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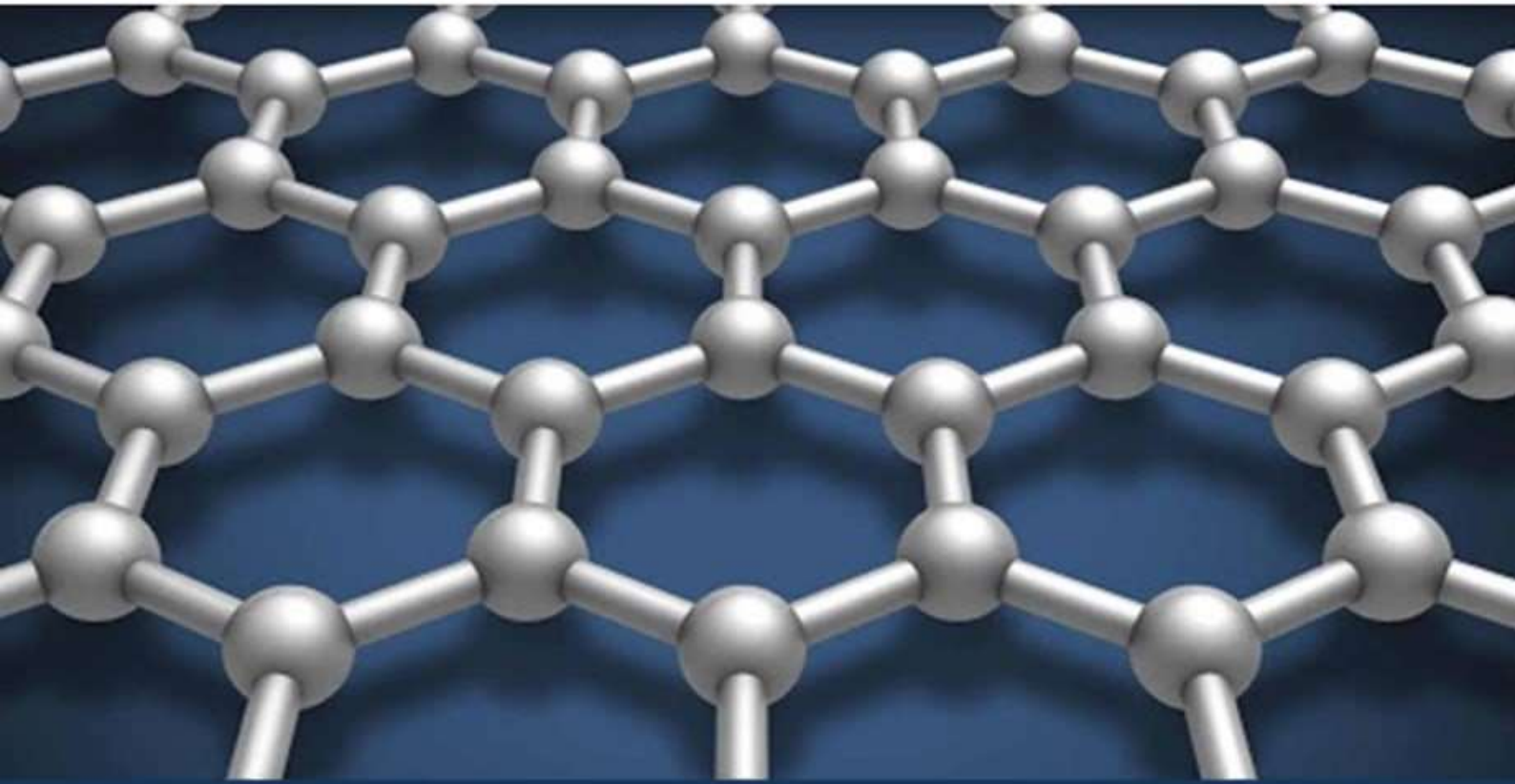

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REQUIREMENTS FOR ALLOY ELECTRODES AND CONTACT MACHINES

A. Kh. Alikulov, F.R. Norkhudjaev, Z.F. Chulliev

Introduction. One of the main requirements for electrode alloys is their high strength at elevated temperatures. Large currents flow through the electrodes of contact machines, for example, in spot welding of aluminum alloys, the current density in the middle part of the electrodes can reach 250-300 A/mm.

Therefore, a high electrical conductivity is also required from the material used for electrodes and rollers (especially when welding light alloys). When welding some light alloys with low corrosion resistance (magnesium alloys), traces of copper on the surface of points and roller seams are generally not allowed. In such cases, the metal of the electrodes must have a low ability to diffuse and adhere to the metal of the parts to be welded.

The electrode used in resistance welding, in contrast to the welding electrodes used in construction in arc welding, is a part of the secondary circuit of the welding machine in direct contact with the parts to be welded. The electrodes supply an electric current that melts the metal at the point of formation of the welded joint, and also transfer the forces necessary to compress the parts to be welded.

The electrodes remove a significant portion of the heat generated during the welding process. A current of up to 100-150 thousand A can flow through the electrodes of contact machines, and the forces transmitted by the electrodes of powerful contact welding machines reach (in butt welding) several hundred tons.The number of welding cycles can reach 200-300 per minute and in some cases even more. Resistance welding begins with pre-compressing the parts to ensure good contact between them. The welding current passed between the electrodes heats the parts to be welded. To the thermal effect on the electrodes from the welding current is added their heating by thermal conductivity from the parts being welded to a higher temperature. Uneven heating of individual parts of the electrode, especially in the case of intensive cooling of the electrode with water, leads to thermal stresses inside the electrode.

The action of these factors is not constant both during one welding cycle and during the transition from the first cycle to the next. The wear of the electrodes and the associated change in the area of the contact surface leads to a change in the specific pressure and current density in the contact, and, consequently, to a change in heat release, heat removal, i.e. working conditions of the electrodes. The effect of the listed factors is joined by the influence of other factors associated with the heating of the electrodes in the initial period of their operation, the distortions of the electrodes, inaccurate assembly of the structure to be welded, etc.

Reasons for the fragility of electrodes of contact electric welding. The resistance welding process consists of the following stages.

1. Preliminary preparation of the surface of the parts to be connected - it should not be easily cleaned of dirt and oxides, but also very even, in order to eliminate the unevenness of the resulting electric field voltage.

2. Manual or mechanical clamping of the welded products - with an increase in the clamping force, the intensity of diffusion and the mechanical strength of the welded seam increase. Local melting of metals in the clampingzone by the heat of an electric current, as a result of which a welding joint is formed.

The clamping of the electrodes at this stage prevents the formation of welding spatter.

3. Cutting off the current and gradual cooling of the weld.

Thus, the material of electrodes for resistance welding undergoes not only significant thermal stresses, but also mechanical loads. Therefore, a number of requirements are imposed on it - high electrical conductivity, high thermal stability (including against constant temperature fluctuations), increased values of ultimate compressive strength, low heat capacity coefficient.A limited number of metals have such a complex of properties.

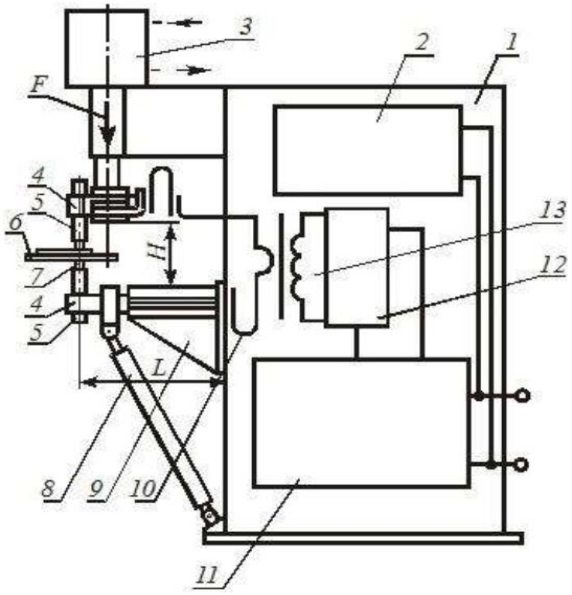
First of all, it is copper and its alloys, however, they do not always meet production requirements. The use of copper electrodes is ineffective for two reasons. First, copper, being a highly elastic metal, does not have sufficient elasticity to completely restore the geometric shape of the electrodes in the period between operating cycles.Secondly, copper is very scarce, and frequent replacement of electrodes leads to high financial costs.

The choice of material for spot welding electrodes also depends on the specific tasks of the process. 1. Electrodes designed for resistance welding in harsh conditions (continuous alternation of cycles, surface temperatures up to 450-500 °C). They are made from bronzes containing chromium and zirconium (Br,Cr,Br.Cr,Zr)0.6-0.05. This

group also includes nickel-silicon bronzes (Br,Cr,Ni) as well as bronzes additionally alloyed with titanium and beryllium (Br.Ni,Ti,)used for spot welding of stainless and heat-resistant steels and alloys. Electrodes used at contact temperatures on the surface up to 250-300 °C (welding of conventional carbon and low-alloy steels, copper and aluminum products). They are made from copper alloys of the MS and MK grades.

2. Electrodes for relatively light operating conditions (surface temperatures up to 120-200 °C). The materials used are cadmium bronze (Br,Kd) chromium bronze Br.X08, silicon-nickel bronze (Br,Ni) etc. Such electrodes can also be used for roller contact electric welding. Satisfaction of the listed requirements is possible only with the correct choice of the design of the electrodes, material and technology for their manufacture. The choice of welding technology, as well as the care of the electrodes during their operation, has a great influence on the operation of the electrodes.For practical use, contact point machines for general use are the most widespread type of contact welding equipment. The most widespread are single-phase AC machines of the MT type.

The complexity of the operating conditions of point contact machines determines the requirements for their design. Fig. (1)



Dot machine diagram:
1 – frame;
2 – welding cycle relay;
3 – compression drive;
4 – console;
5 – electrode holders;
6 – part to be welded;
7 – electrodes;
8 – brace;
9 – bottom bracket;
10 – flexible tires;
11 – contactor;
12 -step switch;
13-welding transformer;
L-stick out of electrodes;
H-solutionbetween consoles;
F-compressive force on the electrodes.

The most widespread are press-type point machines with a double-sided current supply, in which the electrodes move in a straight line and vertically. In radial machines, the electrode is fixed on an oscillating current lead with a drive located inside the machine body. In this case, the space above the upper electrode is free of machine parts and can be used to accommodate items of complex configuration to be welded. By their design, radial machines are simple, economical to manufacture, and less metal-consuming. Their weight is 25–30% less than that of similar press-type machines. The industry serially produces machines MTP-1201 (prototype MT-604), MTP-1701 (prototype MT-810), MTP-2401 (prototype MT-1614). Spot machines of medium and high power have a large mass (1–16 tons), so they are installed permanently, and parts are moved during the welding process.When welding bulky and heavy parts, large-sized products in hard-to-reach places, as well as welding spatial structures, the machine is moved, various pliers and pistols are used.

Machines MTP-1110, MTP-1111, MTP-1409 have separately located welding transformer and welding tongs of various designs. Machines MTP-2401 (K-243V) and MTP-1210 (K-264) are produced with transformers built into the welding gun. Multi-electrode machines (MTM) are one of the types of widespread special equipment for spot welding.

Conclusions. Such electrodes can also be used for roller contact electric welding. Satisfaction of the listed requirements is possible only with the correct choice of the design of the electrodes, material and technology for their manufacture. The choice of welding technology, as well as the care of the electrodes during their operation, has a great influence on the operation of the electrodes.

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Н.Д. Тураходжаев, С.Т. Маткаримов. Мис ишлаб чиқариш шлакларини руднотермик тиклаш усулининг термодинамикаси.....198
Ф.Т. Худойбердиев, Д.Р. Махмудов, К.С. Каландаров, З.Р. Буриева, И.В. Пушкарева. Кинетическая модель набухания гидрогеля при изготовлении патронированной забойки для буровзрывных работ при проведении горных выработок..... 201
М. Каршиев, А.А. Саттаров, Э.Н. Юсупходжаева, И.Х. Аюбова. Расчет закономерности пластического деформирования пористой пластины из бронзы марки БрОФ-10-1 при чистом изгибе по цилиндрической поверхности..... 207
Ш.Ш. Ахмадалиев, Н.М. Ризаева. Расчёт скорости роста и размера рекристаллизационного зерна при моделировании рекристаллизации феррита..... 210
A.Kh. Alikulov, F.R. Norkhudjaev, Z.F. Chulliev. Requirements for alloy electrodes and contact machines.....212
И.Н. Нугманов, Х.Х. Бобоев, З.С. Тураева. Методы получения ультрамелкозернистой микроструктуры в промышленных сплавах..... 214
О.Ш. Сабирова, Т.У. Улмасов, С.С. Негматов, Е.С. Раджабов. Методы расчета внутренних напряжений в полимерных и лакокрасочных покрытиях.....217
Ю.А. Гелдиев, Х.Х. Тўрайев, И.А. Умбаров, А.Т. Джалилов. Полисиликат кислотанинг моноетаноламин билан модификацияланиш тезлигига турли омилларнинг таъсирини ўрганиш..... 220
A.B. Kasimova, N.A. Isaxodjayeva, D.R. Sattorova. Sport kiyimlari uchun mo'ljallangan kompozision materiallarning sifat ko'rsatkichlarini baholash..... 223

6. Вести из лаборатории

Ш.Н. Жалилов, К.С. Негматова, Д.Н. Ходжаева, Н.С. Абед, Д.К. Холмуродова, М.Б. Бойдадаев, А.М. Мадрахимов. Изучение и анализ существующих полимерных связующих, применяемых в производстве древесно-стружечных и древесно-пластиковых плитных материалов, и их недостатки.....226
Ё.С. Раджабов, М.Б. Мухитдинов, Р.Х. Пирматов, Т.У. Улмасов, Т.О. Камолов, Ш.А. Аликобилов, Р.Х. Солиев. Современное состояние производства железобетонных конструкция и пути повышения его эффективности путем применения антиадгезионных смазочных и полимерных материалов рабочей поверхности формирующих оснасти….229
Ш.Н. Жалилов. Состояние получения и исследования структуры мочевиноформальдегидной смолы..... 232
И.С. Умаралиев, С.Р. Худояров, Ш.А. Мухаметджанова, О.М. Ёкубов, А.А. Абдухаликов, Ж.Ш. Эргашев. Современное состояние техногенные отходы металлургической отрасли Узбекистана..... 235
Ё.С. Раджабов. Состояние железобетонных формирующих оснасток в производстве строительных конструкций и пути повышения их эффективности..... 237
А.Н. Шодиев, А.А. Саидахмедов. О возможности извлечения ценных компонентов из отходов и сбросных растворов молибденового производства..... 238
S.A. Muxtarova. Maxsus qurilmalar uchun ilg'or optik faol materiallar..... 241
Ф.У. Ташалиев, А.С. Хасанов, К.Т. Жумабоев. Электрохлоринация медного клинкера как способ его переработки..244
Юбилей. Шарипов Хасан Турабович (к 75-летию со дня рождения и 50-летию научной и научно-педагогической деятельности)..... 247