
CONTRIBUTION OF WELDERS INTO GREAT VICTORY

The remarkable date, the 65 years of Great Victory over fascist Germany and its satellites, is also celebrated by many-million group of welders: scientists, engineers, technicians and workers.

The stimulus for development of welding was given after the First World War having put forward a number of technical problems before welders. By the end of the 1930s welding became leading technology in the production of armaments of many countries, having almost completely replaced riveting.

During the World War II the necessity in acceleration of armament production gave a powerful impetus for widening the application and modernization of welding processes. The main emphasis was made on search of reserves, hidden capabilities of technologies. Perfidious attack of fascist Germany on the Soviet Union, loss of considerable part of the territory of Ukraine with metallurgical and machine-building plants, dismantling of plant equipment and its transportation to eastern regions dragged rates of weapon production at the end of 1941. The application of welding engineering allowed quick disassembling of equipment of evacuated plants in the very shortest terms, accelerating the assembly at the new site and starting the production. The designers, production managers understood that only simplification of manufacturing process, including also welding, will allow production of necessary amount of weapon for the front in the shortest period.

In the pre-war years the Soviet designers constructed the most advanced tanks: heavy KV-1, medium T-34, floating T-40 and SAU, based on them. Armored bodies, assemblies and structure elements were welded manually using special electrodes. To fulfill this work, thousands of high-skilled welders were required. The solution was found in application of automatic welding.

At the end of the 1930s the technology of automatic submerged arc welding of structural steels was developed under supervision of Evgeny O. Paton at the Electric Welding Institute. At the beginning of Great Patriotic War the Institute was evacuated from Kiev to Nizhny Tagil and arranged at the Ural Railway-Carriage Works where high-speed welding began to

be implemented in production of aviation bombs. Soon, the specialists and equipment of Kharkov plant No. 183 were transported there, where tank T-34 was constructed. The plants were united into one enterprise, called the Ural tank plant. E.O. Paton forwarded efforts of personnel to the development of technology of automatic submerged arc welding of special, armored steels and application of the new technology to manufacture intricate three-dimensional structures of armored bodies of tanks. It should be noted that such task was solved for the first time in the world. In the shortest terms it was succeeded to find out the causes of cracks initiation in welds. The technology of defectless welding was developed (V.I. Dyatlov, A.I. Ivanov); the nature of processes was studied and presence of arc charge under the flux layer proved experimentally (B.E. Paton, A.M. Makara); the fluxes of blast-furnace slags were developed (A.I. Korennoj); the phenomenon of self-control of arc processes with consumable electrode was revealed (V.I. Dyatlov), on the basis of which the simplified automatic welding heads with constant speed of electrode wire feed were developed (P.I. Sevbo, B.E. Paton). In 1942–1943, 20 designs of installations for welding of tank bodies and 8 designs for welding of aviation bombs and ammunition were developed and realized. One more remarkable achievement was the construction of the first assembly-welding production line, proposed by Yu.E. Maksaryev, the director of plant, and Evgeny O. Paton.

The works on application of new welding process were carried out in cooperation with the Institute, tank design bureaus and plants. A.A. Morozov, the leading designer of tank T-34, Zh.Ya. Kotin, the leading designer of heavy tanks IS and KV, participated actively in the solution of these questions. The colleagues of the Electric Welding Institute trained workers and set up the equipment at the plants of the country. Automatic welding found its large-scale application in Chelyabinsk where the S.M. Kirov Leningrad Tractor Plant (tanks KV, T-34 and SAU) was evacuated; at Gorky Automobile Plant (artillery installations, shells and other); at S. Ordzhonikidze Ural Heavy Machine-

Building Plant (Sverdlovsk) (bodies of tanks). By the end of 1943 the submerged arc welding was mastered at 52 plants. In the years of war 4 million meters of weld were welded, 5 million of kilowatt-hours of electricity saved, labor-consumption for tank body manufacture was five times decreased. The welding could be performed by teenagers; only at Ural Tank Plant 250 welders were released. By the end of the war the plants produced up to 30 thousands of heavy and medium tanks and self-propelled guns per year.

Already at the beginning of the 1930s the aircrafts of corrosion-resistant steels and aluminium alloys with welded frames of fuselage, wings and tail unit were designed in the number of countries. In the USSR, these were planes of A.I. Putilov «Stal-2», the resistance welding of which was carried out by P.N. Lvov. Contribution into development of resistance welding of assemblies of planes and welding-in of lining of chromium-nickel steels was made by A.S. Gelman, E.V. Sokolov and other specialists of TsNIIT-Mash (Moscow). The successful application of brazing of aluminium alloys was due to works on technology and development of brazing alloys, carried out in prewar years in MAI, NII GVF (P.N. Lvov, N.V. Geveling, S.N. Lotsmanov). Increase of «life» of aircrafts was possible due to application of welded and brazed tubular longerons, corrugated linings, underframes.

Since the first days of war the work of Moscow Mechanical Engineering Institute (nowadays N.E. Bauman MGTU)) was directed to the manufacture of armament. K.K. Khrenov, G.A. Nikolaev, S.T. Nazarov and other colleagues solved a series of problems on manufacture and repair of military machinery. With their participation the designs of artillery and shooting weapon were worked out in the shortest time using widely the resistance welding in the technological process. Thus, S. Shpagin developed a stamped-welded design of a pistol-gun which considerably simplified the production of this automatic weapon. The welders of Leningrad switched over to the production of military products and did all possible for the city defense. N.O. Okerblom, V.P. Vologdin, A.A. Alekseev, D.N. Sagalovich, F.F. Benua and other organized repair of tanks and other combat machinery, developed new technologies of manufacturing pontoons and other floating means. Thus, in November 1941 the structures for crossing Neva

were manufactured at Baltic Ship-Building Yard in several days. The construction of torpedo-boats, guard-boats, trawlers kept on. Manual arc (including underwater) and gas welding were applied for construction of auxiliary ships, pontoons, cutters, repair of ships. Only in the second half of a year of 1941, 84 ships were completed. In the period of blockade in Leningrad and Kronstadt about 850 ships were repaired applying welding, cruiser «Petropavlovsk», sunken after bombardment, was lifted and repaired. For communication with Bolshaya Zemlya during navigation in 1942, 14 barges of loading capacity of 900 t were welded in unprecedented rates. In spring 1942 the Welding-assembly trust of Narkomstroi (A.S. Falkevich) constructed a welded underwater fuel pipeline of high pressure of 30 km extension, including 21.5 km under water at the depth from 1 up to 12.5 m across the Ladozhskoye lake. Non-certified pipes were joined using manual electric arc and gas welding. During war other pipelines were also constructed (Astrahan–Stalingrad is largest). Oil tanks, cisterns of large capacity began to be all-welded.

In liberated regions and regions of combat actions it was urgently necessary to restore railroads. The colleagues of TsNIITMash and National Commissariat of Communications offered new technological processes of arc and resistance welding of rail butts. The installation for resistance welding of rails with the movable platform was designed and manufactured at the plant «Revtrud». Over 30,000 butts were performed in a year by the first rail-welding train in the USSR. In 1943, 10 such trains were already operated. For welding wires under field conditions the magnesium thermite was developed in TsNIIzheldortrans (M.I. Vakhnin, et al.).

In the years of war the urgent demand for underwater welding and cutting of metal appeared. Even earlier, K.K. Khrenov proved the possibility of application of arc welding and cutting using consumable electrode under water in laboratory conditions. In the special laboratory, organized in March 1942 at Moscow Electromechanical Institute of Engineers of Railway Transport, the training of divers-welders began. The special trains were formed, the personnel of which released waterways of rivers from exploded bridges, participated in restoration of bridges, rising of sunken ships and their repair. Several stations of underwater ship repair were

built. Following the example of Soviet Union welding and cutting under water began to be applied to other combat countries as well.

In 1941 the plant in village Novaya Utkha (Sverdlovsk region) began production of electric welding equipment, where part of workers and engineers and technicians of plant «Elektrik» was evacuated from Leningrad. During years of war 6000 movable welding machines, 15,000 welding transformers, about 500 heads of AGE-5-2 for arc welding were produced.

The deficit of metal including steel rolled metal forced manufacturing of metal structures of ill-conditioned steels. The electrodes of series UONI-13 designed by K.V. Petran turned to be universal, providing high quality of a weld. New electrode coatings of non-deficit materials were developed in N.E. Bauman MVTU (K.K. Khrenov and others). In TsNIITMash timber and granite were added to the composition of electrode coating, the electrodes TsS-1 and TsS-2 were designed for surfacing of hard alloys of Sormite type, electrodes for welding of carbon steels (A.A. Alov, V.I. Yarkho, G.I. Glushkov and others).

In the years of war the need in gas welding and cutting arose. Gas cutting was the main technology at dismantling the destroyed metallic structures and preparation of components at the plants, gas welding and brazing was widely applied during repair in field conditions. To produce cutters and torches the plants in Barnaul and Sverdlovsk were built; machines for cutting, installations for pyrolytic gas were produced at the Uralmash. In 1944 All-Union Research Institute of Autogenous Industry (VNIIavtogenmash, director A.N. Shashkov) was founded where research works on development of technologies and modernization of equipment for gas-plasma treatment were started.

In 1941–1945 the field movable repair bases began to be manufactured, where the set of equipment included the installations for arc welding and cutting.

Under difficult period of military times the scientists of the country continued investiga-

tions, the majority of which was directed to the solution of problems arose in production of weapon and restoration of metallic structures. In the years of war colleagues of the Electric Welding Institute wrote and published more than dozen of works. Among them — third edition of fundamental monograph of E.O. Paton «High-speed automatic submerged arc welding», «Automatic welding in shipbuilding» and «Manual on welding of armored structures». In January 1943 on the initiative of Director of the Institute, the scientific conference on submerged arc welding was held in Nizhny Tagil. G.A. Nikolaev published monograph «Application of welding in artillery systems and shooting guns». In 1941 the section on scientific development of problems of electric welding and electrothermics of Academy of Sciences of USSR was organized. Under management of V.P. Nikitin the method of automatic welding with separation of processes of thermal preparation of base and filler metal was developed. N.N. Rykalin conducted research works in the field of electrodes melting and penetration of base metal. A.A. Alov worked on study of slag inclusions and pores in weld metal. The successful investigations of resistance spot welding of large thicknesses were carried out by A.S. Gelman. V.P. Vologdin and N.O. Okerblom worked on the discovery of mechanism of formation of stresses and strains in welding process. G.A. Nikolaev, K.K. Khrenov solved problems of welding special steels and quality control of welding. K.V. Lyubavsky and F.I. Pashukanis developed a number of fluxes (including those of non-deficit materials) for automatic welding of low-carbon and alloyed steels. At the same place the modernization of welding equipment continued (I.L. Brinberg).

Owing to the efforts of many scientists, inventors, workers the welding became leading technology in building enterprises, production and repair of armaments and made a great contribution into Great Victory.

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