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INFLUENCE OF CIRCUIT ELEMENT PARAMETERS ON CAPACITANCE CHARACTERISTICS OF SILVER-ZINC STORAGE BATTERIES DURING CHARGING WITH ASYMMETRIC ALTERNATING CURRENT

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TRANSLATION

ENGLISH TITLE: INFLUENCE OF CIRCUIT ELEMENT PARAMETERS ON CAPACITANCE CHARACTERISTICS OF SILVER-ZINC STORAGE BATTERIES DURING CHARGING WITH ASYMMETRIC ALTERNATING CURRENT

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ABSTRACT: The effect of active, inductive and capacitive resistance of the elements of an asymmetric alternating current (aac) battery charger on the discharged characteristics of silver-zinc storage batteries is examined. It is shown that the capacitive resistance of the storage batteries has the greatest effect.

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A significant amount of study has been done in recent years on the charging of silver-zinc storage batteries (szb) with aac, which improves their electrical characteristics.

The optimum parameters (aac) were determined as a result of the investigations [1]. However, several investigaters, charging silver-zinc batteries with aac with the recommended optimum parameters, obtained different results. The results were found [2] to depend on the size of circuitry elements (transformers, capacitors, resistors). The analogous phenomenon was also noted when aac was used for charging lead-acid batteries [3]. It is useful, therefore, to determine the quantitative effect of the active, capacitive and inductive resistance of circuit elements of the charger on szb characteristics during charging with aac.

The effect of active, capacitive and inductive resistance of circuit elements on szb characteristics was determined on type SZ-70 storage batteries, which had a long service life when charged with aac in accordance with the schematic illustrated in the figure. The principle of generating aac in accordance with the stated schematic consists in superimposing alternating currents, circulating in a closed loop, over a direct current, flowing through both parallel circuits. Here the emf of the secondary windings of the transformers in the closed loop should be matched. The active resistance of the circuit was changed by means of additional resistors R_a, connected into both parallel circuits. The inductive resistance was changed by changes in the number of windings of the secondary coils of the transformers w_2 and the capacitive resistance, by changing the number of series- or parallel-connected batteries (k) in each parallel circuit. The effect of fluctuations of the line voltage of the primary windings of the transformers (u_{t1}, u_{t2}) was also checked.

All charging was done in the standard two-stage mode with a ratio of the alternating component of aac ($I_\sim$) to the direct component ($I_=$), equal to six. With the batteries hooked up in parallel the components of aac increased accordingly in each parallel circuit.

The batteries were charged with dc before the ac cycle and after completion of the cycle. It is known from previously conducted studies that when storage batteries are cycled using aac and dc charges, the dc charges immediately following the cycle with aac charging, have higher capacitances compared with subsequent dc charges.

The test results are presented in the table. The following conclusions are derived from the test data:

1. An increase of the inductive resistance of the circuit with the other circuit parameters maintained constant (first group, cycles 2, 3, 4, and 5) causes some increase in discharge capacitance;

2. An increase in the active resistance of the circuits involves some increase in discharge capacitance (second group, cycles 2, 3, 4, and 5);

3. An increase in capacitive resistance of the circuits due to series connection of the storage batteries instead of parallel-connected, causes a considerable increase in discharge capacitance (second group, cycles 6, 7, 8, and 9), and a decrease in the capacitive resistance of the circuit (second group, cycles 4, 5, 6, 7) causes a reduction of discharge capacitance.

Power in the primary windings of the transformers with different voltages with aac parameters maintained constant ($I_\sim/I_=$ equal 6) results in uneven charging of the storage batteries in the parallel circuits.

Thus, the active, capacitive and inductive resistances of aac charger elements influence the discharge capacity of szb. The capacitive resistance of the storage batteries, an increase in which results in an increase in discharge capacitance, has the greatest effect. The most effective aac charging occurs with certain optimum ratios of the stated values. This must be taken into account for development of aac chargers when investigating the influence of aac charging on the characteristics of high-capacitance silver-zinc storage batteries.

Number of groups	Charging methods	Number of cycles	w_2 (windings)	k. Samples	Ohm	$\frac{u_{t1}}{u_{t2}}$	Average discharge capacitance $1=4.5\alpha$	with predischarge $1 = 1.2\alpha$
1	DC	1	--	--	--	--	13.8	16.7
	aac	2.3	2	Series	--	1	19.4	22.5
	aac	4.5	48	Series	--	1	20.7	24.1
	aac	6.7	48	Series	--	6(2-4.5)*	23.9	26.3
	ac	8.9	2	Series	--	1	25.9	28.0
	C	10	--	Series	--	--	18.5	19.7
2	DC	1	--	--	--	--	19.1	20.6
	aac	2.3	48	Series	--	1	20.8	23.1
	aac	4.5	48	Series	$R_{a1} = R_{a2} = 0.0$	1	22.7	24.2
	aac	6.7	2	Parallel	--	1	21.7	23.3
	aac	8.9	2	Series	--	1	28.9	30.1

*The ratio for the second discharge stage is given in parentheses.

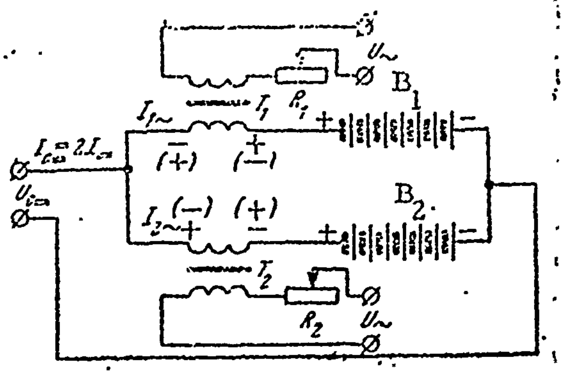

Diagram of discharge of two storage batteries (B_1, B_2) with aac. T_1, T_2, low-voltage transformers; R_1, R_2 - adjustable devices aac parameters, ($I_=$, $I_\sim$, $I_\sim / I_=$).

CONCLUSION

1. The capacitance of silver-zinc storage batteries during aac charging depends on the active, inductive and capacitive resistances of the charger elements.

2. The capacitive resistance, i. e., the number of series- and parallel-connected storage batteries, has the greatest influence.

3. The modes of aac charging must be characterized not only by optimum charging parameters, but also by optimum charger element parameters.

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