In investigating the mechanical characteristics of materials, for instance, reinforced plastics, it is sometimes necessary to compare the strength characteristics of these materials under conditions of intensive one-sided heating. In such tests, stringent requirements for the reproducibility of the results are imposed in each individual case of the equal specific thermal fluxes supplied to the specimen.

One of the well-known methods for intensive one-sided heating of coked reinforced plastics is based on direct transmission of an electric current through the carbonized surface of the specimen [1]. The difficulty in controlling the heat supplied to the specimen is due to the fact that the resistance of the specimen's carbonized layer varies in time [2]. A method for controlling the high-temperature surface heating of transparent plastics by using electrical resistance was described in [3]. This method is based on control with respect to a model of the specimen with a device for automatic program correction, which makes it necessary to construct a model of the specimen before performing the tests. This device is relatively complex, cumbersome, and costly, even if the heating is to last only a few minutes.

We propose a control method based on a system for automatic program correction where the model of the specimen is combined with the specimen itself.

This system offers a simpler way to provide short-duration as well as prolonged programmed heating, which is assigned and corrected with respect to the electric power in the specimen, which, in turn, uniquely

![Fig.1. Heating control circuit and loading system.](image-url)
determines the released Joule heat. The system for specimen loading and the control system are shown in Fig.1. The loading device, 1, consists of a press with a fast electromechanical drive. The testing of $10 \times 15 \times 120$-mm specimens, 2, is performed according to the pure-bending scheme. Electric power is supplied to the lower knife-edges 3 for one-sided heating of the specimen. Type-VKDU-150 thyristors, 4, are connected in antiparallel to this circuit.

A P-004 data unit, 5, to which the voltage and a signal proportional to the current through the specimen are supplied, is used for measuring the power released in the specimen.

An RU-5-02M device, 6, which includes a slide wire, 6, with a 100% proportionality zone, is used as the program controller. A phase-shifting device, 8, which also shapes the control pulses, is used as the control element (power regulator). It consists of the following principal units: the integrator Dpl, C~, the dc-ac voltage converter T1-T4, the ac current amplifier T5, T6, the sawtooth voltage generator T7, T8, the comparison circuit T9, T10, the probing pulse shaper T13, the output amplifier T11, T12, and the supply unit.

The integrator is intended for averaging the output signal of the Hall data unit, which measures the instantaneous power value at the output of the thyristor breaker, i.e., at the load; this power is kept constant or varied in time according to a certain given program.

A semiconductor switch, T3, T4, which is controlled by a multivibrator based on transistors T1 and T2, serves as the dc-ac voltage converter. When the transistor T2 of the multivibrator is open, a negative signal, which keeps the switch open, is transmitted through resistors R9 and R10 to the bases of transistors T3 and T4. When transistor T2 is locked (transistor T is open), transistors T3 and T4 are blocked through resistors R8 and R9 by a positive bias, which arrives from stabiltron KC2 and the limiting diode D1.

The square voltage pulses formed at the output of the switch (emitter of T3) are transmitted through the separating capacitor C8 to the input of the two-stage ac current amplifier T5, T6, which is based on a resistive-capacitive circuit. The output voltage of the ac current amplifier is rectified by means of diodes D8 and D9, filtered by the capacitor C13, and transmitted through diode D10 and resistor R20 to the input of the comparison circuit (base of T9) in the shape of a positive dc voltage whose intensity depends on the output signal of the Hall data unit. A negative voltage from the potentiometer R23 is supplied to this input through resistor R21. Resistors R24 and R25 serve for shifting the firing pulses with respect to each other in order to ensure symmetry during each half-period. Resistor R22 and capacitor C14 form the setting voltage filter. The setting voltage arrives from the slide wire of controller Rcoon. Besides these two voltages (the positive voltage of the negative feedback and the negative control voltage), the input of the comparison circuit also receives a negative sawtooth voltage from the collector of T7, which is amplified by the emitter follower T8, and positive probing pulses, which are formed at the collector of shaper T13. The voltage comparison circuit is based on transistors T9 and T10 with resistive coupling between stages and rigid positive feedback R34, which is necessary for accurate operation of the circuit.

In their initial states, both transistors of the comparison circuit are locked. When the total base-emitter voltage of T9 is equal to zero (more accurately, when it is slightly negative), both transistors T9 and T10 are open. The output voltage of the comparison circuit, which is taken off resistor R35, is differentiated by the C17, R37 network and is transmitted to the input of the output amplifier T11, T12. The secondary windings of the pulse transformer Tr2, which constitute the load of this amplifier, are connected to the thyristor control circuits.

Since the signal received from the Hall data unit, which is connected to the load, forms negative feedback in the system controlling the firing angle of the power tubes, the system tends to maintain the assigned power in the load regardless of possible disturbances.

The system for heating the specimen operates in the following manner. An electric current flows along the specimen when a voltage is applied to the circuit. The data unit produces a signal proportional to the power released in the specimen. This signal is compared with another signal, which is produced by the controller in the comparison unit (the slide wire of the controller).

If these values do not match, the difference (signal) between the feedback voltage and the controller voltage is taken off the amplifier with an allowance for the phase. The thus-amplified voltage (signal) is supplied to the phase-shifting device, which shifts the controlling pulses with respect to phase in dependence on the error voltage and transmits them to the thyristors. The latter transmits to the specimen that portion of the half-period of the operating voltage which secures the assigned power. The system maintains