The efficiency of the coil is increased by placing in shunt with the secondary circuit a condenser composed of 16 pieces ordinary 10-inch by 12-inch window glass, "double strength." Eight sheets of tinfoil, 8 inches by 12 inches, are pasted on seven sheets of glass, allowing one inch as margin on three sides; on the fourth (long) side the tinfoil projects over the edge of the glass; assemble the sheets of glass together, first a blank sheet, then one with foil on, leaving the projecting edge lapping over on the right-hand side, then another blank sheet, then one with foil on with the projecting edge lapping over on the left-hand side; continue to build the pile, and when complete there will be four sheets of foil projecting on the right side and three on the left. Solder those on each side together and wires to them, keeping the wires and foil always more than six inches away from each other outside of the condenser; mount the condenser in a box made of red fibre so as to keep the plates from being disturbed; make the box oil proof and fill it with rosin oil (this last can be dispensed with where moisture is not prevalent.) The condenser is to be placed in shunt between the terminals of the coil.

Cells of storage battery having a capacity of 50 volts and 10 amperes, or current direct from a lighting circuit through 5 to 6½ ohms resistance, should be used to excite the coil; the circuit breaker motor invariably using a single storage cell to operate it. With the above mentioned current the secondary circuit with condenser in circuit will spark five inches through air, its power being sufficient to excite vacuum tubes for radiography.

Instead of a coil for producing high potentials a "static" machine such as a "Toepeler-Holtz" glass disc, or a "Jacobi" tube machine, may be used; the only objection to a "static" machine being the liability of its losing its charge from condensed moisture on its standards.

Vacuum (X-ray) tubes are produced and sold very cheaply by the various incandescent lamp manufacturing companies.

The above described arrangement provides a cheap but efficient induction coil which will stand ordinary usage.

ALUMINUM.

SOME OF ITS CHARACTERISTICS.

When acted on by attrition with sand or hard clay rock containing silica, aluminum corrodes. An interesting proof of that is to draw lines upon glass with a piece of the metal, using a heavy, steady pressure; the result of which is to leave a groove in the glass which may be seen and felt. When melted in an atmosphere of steam or "carbonic acid" gas, the metal decomposes those compounds and forms oxide; a thin film of fluor-spar, or even common salt, will act as a protection. Eventually "black lead" crucibles are attacked by the metal, and when used for a considerable length of time become honey-combed, dissolving the clay and leaving the black lead intact. Aluminum is attacked superficially by salt or sea water; but the corrosion is probably due to a small percentage of sodium, which is deposited from the electrolyte simultaneously with aluminum. Newly fractured aluminum has a grain hardly distinguishable from the best steel except by its color.

The metal is not readily attacked by vegetable acids, and therefore is eminently suitable for culinary purposes. When in use for a time it assumes a light gray blue color, which is hardly pleasing to the eye, and therefore spoons, forks, etc., made of the metal are not very desirable.

It is well nigh impossible to plate other metals on aluminum. The writer, who is a practical plater, attempted to copper, gild and silverplate some small articles, but met with dire failure. All sorts of baths, with greater or less voltage, acted the same. The nearest satisfactory result was obtained with copper, using a cyanide bath, with a potential of 7 volts. The copper was deposited in an even, adherent film, but after a few minutes it began to scale off, and finally, in less than two days, the copper had all disappeared, leaving the surface of the aluminum in its natural state. The other metals would not adhere. Aluminum cannot be used to plate other metals with, in a satisfactory manner, even as an alloy, although a Philadelphia concern claimed and published a description of what they considered a workable process, but the proportion of aluminum to tin in the alloy was ½ to 99½.

As a conductor of electricity, aluminum is less valuable than copper, area being considered, but weight for weight, aluminum is twice as good as copper.

At present there is only one workable process for the production of aluminum, it being the reduction of alumina (oxide) dissolved in a fused bath composed of calcic, sodic, and aluminic fluorides by electrolysis. The oxide may be reduced directly by electricity, but unfortunately it rises to the surface of the fused oxide and volatilizes. The action of the bath of fused salts is to serve as an intermediary substance, which is decomposed by the current and the more electropositive metals. Calcium and sodium deposit aluminum, in turn combining with the fluorine, and the freed fluorine combines with the metal in the alumina, replacing the oxygen, which combines with the carbon of the anode, forming carbonic oxide which escapes into the air. The flux or solvent bath is practically constant, only requiring renewal in several weeks operation. Calcic carbide* is formed as a secondary product which deposits on the bottom of the reduction pots, and eventually, by its resistance, increases the working volts until the bath must be renewed. The removal of the aluminum by a duct from the bottom of the pot is rendered impracticable by the formation of the calcic carbide, and carbon ladles are provided which are dipped down through the fused bath, and remove the metal in a more or less crude way. Owing to the decomposition of the bath and the presence of silica in the carbon anodes (caused by grinding the coke used in their making with buhr stones), the metal seldom is over 98.5 per cent. pure, the impurities being carbon (*as carbide of aluminum, and graphite*), *sodium*, *silica* and occasionally iron. Chemically-pure metal can only be obtained by enormous expenses, and then not always when desired.

The horse-power consumed was given some years ago by Capt. A. E. Hunt, pres. of the Pittsburg Reduction Co., at the enormous expenditure of 22 E. h.-p. per hour. No doubt by this time that figure has been cut in two, but even then it is 33 per cent. greater than the theoretical; for the voltage required is 4.32, and current is 1,394 (roughly) ampere hours, and the watt-hours expended is 6022.08 against 16412 watt-hours in 22 E. h.-p. hours. Until a process of direct reduction is found aluminum can hardly expect to rank

*Calcic carbide is the compound used in making acetylene.