Materials of Conferences

FREQUENCY ELECTRIC DRIVE

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In the described electric drive three-phase motor of alternative current *M* (Fig. 1) that can be anisochronous or synchronous, feeds from an autonomous invertor that is plugged into the main through a matching transformer *T* (depending on parameters of electric drive, plugging into the main through current-limiting reactors is possible).

Bridge thyristor rectifier VD_1, identical thyristor invertor WD_4, and an artificial commutation condenser facility C_c is included into the composition of the autonomous invertor.

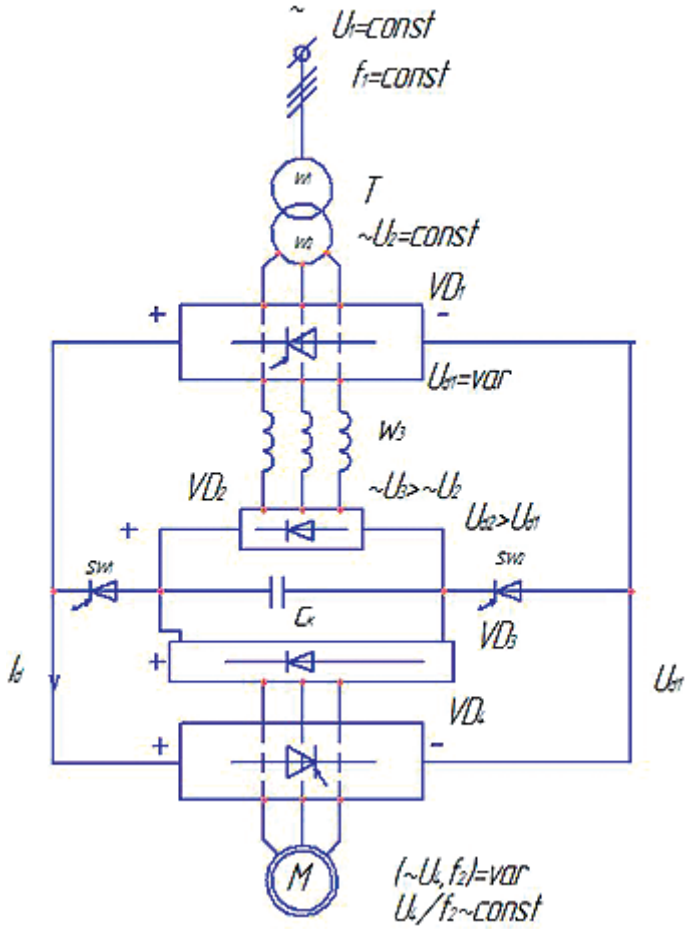

Fig. 1. Power scheme of frequency electric drive

The artificial commutation facility contains a diode bridge VD_2, and commutation condenser C_c is attached parallel to its direct current outputs, and corresponding keys of the condenser C_c are linked to the outputs of the inverter feed. As in well-known transistor invertors, reverse diode bridge VD_3 serves to limit overpower and energy exchange between condenser C_c and motor *M*. Input of alternative current of diode bridge VD_2 is plugged into volt-adding winding W_3 of transformer *T* that is correspondingly-logically to secondary winding W_2 of the mentioned transformer.

The design functions as follows: Let keys SW_1 and SW_2 close at a moment ωt_1 (Fig. 2). Then, loading current I_d from any operative pair of transistors of bridge VD_1 transfers into a corresponding pair of diodes of bridge VD_2 under the impact of volt-adding winding W_3, and then into invertor VD_4 through the mentioned closed keys (there a corresponding pair of transistors of invertor VD_4 is opened simul-

taneously with the keys). Bridge VD_1 deenergizes almost instantly and feed of motor M is delivered from condenser C_c and bridge VD_2. By the moment of ωt_2 (Fig. 2), in other words, in void time interval t_1–t_2 that is necessary for deenergizing thyristors of bridge VD_1, commences a «discharge» of electromagnetic energy that has been accumulated in phases of motor M and inductances of dispersion of transformer T. By the moment ωt_3 (Fig. 2), current in phases of transformer T and invertor VD_4 decreases down to zero. The first stage of commutation is finished. Further, at the moment ωt_3, unlocking impulses for the corresponding thyristors of rectifier VD_1 and invertor VD_4 are supplied from the control system (not displayed in Fig. 1). From the moment ωt_3 to ωt_4 current in the corresponding phases of transformer T and motor M increases to a value that preceded ωt_1, and the process restarts in intervals that are defined by a given frequency f_2 and, correspondingly, frequency of keys SW_1 and SW_2 response.

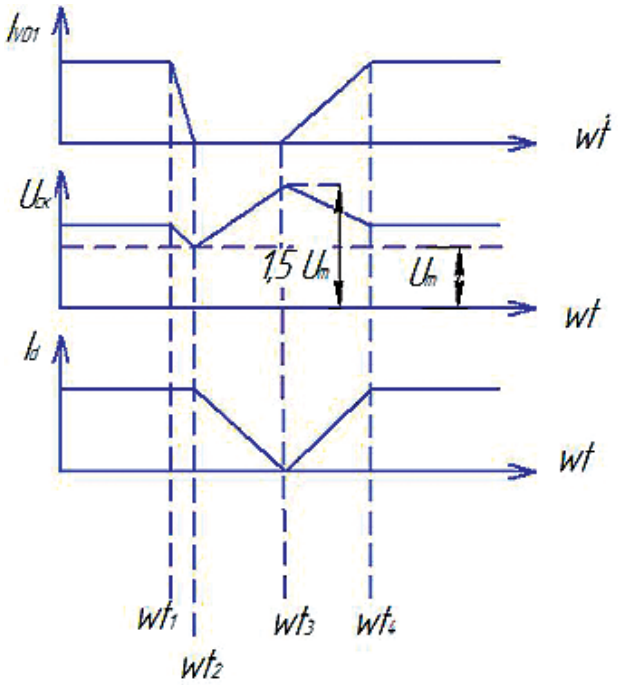

Fig. 2. Simplified diagrams of currents and voltage under $f_2 = f_1$; I_{VD1} is current in trysistors of rectifier VD_1; U_{Cc} is voltage on condenser C_c; I_d is current at the input of the invertor

Calculations of capacity of C_c considering transformer and motor inductances show us that, within the frame of voltage oscillations, U_{ck} of the commutation condenser (Fig. 2) increases along with an increase of frequency f_2. Particularly, if $f_2 \approx 150$ Hz, overpower altitude reaches 1,5 um (Fig. 2), where Um is an altitude of linear voltage U_2 at ends of volt-adding winding W_3 (voltage of the very winding W_3) does not exceed (6–7) V).

Resume

1. Frequency-regulated electric drive with three-phase anisochronous or synchronous engine has been described. Engine feed is carried out from an autonomous voltage invertor with an original facility of group commutation that is general for rectifier and invertor.

2. Rectifier and invertor represent identical three-phase bridges on general-industrial thyristors that allows us to remove limitations of electric drive power.

3. Artificial commutation provides for regulation of motor rotation frequency from null to nominal value under a constant moment, and over nominal – under a constant power, general range of regulation varies from null to triple nominal speed.

4. Facility of artificial commutation that contains two keys at locked transistors, one unipolar condenser, and diode bridge provides for an even commutation throughout the whole mentioned range and free circulation of the reactive power between a feed source, load, and commutation condenser.

5. The developed frequency inverter can be used in electric drives of average and high power as well as for other active-inductive loads that are regulated in voltage and frequency.

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