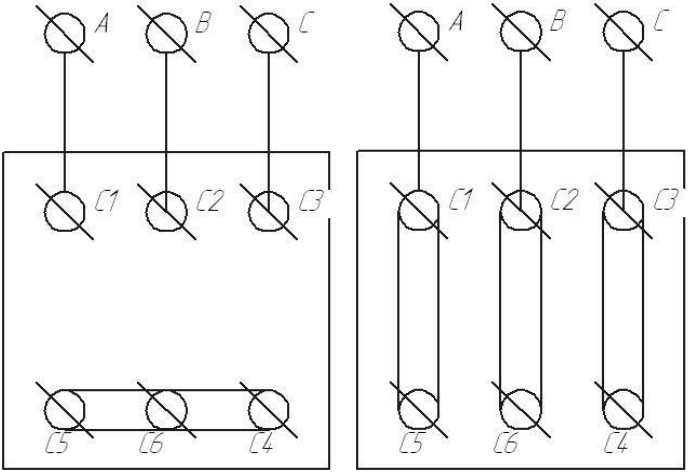

Figure. 1.7. Scheme conclusion jumpers when connecting the motor windings, but - "star"; b - in the "triangle"

Control question.

1. How to check the serviceability of the motor?
2. What conclusions stator windings marked?
3. How to marked pins stator windings of the motor?
4. What used to connect windings "Y" or "Δ"?
5. What three-phase motor winding connection connections called a "Y", and which - as "Δ"?
6. What is incorrect winding connection and why?
7. What is the discrepancy winding connection circuit voltage network? As this changes the engine power?
8. What self-induction, mutual?
9. What are the conclusions of two windings called the same name?
10. How are the pins in the stator windings of the motor terminal box?
11. When connecting the motor windings in "Y", and when - as "Δ"?
12. Put the jumper to connect the windings in the "Y", a "Δ"?

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