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TRANSITION STARTER-GENERATOR IN GENERATING REGIME AFTER STARTING OF INTERNAL COMBUSTION ENGINE

Z.N. Musayev S.A. Khanakhmedova

Department of Electric Equipment and Automation of Productions, Azerbaijan State Oil Academy
Baku, Azerbaijan
samira1009@mail.ru

Abstract- The paper considers the issue of the transition of starter-generator regime, arc analyzed constructive and physical processes, where are given the whole picture of the elimination of the commentator-brush system activity and the connection of starter-generator as generator with board electrical network-the electric connection of two sources of electrical energy.

Keywords: Starter, Generator, Collector, Rectifier Blocks, Contact Rings, Disk, Anchor Shaft, Diode, Contact Rings, Brush-Bracket, Barrier Resistance.

I. INTRODUCTION

Increase standard of life causes increases people's requirement for the means applied to simplification of work, moving, transportation of cargoes, comfort and so forth. Most widespread kind of such means is vehicles cars and tractors of various marks and appointments which function and park near to vein files.

The power block internal combustion engine (ICE), established onboard, is started often, at any time and accompanied by the raised noise level. Noise is created in the beginning starting ICE by elements and further ICE. Initial noise has more adverse combination various on level and frequency of sounds as well as number of attempts start ICE.

Noise, being the general biological irritant, operates not only on a hearing aid of people, but also can cause frustration of nervous system. These factors are especially intolerable at nights when people have a rest.

Considering above-stated circumstance for the purpose of economy of expensive materials as an electro-technical steel, copper, isolating materials, the starter-generator [1, 2] is created, carrying out two function-starter and generator which are the basic power elements of regimen onboard system of an electric equipment.

II. ELECTRIC SCHEME OF GENERATING REGIME FOR TWO-PORT CAR

One of the problems demanding the decision at transition of the starter-generator from a starting regime in generating is realization of connection onboard generating electric networks. The anchor winding which is carrying out start-up, simultaneously has electric connection with system of an electrical supply of an onboard network (Figure 1).

At the bipolar car it is necessary to establish on an anchor two identical windings [2] which at starter a regime incorporate in parallel, in generating - it is consecutive, rectifier blocks thus incorporate to these windings.

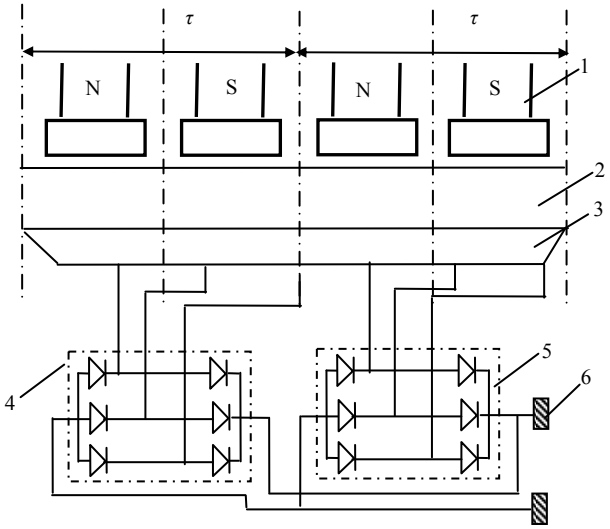

Figure 1. The scheme of a generating regime for two-port car
1- poles; 2- an anchor winding;
3- collector; 4, 5- the rectifier blocks;
6- contact rings.

Figure 1 shows the scheme which is constructed for the four-part car. Rectifier blocks 4 and 5 are connected to the same winding of an anchor; one block covers pair of the poles, the second–other pair. Thereby the electric scheme of a generating regime is ready to use.

III. RECTIFIER BLOCKS AND CONTACT RINGS

Rectifier blocks take place on a disk from isolating a material where also in install two contact rings, whence by means of brushes there is a connection of these blocks with an onboard network; the disk is planted on a shaft of an anchor and rotates with it (Figure 2).

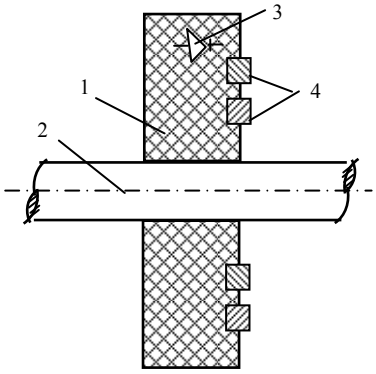

Figure 2. Placing rectifier blocks and contact rings
1- disk; 2- anchor shaft; 3- diodes;
4- contact rings.

Rectifier blocks incorporate in parallel for reduction of some high-frequency fluctuations and reception of normal voltage of an onboard network at low frequencies of rotation of an anchor.

Considering increase in size of voltage of a winding of an anchor at straightened several times, the range of a generating regime (Figure 3); also increases; if frequency of rotation of an anchor in starter a regime makes n_{st} at $n_{st}/(2\div3)$ the starter-generator develops electric motive force, equal to voltage of an onboard network, i.e. voltage of the storage battery.

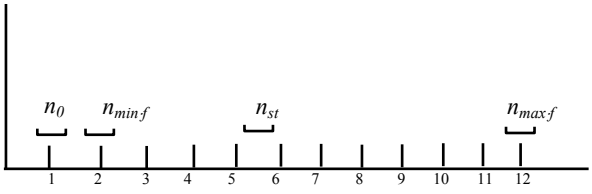

Figure 3. A range of frequencies of action of the starter-generator

The designed anchor on n_{st} is quite capable to sustain frequencies of rotation $n_o \div n_{max.f}$, where n_o is low frequency of rotation when electric motive force. The generator is equal to voltage of storage battery U_{ab}. Frequency of rotation $n_{min.f}$ is frequency at which a starter-generator develops onboard voltage $U_{bc}=U_{ab}+\Delta U$; such voltage is stably supported by a voltage regulator.

Taking into account above forth decisions set, we will consider transition of the starter-generator from a starting regime on the generating. transition consists of two processes: mechanical transfer of brushes from a collector on racks and connection of the starter-generator as the generator with an onboard electric network, i.e. electric connection of two sources of electric energy.

IV. COLLECTOR-BRUSH SYSTEMS

At mechanical transition brush-bracket, collected on an integral basis, by means of the starting relay of the starter-generator moves from a collector and process is carried out slip brushes on a collector towards a rack (Figure 4) where rising all on 1-2 mm, lose electric touch with collector plates.

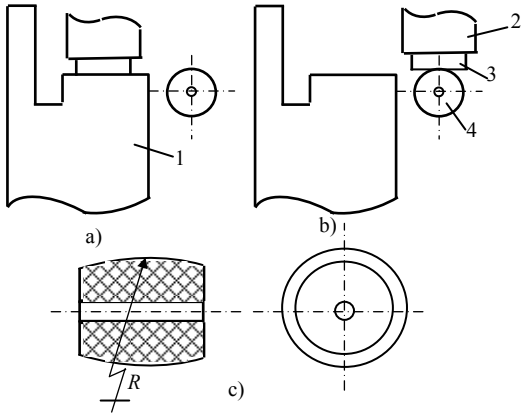

Figure 4. Position collector-brush systems
a- starter regime; b- generator regime;
c- rack cut; 1- collector; 2- brush-bracket;
3- brushes; 4- rack.

In the starter-generator, the size of switched capacity is not a constant in all range of currents and voltages which admissible relays for the switching contacts calculate the maximum starting current.

The regime is established, so the brushes rose on racks after the electric chain anchor windings will be disconnected by contacts of the starting relay.

Under such condition the causes of mechanical characters can affect on the brushes, collector-deterioration of brushes, collector plates only at lifting, descent of brushes to a collector, the deterioration connected with change of frequency of a surface of a collector on all area and so forth.

But distance of 1-2 mm between collector plates and brushes will not give the chance to occurrence of strong blows of brushes. The second important element in this process is infringement of a switching regime or failure of elements of switching system of the relay, i.e. lifting of brushes on racks will be carried out alive an anchor winding. In this case there can be two variants: the anchor current came nearer to a minimum after successful start ICE and the anchor current is equal to rating value after unsuccessful start ICE.

Considering a low class of voltage of onboard electric system, it is possible to admit removal of brushes from a surface of a collector under the influence of anchor rated current, as emergency operation. The arc category, thus, even the big size of a current will pass more favourably as low potential between a collector and brushes and, plus to that, current rupture is carried out under the influence of two ruptures [3].

V. MECHANICAL TRANSITION OF STARTER-GENERATOR

Mechanical movement of brush system from a working strip of a collector surface to a rack does not demand the big force as the friction factor on a collector for applied brushes of the starter-generator does not exceed 0.15÷0.17.

The rack has the cylindrical form with the segment radius equal to radius of a collector (also to radius of a working surface of a brush); easily rotates round an axis;

it is carried out from isolating a material; diameter of a rack is specified at designing of system taking into account mechanical resistance and reliability.

Last stage of transition to teamwork of the generator and the storage battery is connection of two sources for creation of a reliable uniform onboard electric network (Figure 5).

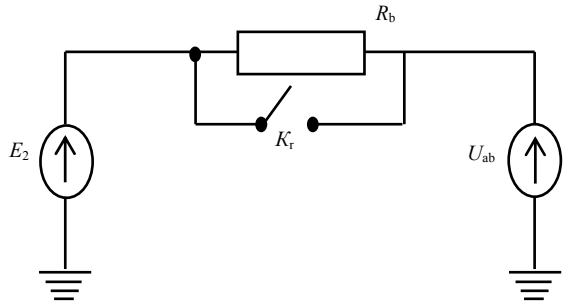

Figure 5. The scheme of connection of power supplies of an onboard electric network
E_2- electromotive power of a generating network;
U_{ab}- voltage of the storage battery;
R- barrier resistance;
K_r- contacts of the starting relay.

At this stage there are some processes complicating joining of these two sources: electromotive power of a generating network and voltage of the onboard network, which equal to voltage of storage battery $U_{ab}=U_{bc}$.

With transition of brushes to a rack the current passing through a consecutive winding of excitation stops that sharply reduces magnetic motive force and it is defined by a current of excitation of a parallel winding of the starter-generator. The straightened electromotive forces rectifier blocks (Figure 1), connected in parallel, will be equal in the sum E_2 a little more than voltage U_{ab}.

On the other hand during time of starting process E_2 and U_{ab} which is electric communication through so-called, barrier resistance R_b. Being between two different potential points (E_2 and U_{bc}) R_b, passing some stabilizing current, created fall of potential E_2 that at connection with relay K_r contact there was no strong transient with notable influence on voltage of onboard network U_{bc}. However increase of voltage U_{bc} can be suppressed action of a regulator of voltage.

Values of barrier resistance R_b, time of transition of the starter-generator from starting to a generating regime and a constant of time of reaction of a regulator of voltage are regulated during definitive designing and coordinated at calculation of regime process.

Mechanical transition of starter-generator from starting to a generating regime is carried out start reversing switch by the device. This device - a reducer with big factor of transfer - is designed in such a manner that at an impellent regime of the starter-generator (n_{st} by Figure 2) reduces frequency of rotation of a cranked shaft (taking into account factor of transfer of a belt) ICE.

At successful start ICE frequency of rotation of a cranked shaft sharply raises to value of above idling. At this time, in spite of the fact that the starter-generator is disconnected, its anchor inertia continues to rotate with high frequency empty, and reducer elements receive rotation by means of a shaft start reversing switch devices.

The uniform shaft between the starter-generator and cranked shaft ICE is created at equality of frequencies of rotation of an anchor of the starter-generator and shaft start reversing switch devices; this device carries out regimes without intervention from the outside.

From this point the starter-generator carries out function of the high-frequency generator of an alternating current, providing an onboard network with the electric power.

VI. CONCLUSIONS

All process of transition of the starter-generator in a generating regime after internal combustion engine start is analyzed. Physical problems, such, as participation liquidation, collector-brush systems and electric connection of two independent sources in a uniform electric network and creation of integral system of an onboard electrical supply are revealed.

REFERENCES

[1] Z.N. Musayev, Patent of the Azerbaijan Republic, I990212, kl. F02, № 11/04, 11.04.1996.
[2] Z.N. Musayev, Patent of the Azerbaijan Republic, I2007 0226, kl. F02, №11/04, 13.12.2007.
[3] P.V. Saratov, "Designing Sugars of Electric Devices", Moscow, "Energy", with. 558, 1971.
[4] S.P. Timoshenko, "Fluctuation in Engineering, Physics and Mathematics", with. 375, 1979.

BIOGRAPHIES

Zabulla Nureddin Musaev was born in Azerbaijan, 1939. He has ended the Power Faculty, Azerbaijan Institute of Oil and Chemistry (nowadays Azerbaijan State Oil Academy) in 1962. He received the M.Sc. degree in 1969. Now, he works as the senior lecturer of chair of "Electric the Equipment and Automation of Plants" in Power Faculty of Azerbaijan State Oil Academy, Baku, Azerbaijan.

Samira Alkhadi Khanakhmedova is the post-graduate student of chair of "Electric the Equipment and Automation of Plants" in Power Faculty of Azerbaijan State Oil Academy, Baku, Azerbaijan.