

UNITED STATES PATENT OFFICE.

LUDWIG MOND, OF LONDON, ENGLAND.

PROCESS OF MAKING COMPOUNDS OF NICKEL AND CARBON MONOXIDE.

SPECIFICATION forming part of Letters Patent No. 455,227, dated June 30, 1891.

Application filed November 11, 1890. Serial No. 371,096. (No specimens.)

To all whom it may concern:

Be it known that I, LUDWIG MOND, manufacturing chemist, a subject of the Queen of Great Britain, residing at Regent's Park, London, in the county of Middlesex, in the Kingdom of England, have invented a certain new and useful Improvement in a Process of Manufacturing a Compound of Nickel and Carbonic Oxide, of which the following is a specification.

This invention is a new discovery in science and relates to a new compound of nickel with carbon monoxide. The method of obtaining it is as follows:

In treating ores which contain the nickel in combination with sulphur or arsenic or other elements of the same nature these ores have first to be treated so as to convert the nickel into oxide by the usual methods. After such treatment, and in the case of all other ores or substances which contain the nickel in the form of an oxide or salt without such treatment, the oxide or salt is reduced to the metallic state in any convenient manner, such as by treating it with carbonic oxide or with hydrogen or a hydrocarbon or a gaseous mixture containing these gases at a temperature of between 350° and 400° centigrade. In treating oxalates of nickel these may be heated by themselves to the temperature required for their complete decomposition. In this manner the metallic nickel is obtained in a very finely divided state particularly suitable for the subsequent operations. Substances containing metallic nickel obtained by other methods should be finely comminuted before proceeding with the extraction process hereinafter described. Any substance containing metallic nickel obtained in this or any other manner is treated at a temperature below 150° centigrade with carbonic oxide gas, which may be mixed with other gases, but should be free from oxygen or halogens. The nickel combines with the carbonic oxide and forms a readily-volatile compound called "nickel-carbon oxide," which is easily carried off by the excess of the gas employed. This compound forms at all temperatures below 150° centigrade, even below 0° centigrade, and is very freely obtained at ordinary atmospheric temperature; but I prefer to work at about 50° centigrade. None of the impurities

in the nickel or the oxide (not even the cobalt) are in the least acted upon by the carbonic oxide, but remain behind after the nickel has been volatilized. The treatment is preferably carried on in a chamber or cylinder revolving on a horizontal axis or in one provided with a stirring or agitating device, whereby the pulverulent matter shall be freely and thoroughly exposed to the gas. After some time the action of the finely-divided nickel upon carbonic oxide becomes less energetic. It is then heated up to 350° to 400° centigrade in a current of carbonic oxide or hydrogen and cooled down again to ordinary temperature, by which means its energy is restored.

The vapors of nickel-carbon oxide mixed with carbonic oxide obtained as stated are condensed by passing them through any convenient cooling apparatus, if desired, under pressure, so as to hasten the condensation. It is preferable to effect this condensation at a temperature below 0°—say—20°—which can easily be effected by artificial refrigeration of the condensing apparatus. In this way the nickel-carbon oxide is obtained as a colorless liquid of the composition NiC_2O_4 , which boils at 43° centigrade and solidifies at—25°. Its specific gravity is 1.3185 at 17° centigrade.

The vapor of the new compound when heated to 180° centigrade decomposes into nickel and carbon monoxide of the formula CO.

The compound is useful for obtaining nickel therefrom either in the form of masses, plates, or nickel-plating, and these uses form the subject of other applications contemporaneous with this.

I declare that what I claim is—

1. The method of manufacturing nickel-carbon oxide, which consists in roasting nickel ore till it is oxidized, then exposing it to the reducing action of carbon monoxide, hydrogen, or a hydrocarbon at a temperature of about 350° to 400° centigrade, then roasting the reduced ore to below 150° and treating it with carbon monoxide (reheating the reduced ore to about 350° whenever the action of the cold carbon monoxide becomes sluggish) till the nickel is extracted, and condensing the vapors.

2. The method of manufacturing nickel-carbon oxide, which consists in exposing an oxide of nickel to the reducing action of carbon

monoxide, hydrogen, or a hydrocarbon at a temperature of about 350° to 400° centigrade, cooling the reduced oxide to below 150° centigrade, and treating it with carbon monoxide.

3. The method of manufacturing nickel-carbon oxide, which consists in exposing finely-divided nickel to carbon monoxide at temperatures below 150° centigrade.

4. The method of manufacturing nickel-carbon oxide, which consists in exposing finely-comminuted nickel to a current of gas containing carbon monoxide, but free from uncombined oxygen and halogens, and condensing the product, substantially as described.

5. In the process of obtaining nickel-car-

bon oxide, exposing a largely-extended surface of nickel to carbon monoxide, and, when the action becomes sluggish or ceases, heating the nickel to about 350° centigrade in a current of hydrogen, carbon monoxide, or hydrocarbon, and after cooling treating it with carbon monoxide as before.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

LUDWIG MOND.

Witnesses:

WM. P. THOMPSON,
JOHN HAYES.