forming other planets, these figures are not high.

The great infrastructure projects proposed by Mitsubishi Research Institute require tens of millions of tons of steel. If these projects are going to go through in the next decade, we must see a fantastic leap in U.S. and world production of steel, aluminum, and other metals. This will not be possible, by building more plants along the lines of those currently in use in the United States, Japan, or elsewhere. It is absolutely necessary to take immediate steps to build new steelmaking plants, that can be constructed more quickly and cheaply and that operate at higher efficiencies and higher labor productivities, to meet the challenge of world steel needs.

Furthermore, to make up the world infrastructure deficit, requires more than steel. In the same way that its production must skyrocket, so must that of cement, aluminum, and other products.

Steel, and all these other metals, is now produced with obsolete technology. We must deploy new technologies that

# What is a plasma torch?

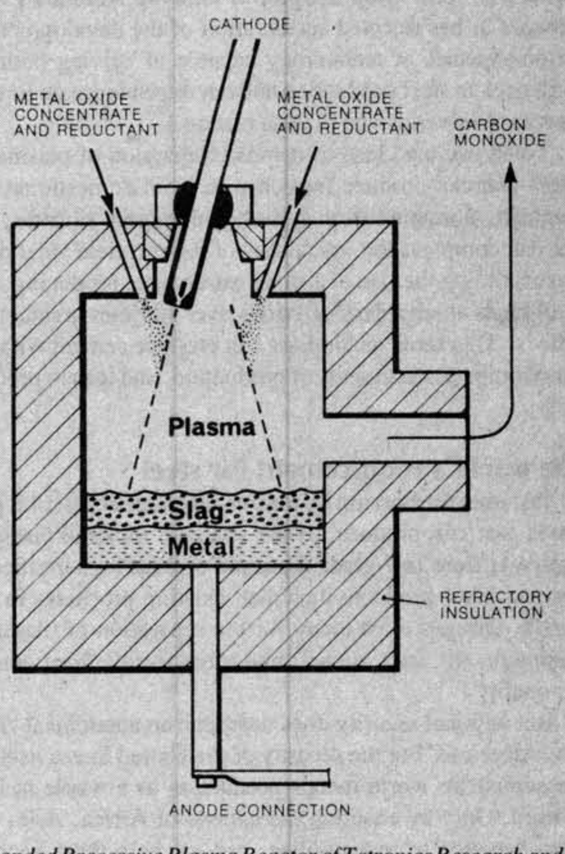
Traditionally, the energy from the combustion of fossil fuels, mainly heat, has been used for raw materials extraction, reduction, and processing. Conventional methods to produce energy generate heat by the combustion of fossil fuels. In 1968, two scientists, William C. Gough and Bernard J. Eastlund, proposed harnessing the unique properties of the ultra-high-temperature fusion plasma to meet the energy, materials, and fuels needs of the future. Fusion, the fusing of isotopes of hydrogen at a temperature of tens of millions of degrees, produces not only heat, but also a full array of electromagnetic radiation, charged particles, and neutral particles at high energy levels, as well as electric power by conventional or advanced conversion methods.

The unique by-products of the fusion process can be used to reduce metal ores, for chemical processes, and bulk materials separation. Unlike the fusion energy of the sun, controlled fusion plants on Earth can be "tuned" to produce more or less of various by-product particles and radiation, depending upon what is required.

But the plasma torch does not require nuclear fusion reactors, as subsequent research and development have shown. The plasma torch produces a flow of ionized gas (a gas with electrons stripped off its atoms), that can be used to reduce metals and perform other useful functions. The species of plasma torch discussed in this article, is powered by conventional electricity. It generates a direct current (DC) arc discharge plasma; the plasma, flows from cathode to anode, as shown in the Figure. It plasma is generated from a neutral gas, such as argon. In a small 40 kilowatt laboratory plasma reactor, there might be an arc voltage of 100 volts between cathode and anode, with the plasma carrying an arc current of 300 amperes. The name "arc discharge plasma" originates from the effective electric discharge that occurs from cathode to anode by means of the presence of the plasma as a conductor. The arc voltage and current ionize the gas and produce the plasma flow.

By pulsating the arc voltage and/or current, it is possible to vary the electrodynamic action of the plasma jet emitted by the cathode, and so tune such action to the specific ore being reduced, as one would a radio.

In addition, rotation of the plasma arc (as is done in the device illustrated) increases the amount of time that solid ore particles are entrained in the plasma.




*Expanded Precessive Plasma Reactor of Tetronics Research and Development Co. Source: Foster Wheeler Corp., Heat Engineering, Oct.-Dec. 1978.*