Short Reports

AN ELECTRONIC STABILIZER WITH MINIMAL VOLTAGE DISTORTION OF A POWER LINE

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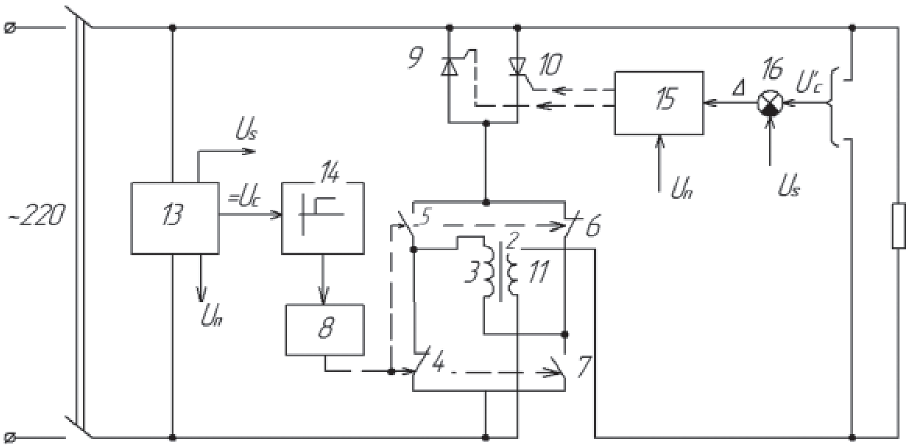
It is offered to use an electronic voltage stabilizer on change expensive and bulky ferroresonance voltage stabilizers of small capacity and the voltage stabilizers of the big capacity executed on the basis of the autotransformer.

Nowadays a phase i.e. smooth regulation inside steps by means of impulse-phase controlled thyristors is replacing expensive and bulky ferroresonance voltage stabilizers of small (up to 1 kWA) capacity based on an autotransformer with step regulation of voltage adding welded points employing a semiconductor commutator. However, voltage distortions in the net are inevitable in the process and it is not always acceptable.

An electronic voltage stabilizer with a voltage adding transformer, filter condensers connected in parallel with loading and a regulating key with a control system is offered [1].

The scheme of the device offered is shown in Figure.



An electronic stabilizer with minimal voltage distortion of a power line

The device functions as follows. If automatic switch 1 is on and the voltage below nominal is applied to a stabilizer, the signal equal U_c of power unit 13 is also below the operation level of semiconductor relay 14, accordingly relay 8 is off and contacts 5, 6 are closed. In this case transformer 2 is used as voltage adding, i.e. the voltage of transformer secondary winding 11 is added to the voltage of power line U_c. Let U_c have plus on the top terminal of loading 12 at the considered moment of time. We name this half-cycle positive. In this case a network voltage «positive» signal and a current zero signal in transformer 2 primary winding 3 enter one output of logic circuit. At the same time transistor is unlocked and winding 3 is short-circuited via voltage gauge, therefore the whole voltage of network U_c is applied to the loading .The positive signal of voltage and zero signal of current form a logic unit at the control unit of key 15 and the very first pulse from a pulse-width modulator comes to the base of transistor 9 unlocking it. The voltage at transistor 9 falls practically up to zero, transistor is locked and the voltage of network U_c is then applied to primary winding 3 of transformer 2.

At secondary winding 11 of this transformer there develops the voltage which adds to the network voltage. The resulting voltage U_n average by condenser not shown for simplicity by a module extruder also having a condenser at the output, is compared to the reference voltage U_s supplied by power unit 13.

If $\Delta = U_s - U_n > 0$, i.e. the network voltage is i.e. with pulse width modulation below the nominal one, the pulses from unit 17, extend, increasing the average by voltage adding, otherwise pulses of pulse width modulation are compressed, i.e. the signal from comparator determines the porosity of pulse width modulation. During a negative half-cycle the scheme functions similarly with the described one, the only difference is that key 16 is unlocked and winding 3 is periodically short-circuited by transistor. As logic circuit carries out the elementary function of summation and is realized on typical triggers, elements AND, OR, for simplicity it is designated only structurally. We'll notice that positive and negative working cycles can be displaced depending on the character of loading 12: at inductive loading the transition point of a current sinusoid through zero is displaced to the right and, accordingly, the unlocking moment of logic keys 15 and 16 is displaced as well. Condenser serves for compensation of input inductance.

If the network voltage exceeds the rating value, relays 14 and 8 will be on. Contacts 5 and 6 will open and contacts 4, 7 will close. Winding 11 of transformer 2 becomes voltage adding. Thus, the stabilizer carries out its function at fluctuations at network voltage both downwards and upwards from the nominal value. As the modulation frequency can be high enough, e.g. 1–12 kc, voltage pulses filtration of voltage adding does not represent a problem and is carried out by means of condenser of a small capacity and also due to dispersion inductance of transformer 2 designed for 50–60 cycles, i.e. is a typical stepping down transformer. However, it is necessary to note that in this case the transformer has alternatively two modes: the mode of an autotransformer when it is connected for a network and the mode of a current transformer when primary winding 3 is short-circuited by transistor. In the first mode the current in transistors and in a primary winding is equal to the magnetization current which is an additional advantage of the scheme and high frequency of modulation allows us to get rid of distortions. Semiconductor relay 14 is necessary to provide the high factor of return, i.e., the necessary accuracy of operation of relay 8.

Thus, the device offered provides high frequency of modulations with filtration of impulses of voltage adding by means of a condenser of small capacity and also due to dispersion inductance of a transformer. It allows us to exclude voltage distortion in a network.

References

1. The patent № 2123717 Russian Federation. An electronic voltage stabilizer / L.T. Magazinnik, J.J. Magazinnik // Bul.№№5,20.12.1998.

A SMALL-SIZED VOLTAGE STABILIZER WITHOUT SWITCHING CONDENSERS

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A small-sized voltage stabilizer without switching condensers in comparison with widely known analogue provides smaller mass parameters due to the application of a minimum quantity of semiconductor devices and more effective current loading of the device and a network as a whole.

It is necessary to recognize as a lack of many stabilizers comparative complexity and big mass parameters connection with the necessity of application of switching condensers.

In comparison with widely known analogues the offered voltage stabilizer [1] provides smaller mass parameters due to the application of a minimum quantity of semiconductor devices and more effective current loading of the device and a network as a whole. The device provides a combination of voltage adding transformer functions and functions of a compulsory locking thyristor device.

Let's consider the stabilizer operation (Figure) the network and loading voltage are smaller than a nominal level, i.e. at $U_s < 220$ V. It is assumed that in this case relay 6 is initially switched on and its contacts 5 shunt a primary winding of transformer 1, accordingly, the voltage at its secondary winding is also equal to zero. When thymistor 4 is off, the loading forms a series circuit with a secondary winding of transformer 2, which in this case acts as a reactor. Thus the most part of the mains voltage will be applied to a winding and loading voltage can be practically equal to zero. However it takes place only on the initial site of a mains voltage half-wave the duration of which is determined by the «breakdown» voltage of stabilitron 9

$$\gamma = \arcsin\frac{U}{220\sqrt{2}} \approx 10\ el.\deg rees.,$$

$$at\ U_{cm} \approx 50\ V.$$

When the voltage reaches the specified level and stabilitron 9 in transformer 8 primary winding of galvanic outcome starts to conduct current, the in thymistor 7 control circuit will be increased and the latter will be on. Shunting of transformer 2 secondary winding by means of thymister 7 will result in spasmodic change of the loading instant voltage up to the level of the network U_s voltage.

It is assumed that the automatic control and output voltage stabilization system functions according to the principle of output coordinate (U_c) deviation from a present value (U_y). The signal of a regulation mistage from an output of regulator 12 enters the input of pulse phase control device 11 which develops unlocking pulses for thymistor 4. The smaller the stabilizer output voltage, the smaller the phase angle of thymistor a control, the more the voltage adding which is delivered to the loading circuit by transformer 2 primary winding is connected to the mains voltage source, the e. m. being induced in the secondary winding, the phase of which due to the way of primary and secondary winding connection specified in the scheme coincides with the network voltage phase. As a result thymistor 7 is under the influence of the specified winding indirect voltage and is locked. Thymistor 7 locking out results in the fact that the loading instant voltage from the moment a up to the end of a half -cycle is determined by the sum of the mains voltage and voltage adding transformer 2 secondary winding voltage. Thus the effective value of voltage adding provided by transformer 2 during the period is in direct dependence on a regulation mistake and it provides a sta-