Materials of Conferences

THE TRANSISTOR CHOPPER BLOCK SCHEMATIC DIAGRAM OPTIMIZATION WITH THE TRANSFORMER LOADING

Magazinnik L.T.
The Ulianovsk State Technological University
Ulyanovsk, Russia

The transistor choppers are being widely used in the various electrical installations. In those cases, when the transformer is the inverter loading, the double – step transducers with the bridge circuit, or the circuit with the midpoint in the transformer primary winding (e.g. «the neutral circuit») is quite inefficient, as the constant component appearance is inevitably just in the inverter alternating current (AC) diagonal, that it is being resulted in the transformer usage contamination, and also the air clearance in the core necessity. The constant component is absent in the half – bridge inverters, having presented by themselves the half – bridge from both transistors, having shunted by two bypassed diodes and two tandem – connected capacitors [1, 2]. The control, that is the output parameters regulation (e.g. the current, voltage) in the known inverters of such type, is carried out by the pulse – width modulation method just from the standard control systems. The external characteristics consideration at the various control pulses on – off time ratios has been shown, that it is necessary to have, approximately, the three – fold supply by the voltage for the linear hardening characteristic receiving in the closed by voltage loop control system (e.g. in the range of 0 – $I_{dном}$), or to increase the capacity of the capacitors. In the both cases, the overall dimensions and the installation's rated capacity are being increased, and also the losses in the transistors are being increased. All these shortcomings removal and defects elimination have been suggested the decisions, which have been stated in [3]. The new block schematic diagram of the half – bridge transistor has been presented in the Fig. 1, and it is contained the half – bridge just from the transistors 1, 2, having shunted by the both bypass diodes 3, 4, the both capacitors 5, 6, having formed, as a whole, with the transistors 1, 2 the bridge, having connected by the direct current (DC) diagonal to the $U_п$ power supply. So, the primary winding 7 of the impedance matching transformer is being included in the alternating current (AC) diagonal, and its secondary winding 8 through the diode bridge 9 is being connected to the direct current (DC) loading 10 of the actively – inductive character. The smoothing choke 11 and the current sensor 12 are being connected, sequentially, with the loading 10, but the half – period average voltage sensor 13 – in parallel on the loading. The control system 14 is being connected with the transistors 1 and 2 driving points by its outputs, and it is closed by the load current and by the load voltage by its output signals, correspondingly, just from the current sensor 12 and the half – period average voltage sensor 13. The R – C chain, having consisted in, serially, connected the capacitor 16 and the both resisters 17 and 18 to the corresponding pulses generator terminals 15, having had the control system component part 14. The diode bridge alternating current (AC) diagonal 19 is being connected in, in parallel, the resistor 18, and its direct current (DC) diagonal is being shunted in the direction, which is being carried the current, by the transistor 20. To the transistor driving point 20 through the logical switch 21 the comparison element output 22 is being connected to, on the first input of which the standard voltage $U_{1э}$ is being connected to, which is quite proportional to the given rectified load voltage, and on the second input it is being connected to the sensor voltage from the transducer output of the half – period average voltage 13 by the degenerative feedback principle, which is quite proportional to the factual load voltage, the logical switch driving point 21 is being connected to the comparator output 23, on the first input of which the standard current signal $U_{2э}$ is being connected to, which is quite proportional to the critical current (e.g. $I_{кр}$) of the non – linear part conversion of the half – bridge transistor inverter external characteristic, and on the second input from the current sensor transducer output 12 is being given by the negative feedback loop signal principle, which is quite proportional to the factual load current.

This device is being functioned in the following way. Let the power supply $U_п$ is being turned on, the corresponding reference voltages values $U_{1э}$ и $U_{2э}$ have been defined, that is the device's mode of operation has been specified, for example, with the maximum value on the load voltage and the load current within the limits of $0 < I_d < I_{max}$. Let us suppose also, that the current I_d is not being changed during the inter – switching interval, and the matching transformer has the «ideal» rectangular hysteresis loop, because of the inductance presence in the loading 10. In this mode of operation, at $I_d \leq I_{кр}$ the current sensor output signal standard 12 is less, or it is quite equal to the $U_{2э}$ signal, therefore, the enabling signal at the comparator output 23 is absent, and the logical switch 21 is being locked. And, correspondingly, the transistor 20 has been shunted, that is the pulse generator 15 is just being functioned with the constant frequency, but the load current and the load voltage regulation is being conducted by the pulse – width method. At $I_d = I_{кр}$ the voltage is still equal to, approximately, $U_п/2$. The external characteristic (e.g. with no account taken of the pulse – width modulator functioning, and at the voltage supply complete absence) is quite the linear and the rigid one.

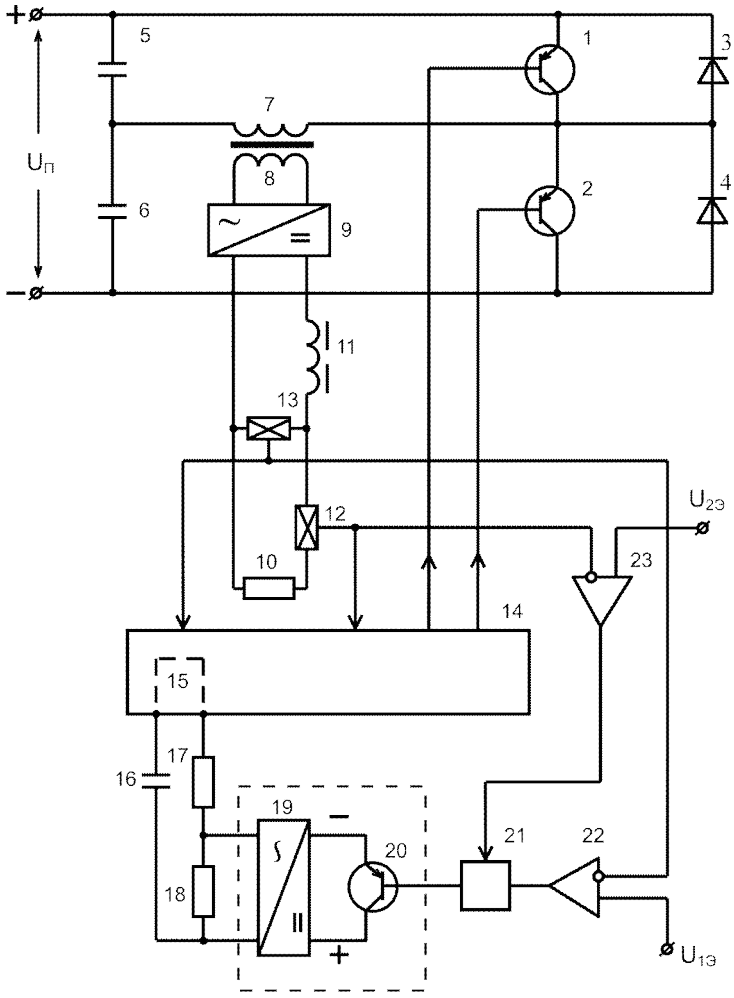

Fig. 1

At $I_d > I_{кр}$, the signal from the current sensor 12 is being become more, than $U_{2э}$, the switch 21 is being unlocked, and it is being gated the signal through just from the comparison element output 22, the capacitors 5, 6 are being discharged for the less time and, moreover, the trigger voltage is being appeared at the transistor input 20, at the signal fade – down just from the half – period average voltage sensor 13. As the transistor 20 is being shunted the resistor 18 in the aggregate with the diode bridge 19, the R-C chain resistance is being descended, the time constant is being declined, and the impulses oscillator frequency 15 is being risen. The external characteristic (e.g. at the voltage supply complete absence) is being increased its inclination in somewhat, but it is being left quite near to the linear one and, moreover, it is being left the, sufficiently, hardening one, therefore, (10-15)% voltage supply of the $U_п$ power source is quite sufficiently just for the absolutely hardening external characteristic receiving, whereas it is usually needed about 300 % supply just in the known circuits.

Thus, the suggested block schematic diagram is being permitted to provide the linearity and the necessary external characteristics rigidity of the half-bridge transistor inverter without any voltage supply increase, or the capacity rise of the capacitors, and also to reduce the switching losses just in the transistors.

References

1. «Invertec» – V – 130 –S – Lincoln, the USA, (The catalogue) 1998 – 2000-es.

2. “The Secondary Power Supplies”. The Patent of the Russian Federation (RF) № 2131640 dated from 10.06.1999 The authors L.T. Magazinnik etc.

3. “The Half – Bridge Transistor Inverter”. The Patent of the Russian Federation (RF) № 2326484 dated from 10.06.2008. The authors L.T. Magazinnik, A.G. Magazinnik.

The work was submitted to international scientific conference «Priorities for Science, Technology and Innovation», Egypt (Sharm el-Sheikh), November, 20-27, 2008. Came to the editorial office on 07.04.2009.

THE GALVANIC PRODUCTIONS WASTE WATERS AND SLUDGES PROCESSING WITH THE HEAVY METALS IONS EXTRACTION

Rubanov Yu.K., Tokach Yu.E.,
Nechaev A.F., Ognev M.N.
The Belgorod State Technological University named after V.G. Ognev
Belgorod, Russia

The galvanic sludges utilization challenge is, in general, one of the most actual and the most urgent ecological challenges of the industrial enterprises, having had just in its galvanic processes' technological repeat cycle. They are being presented by themselves the blended saline, the hydroxides, the carbonates, the heavy metals sulphides, having formed during the sewage cleaning.

The heavy metals are being occupied the first place by the stress – factors scale (e.g. the Courteu – Dubinin indices), having characterized the pollutant's danger. The heavy metals ions are quite able to be accumulated just in the human organism and also to be brought on the most serious damages in his vital functions activity, having entered in the human organism together with the water and the food products. The metals ions are negatively being made their influence upon the organoleptic water characteristics.

As a result of the heavy metals ions toxicity, their disposal is not quite being allowed at the solid domestic waste refuse dumps, and the enterprises are being made to be stored them at their own territory, at the same time, having formed, ipso facto, the secondary pollution sources of the environment.

Besides, only up to 50% the colored metals ions quantity, having taken their part just in the galvanic process, are being left the electrolyte solution and, at the same time, are being accumulated on the details. The rest ones are being left just in the baths, in the electrolyte, or in the form of the laid – down the sludge on its bottom. In this connection, the valuable components extraction just from the galvanic production waste products must make up the considerable profit.

The heavy metals ions leaching, by means of the sulphuric acid is the one of the galvanic sludges processing directions.

The paper's authors have already developed the manufacturing scheme of the galvanic production waste products deactivation, by means of the simultaneous extraction the heavy metals ions just from the sludges and the waste sewage.

The galvanic workshop sludge, having contained mg/kg, has been served the investigations object:

Zn – 46625; Ni – 1433; Cu – 12750; Fe – 20100; Ca – 115500; the sand, the magnesium carbonates, the sodium carbonates – 767811 and the waste water of the same workshop, having contained the same and identical components. The waste water hydrogen index has been made up pH=2,5.

The main aim of these investigations has been consisted in the deleterious effect lowering upon the galvanic production environmental toxic waste, in the form of the sludges and having been formed waste sewage, owing to the heavy metals – such as Zn, Ni, Cu, Fe final extraction just from them.

It has been developed the manufacturing scheme, having included the galvanic sludge blending with the special additions, having contained the chloride – or the sulphate – the ions, in the ratio Cl^- or (SO_4^{2-}) : $\sum Me^{n+}$= not less 1:1, the received mixture mechano – chemical activation, by means of the following grinding just in the ball grinder of the dry grinding up to 0,5 – 5 mkm size, the following thermal treatment just in the muffle furnace, having the 550 – 600 ^{0}C temperature, the received sinter leaching of the proper galvanic production waste water at pH ≤ 3, the solution separation just from the settled sludge, by means of the filtration, and the metals extraction just from the received solution, by means of the electro – flotation at the increased pH = 8 – 10 for the assigned object achievement.

The sludge mechano-chemical activation with the chloride – or the sulphate – the ions is being intensified the following the water – soluble many – metallic bonding formation at the heating up to the 550 – 600 ^{0}C temperature, in the form of the chlorides and the sulphates. So, the hypothetical chemism of the sulphides, the hydroxides, and the metals carbonates transition proceeding processes just into the water – soluble sulphates and the chlorides has been presented by the following scheme:

For the sulphides:

$$MeS + 2NaCl + 2O_2 \rightarrow MeCl_2 + Na_2SO_4$$
$$MeS + CaSO_4 \cdot 2H_2O + O_2 \rightarrow MeO + CaO + 2SO_2 + 2H_2O$$
$$2MeO + 2SO_2 + O_2 \rightarrow 2MeSO_4$$

For the hydroxides:

$$Me(OH)_2 + 2NaCl \rightarrow MeO + Na_2O + 2HCl$$
$$MeO + 2HCl \rightarrow MeCl_2 + H_2O$$
$$Me(OH)_2 + CaSO_4 \cdot 2H_2O \rightarrow MeO + CaO + SO_2 + 4H_2O$$
$$2MeO + 2SO_2 + O_2 \rightarrow 2MeSO_4$$

For the carbonates:

$$MeCO_3 + 2NaCl + 0{,}5O_2 \rightarrow MeO + Na_2O + CO_2 + Cl_2$$
$$2MeO + 2Cl_2 \rightarrow 2MeCl_2 + O_2$$