In most cases isothermal transformation diagrams of austenite give an idea only of the degree of isothermal transformation of austenite at different temperatures. Some information on the kinetics and formation mechanism of the microstructure can be obtained from these diagrams only for the pearlite region in the case where excess phase lines are drawn on the diagram. Data on the formation of the microstructure in the bainite region are not reflected on the diagram.

For most alloy steels the complete decomposition of austenite in the bainite region requires a long time and is seldom attained under experimental conditions. Nevertheless, this is not always reflected on the isothermal transformation diagrams and is the particular reason for the fact that diagrams obtained experimentally by different investigators differ from each other [1].

The results of the investigation of the bainitic transformation in structural steels leads us to conclude that the special characteristics of the kinetics of the transformation of austenite and formation of the microstructure of steel in the bainite region can be reflected on the isothermal transformation diagrams of austenite.

For the bainitic transformation of austenite in the majority of alloy structural steels the kinetic curve is characterized by a plateau corresponding to the retardation period of decomposition (400 and 450° isotherms in Fig. 1a), which divides the curve into two parts. Obviously, the transformation itself can also be divided into two periods [2]: before retardation of the process and after its resumption. In between the first and second periods no decomposition is observed for a certain time.

In the first transformation period, as was shown in [3], the phase is formed by martensitic kinetics \( \alpha_m \). At first isolated inclusions of ferrite appear (Fig. 2a), which are then enlarged in the upper bainite region, assuming a lamellar form (Fig. 2c). In the lower bainite region the ferrite is acicular (Fig. 2b) and as a consequence of supersaturation with carbon [4] undergoes self-tempering \( \alpha_m + C \). The second phase in the first transformation period is austenite enriched in carbon \( \gamma \) rich.

Fig. 1. Kinetic curves of the decomposition of austenite in 60S2 steel. a) Isothermal transformation of austenite in bainite region; b) variation of amount of \( \alpha_m \) phase formed by martensitic kinetics in the bainite region and martensite in the \( M_s-M_f \) region with temperature.
Thus, at the moment the isothermal transformation process is retarded, a metastable equilibrium is established: $\alpha_m + \gamma_{\text{rich}}$ or $(\alpha_m + C) + \gamma_{\text{rich}}$.

At certain temperatures in steels alloyed with silicon and aluminum the transformation is not resumed (in steel 60S2, for example, at 350°C and lower; see Fig. 1a) and the enriched austenite $\gamma_{\text{rich}}$ has a high resistance to transformation not only at the constant temperature but also during subsequent cooling. In this case the metastable equilibrium is fixed at room temperature: $\alpha_m + \gamma_{\text{rich}}$ (Fig. 3b) or $(\alpha_m + C) + \gamma_{\text{rich}}$ (Fig. 3a).

If, however, the transformation resumes after retardation at constant temperature, then the austenite enriched in carbon at the time of retardation is less resistant to martensitic transformation and during cooling to room temperature is partially transformed into martensite. But in such cases the structure is the same as in Fig. 3, a, b, since the martensite has a cryptocrystalline structure which is not manifest in the former $\gamma_{\text{rich}}$ lamella. The amount of $\alpha_m$ formed in the first transformation period is strongly dependent on the transformation temperature. The lower the temperature, the more austenite is transformed before retardation of the process, i.e., the more the $\alpha_m$ phase formed by martensitic kinetics. If we plot the variation of the amount of $\alpha_m$ phase formed with the temperature in the bainite region then the kinetic curve will be the same as in the martensite region (Fig. 1b). Thus, one finds a similarity in the development of the $\gamma - \alpha$ transformation processes by martensitic kinetics for the bainitic and martensitic regions.