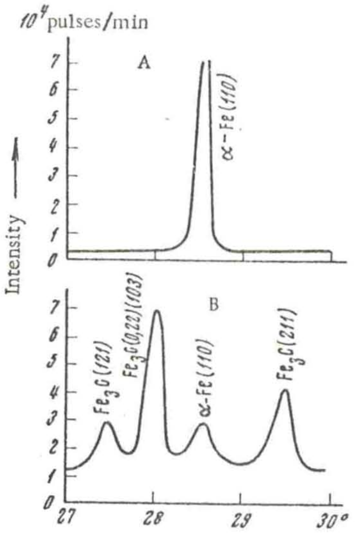


Fig. 1. Curves of intensity of lines on x-ray graphs for low carbon steel 20 (0.2% C). A) before and B) after saturation with carbon in an impact wave.

Study of the structure in the section perpendicular to the carbonized layer (in the direction of propagation of the impact wave) showed the following sequence of structures. The carbonized layer is thin (about 0.05 mm) and very hard (from 580 to 935 kgf/mm$^2$), and its boundary is very sharp. The zone of carbon saturation contains round pores apparently caused by the evolution of a gas phase.

The next is the zone of thermal influence; it is up to 0.05 mm thick, and in addition to ferrite grains of hardness 160-190 kgf/mm$^2$ it also contains grains which in the initial state had pearlite structure (Fig. 3). During impulse heating these grains were converted to austenite containing 0.8% C, and on sudden cooling a martensite-austenitic structure was formed in them with hardness 460-760 kgf/mm$^2$. In the ferrite regions surrounding these grains, as a result of transition of the $\alpha$ phase to the $\gamma$ phase during heating, and inverse transition during cooling, the grain structure became finer. Therefore, the heating and cooling rates were so high that the carbon could not be redistributed between the pearlite being converted into austenite and the ferrite. The structure is also typical of the zone of thermal influence when steel is treated by laser light impulses [5].

The next polygonization zone is two orders of magnitude (5-6 mm) and contains fine polygonal blocks which retain residues of twins. This very hard structure (250−260 kgf/mm$^2$) was apparently formed by short-time heating of the metal after dynamic plastic deformation.

Finally, the last zone, which forms the main structure of the specimen deformed by impact waves, contains a considerable number of twins in grains of ferrite of hardness 160-180 kgf/mm$^2$, which is somewhat harder than the ferrite in the initial material (150-170 kgf/mm$^2$).

On the basis of the structural studies the following physical mechanism can be proposed for processes that lead to iron being saturated with carbon in exposure to impact waves. A shock wave that occurs on collision with the plate compresses the porous layer of graphite powder. Here in addition to being subjected to high pressure the powder is heated to a temperature higher than the

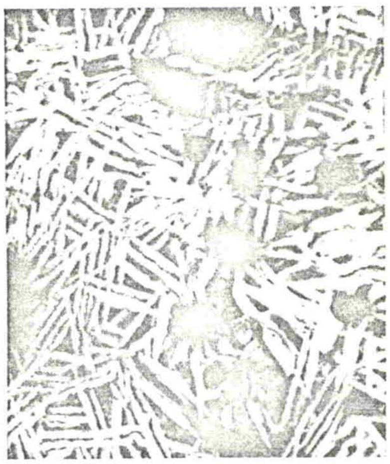

Fig. 2. Microstructure of carbon saturation zone after deep etching. ×1000.

Fig. 3. Microstructure of carbon saturation zone and thermal influence after weak etching. ×450.