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UNION CARBIDE AND CARBON CORPORATION

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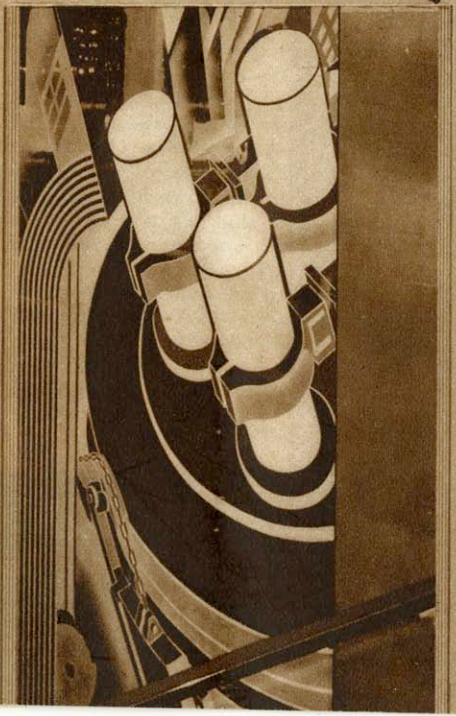
CARBON and GRAPHITE Electrodes



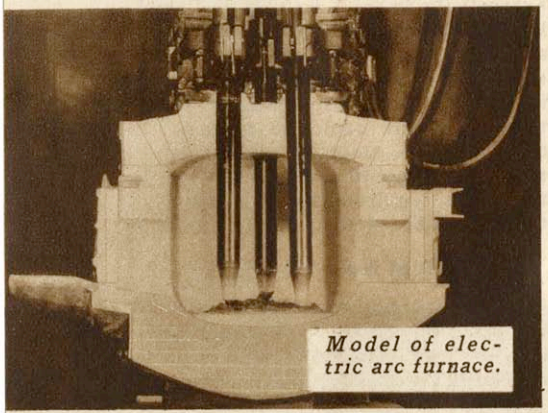
CARBON AND GRAPHITE ELECTRODES

The electric furnace is necessary for the manufacture of a great many things that have become every day commodities of our modern life. Calcium carbide used to produce acetylene, ferro alloys used extensively in steel making and particularly in alloy steels, the alloy steels themselves such as the now familiar stainless steels and many other products are made in electric furnaces. Possibly some of these products could be made without the aid of the electric furnace, but certainly many could not because temperatures are required that are far beyond those possible with ordinary fuels.

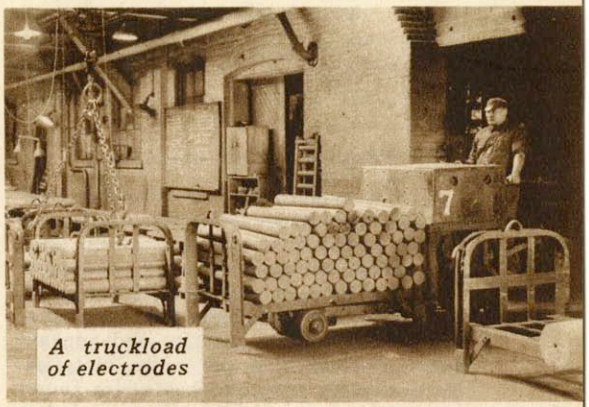
Heat from Electricity

In the electric furnace electricity takes the place of ordinary fuels such as coal, oil, or gas. Its use makes possible obtaining the very high temperatures

necessary. In general the electricity is changed into heat in the furnace by one of two methods. In one the resistance of the material being treated to the flow of electric current is used to change electricity into heat in exactly the same way as the resistance of the filament of an electric light changes the electric current into heat and light. In the other electricity is made to jump over a gap and form an arc which gives heat and light as does an ordinary arc lamp. Either one or the other of these principles or a combination of the two is used in practically all electric furnaces. Of course as the amount of electricity used in a commercial electric furnace is many thousand times as great as that used in an incandescent or arc lamp, the



Model of electric arc furnace.



A truckload of electrodes

amount of heat produced is proportionately greater. Many modern electric furnaces use more electricity in one furnace than would be used in a town of 10,000 inhabitants. Naturally this will produce enough heat to raise a large quantity of materials to a very high temperature.

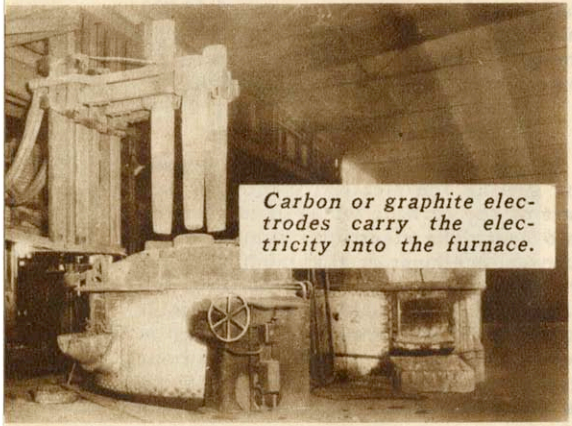
Carbon the Conductor

In any case, some means must be used for getting the electricity into the hot part of the furnace where it is changed into heat. The electricity comes to the furnace on copper or aluminum bars, but we cannot just continue these into the furnace, as they would immediately melt at the high temperature. Something is needed that will carry electricity without itself heating up,—that is, what is known as a good conductor—and that will not

melt at the temperature maintained in the furnace. Carbon answers both these requirements, and the pieces of carbon used for this purpose are called "Electrodes."

Familiar Forms of Carbon

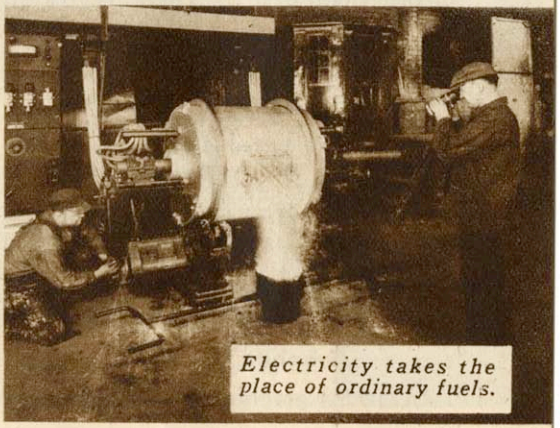
Carbon is a very interesting material in that it exists in three distinct forms. Ordinary coal or charcoal is carbon. Graphite from which lead pencils are made is carbon, and the diamond is pure carbon. All these materials with such distinctly different properties and appearance are basically the same material. Naturally the diamond has never found extensive use as electrode material, but both ordinary carbon and graphite are successfully used for this purpose.



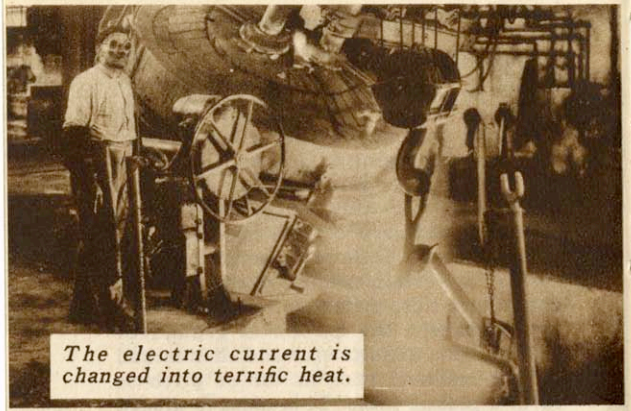
Carbon or graphite electrodes carry the electricity into the furnace.

Carbon Electrodes

National Carbon Company, Inc., and Acheson Graphite Corporation, both units of Union Carbide and Carbon Corporation, manufacture electrodes of carbon and graphite. Carbon electrodes are made by first selecting a proper form of carbon for this purpose. Various forms of ordinary carbon may be used, but care must be used in selecting such forms for certain definite properties and characteristics. After certain preliminary treatment the carbon is ground or crushed to a definite size and then mixed with a material such as tar or pitch to form a plastic mass. This mass is placed in a large press, at one end of which is an opening the size and shape of the electrode to be manufactured. The plastic



Electricity takes the place of ordinary fuels.

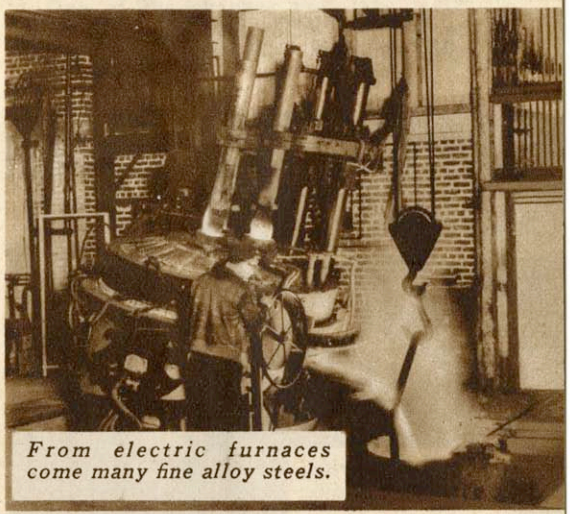


The electric current is changed into terrific heat.

mass is thus pressed through this opening and takes the form of the desired electrode, being cut off as it comes out to the length desired. These lengths of electrodes are then very, very slowly baked in fuel fired ovens for many days until the tar or pitch which made the mass plastic has itself become changed to hard carbon. After many days of slow cooling these baked electrodes are removed from the ovens in the form of solid, uniform pieces of pure carbon. These pieces after proper cleaning, inspection, and machining to allow them to be joined together, form the carbon electrodes that are used in many types of electric furnaces.

Graphite Electrodes

In making graphite electrodes, advantage is taken of another peculiar property of carbon. If ordinary forms of carbon such as coal or coke are heated to a sufficiently high temperature they change into the graphite form of carbon and while still remaining nothing but carbon, take on considerably different properties. Therefore, in order to make a graphite electrode, all that is necessary to do is to start with a properly made carbon electrode and heat this up to the temperature at which carbon is changed into graphite. In doing this, because carbon does not melt at any temperature, practically no change in form or shape takes place and the electrode that was origin-



From electric furnaces come many fine alloy steels.

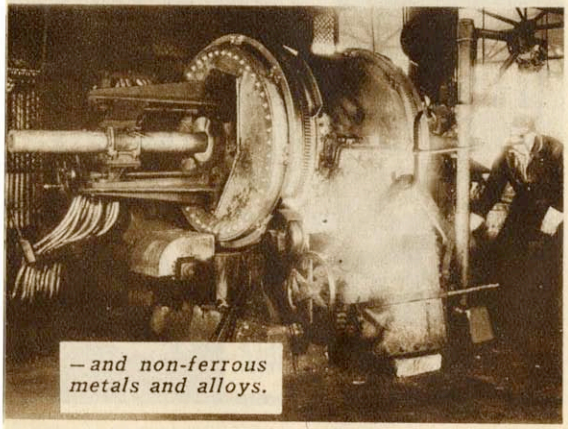
ally a solid uniform piece of pure carbon is now a solid uniform piece of pure graphite. Very high temperatures obtainable only in the electric furnace are necessary to cause this change and a different class of raw materials must be selected to begin with for the manufacture of carbon electrodes that are subsequently going to be converted into graphite.

After the graphitizing process the graphite electrodes are cleaned, inspected, and machined exactly as in the case of carbon electrodes.

Use in Electric Furnace

Either carbon or graphite electrodes may be used in most types of electric furnaces. Just which type is selected depends on a great many factors having to do with the type of electric furnace being used and the class of product being made. The proper kind and size of electrode to be used on an electric furnace can be determined only by a careful engineering study of the furnace operation. Both National Carbon Company, Inc., and Acheson Graphite Corporation have had years of experience in the manufacture and application of both carbon and graphite electrodes and are in excellent position to give unprejudiced advice as to the best type and size of electrode to use in any particular furnace.

One of the changes that take place when the carbon electrode is converted into a graphite electrode is that its elec-



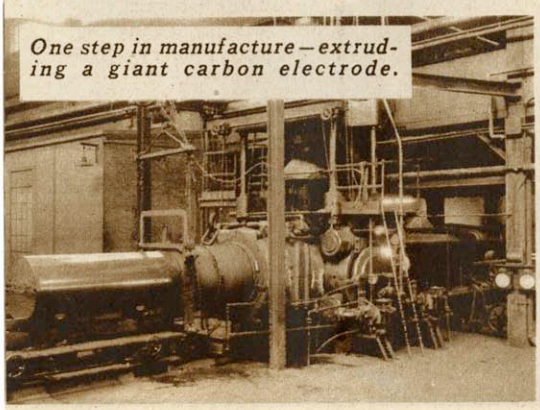
— and non-ferrous metals and alloys.

— and steel and iron for castings.

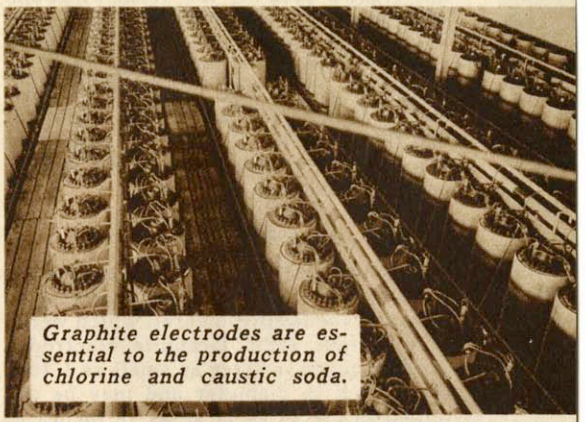
trical conductivity or the ease with which it allows electricity to flow through it is increased about four times. This means that for a given amount of electric current that is to be carried into the furnace a much smaller graphite than carbon electrode can be used. For this reason graphite electrodes are not made in such large sizes as are carbon electrodes as no electric furnace has yet been developed using electric currents larger than could be safely carried on the larger sizes of graphite electrodes made at the present time.

Use in Electro-Chemistry

Another very extensive use for graphite electrodes is in the production of chlorine and caustic soda by breaking up ordinary salt by means of the electric current. Ordinary salt consists of the two elements, sodium, and chlorine, and when an electric current is passed through a concentrated solution of salt these two elements separate from each other, one going to the electrode carrying the current into the solution, the other to the electrode by which the electric current leaves the solution. Graphite electrodes are used almost universally as the electrode at which the chlorine is given off. Although chlorine is a very active chemical violently attacking practically all metals, it has no action on graphite. Graphite, being a good conductor of electricity and not being attacked by the products of the electrolytic cell is therefore an ideal material for this purpose. In the electric furnace graphite and carbon electrodes are almost



One step in manufacture—extruding a giant carbon electrode.



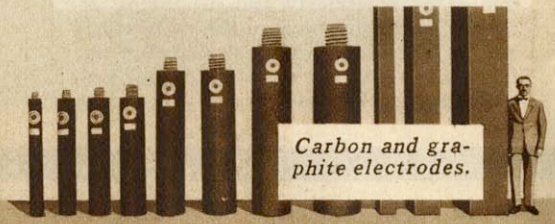
Graphite electrodes are essential to the production of chlorine and caustic soda.

universally used in the form of round rods, while for use in the production of chlorine by the method described above they are usually used in the form of plates or slabs. The fact that graphite electrode material can be very easily cut and shaped makes it possible to build up electrodes for this purpose of almost any form desired.

All Sizes

Carbon electrodes are made in sizes from 1 16th of an inch in diameter up to pieces 40 inches in diameter, which weigh several tons each. Graphite electrodes are also made in sizes as small as 1 16th of an inch in diameter and may be obtained in pieces as large as 18 inches in diameter and 6 feet long. The largest sizes of both carbon and graphite electrodes will carry without trouble the largest electric currents used in electric furnaces today.

The development of carbon and graphite electrodes has made possible the operation of the modern electric furnace and electrolytic cell. Without this development these could not have operated and many products which are now of common daily use and which add greatly to the pleasure of living could be obtained only by means so expensive as to render their use practically prohibitive.



Carbon and graphite electrodes.

If the manufacture of your products requires the use of carbon or graphite electrodes, we shall be glad to give you further information. Ask for it at the Union Carbide and Carbon Corporation exhibits at A Century of Progress, or write to:

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