tain this temperature. In the plant at Smethwick the volatilizer was made the same size as the reducer, but in the new plant it is somewhat smaller.

The decomposer has been devised with much care, and has, in its present form, only recently been patented. The nickel is deposited in it, from its gaseous compound with carbon mon oxide, on granules of ordinary commercial metal. The arrangements by which this is effected are very ingenious, and may be described almost in the words of Dr. Mond's latest patent. The object is to obtain metallic nickel from nickel carbonyl in the form of pellets, which are specially suitable for the production of nickel alloys. For this purpose gases containing nickel carbonyl are passed through granulated nickel, which is kept at the temperature required for the decomposition of the carbonyl —about 200° C. The nickel which thus separates from the carbonyl becomes deposited on the granulated nickel, which consequently increases in size. In order to prevent cohesion of the granulated nickel, it is kept in motion. When a number of the pellets have attained a convenient size, they are separated by sifting without interrupting the depositing operation, the smaller granules being returned to receive a further deposit from the nickel carbonyl. A convenient form of apparatus for effecting the process described is shown in Figures 3, which represent vertical sections of the apparatus on planes at right angles to each other. A is a cylindrical vessel, preferably built up of short cylinders, *a a*, bolted together; it contains a central tube, C, provided with gas outlet holes, O, through which the gas containing nickel carbonyl, entering at the gas inlet, B, passes into the vessel which is filled with shot, or small granules, of nickel. The gas permeates through the interstices between these granules, and is brought into intimate contact with them, and when the nickel carbonyl is decomposed the nickel is deposited on the granules. The gases finally escape through the outlets, L, into the gas-exit pipe, M. In order to prevent the granules from cohering, they are kept slowly moving by continuously withdrawing some of the granules from the bottom of the cylindrical vessel, A, by means of a right and left-handed worm conveyor, U, which delivers the granules into two sifting-drums, N. The smaller granules fall on to the inclined plane, W, and collect at the base of the elevator, E, which conveys them again to the top of the cylinder, A, and feeds them through the feeding hole, X. In order to avoid the deposition of nickel from the nickel carbonyl in the central tube, C, it is kept cool by causing water to circulate down the tube, F, and up through passages F[1], formed in the central tube, to the water outlet, F[2]. The cylindrical vessel, A, is surrounded by a wrought-iron casing, Q, which forms heating spaces, H, communicating with heating-flues, P, which are so arranged that the temperature of each cylinder can be separately regulated by dampers, so as to maintain the temperature of the granules of nickel contained in the vessel, A, at about 200° C., at which temperature the nickel carbonyl is decomposed. With a view to ascertain whether the cylinder, A, is full of granules, a rod, R, is fixed to the spindle of an external handle, which can be turned partly round, so that if the operator feels resistance to the motion of the R, it is certain that the granules extend to that height. The appliance used for depositing the nickel originally consisted of a series of retorts lined with thin steel sheets, on which the nickel was deposited in layers. It was found, however, that the metal so obtained was very difficult to cut, and the apparatus above described was accordingly devised.

A magnified section of a granule of nickel shows that there is a core of nickel which under higher magnification shows a crystalline and convoluted structure, and this core is surrounded by concentric layers. The central core is ordinary commercial nickel, and the layers are nickel deposited from its carbonyl. In some cases granules of deposited nickel are found without any central core. These have grown from minute fragments of deposited nickel which have become detached during the course of deposition.

The water-gas used in the reducer is generated in gas-producers. Anthracite is used to decompose the steam, and the water-gas is collected in a gas-holder, whence it is taken to the reducing tower, to which reference has just been made. This gas contains, on entering the reducer, about 60 per cent. of hydrogen. The reducing operation is so regulated that only a small quantity of hydrogen remains in the escaping gas, as a rule not more than 5 per cent. to 10 per cent. This waste gas is subjected to the action of a fine water-spray, which condenses the steam generated by the combustion of the hydrogen in the water-gas. Part of this waste gas is used for making the carbon-monoxide required in the volatilizer, by passing it through the C O retort charged with incandescent charcoal, which reduces the carbon dioxide contained in the waste gas, and this increases the amount of carbon-mononoxide in it. The gas issuing from this retort contains about 80 per cent. of carbon-monoxide, and is stored in another gasholder, which communicates with the main circuit of carbon-monoxide gas. The main circuit of the carbon-monoxide passes through the volatilizer already referred to, where the nickel is taken up. The carbon-monoxide, now charged with nickel, passes through a filter to separate the fine particles of matte-dust from the gases, then through an apparatus called the decomposer, and so described in the Figure. In this decomposer the nickel taken up in the volatilizer is deposited. The gas now deprived of its nickel passes to the C O blower, Figure 1, which sends the carbon-monoxide to the volatilizer in order that it may take up a fresh charge of nickel.

The solid material from which the nickel is being extracted is kept circulating through the reducer and volatilizer for a period varying between seven days and 15 days, during which time the oxides are gradually reduced to the metallic state and the nickel volatilized. When the material originally charged in has had the bulk of its nickel extracted it is run out through a rotary calciner roaster, Fig. 1, which converts the metals into oxides, so that they may be treated for the second time with sulphuric acid and carbon-monoxide. The ratio between the nickel and copper in the residues from the nickel extraction is practically the same as in the calcined Bessemer matte, with which the operations were started, but the amount of iron has increased by the removal of the copper and nickel, as the following figures show: Original matte contains, nickel, 35.27 per cent.; copper, 41.87 per cent.; iron, 2.13 per cent. After the first treatment of copper and nickel extraction, the quantities are, nickel, 35.48 per cent.; copper, 38.63 per cent.; iron, 4.58 per cent., and after the second copper and nickel extraction, nickel, 35.83 per cent.; copper, 35.56 per cent., and iron, 7.82 per cent. The amount of nickel extracted in these two cases was, after the first treatment 61 per cent., and after the second treatment 80 per cent. of the nickel present in the original matte. It must be remembered, however, that in the second treatment only one-third of the original amount remains to be treated, while the final residue is only one-tenth. To avoid the formation of iron carbonyl, the temperature in the reducer has to be kept very low, and if this is done the nickel extracted from a matte originally containing as much as between six per cent. and ten per cent. of iron will not contain more than 0.5 per cent. of iron. If the amount of iron in the residues rises above this percentage, the extraction of the nickel is very much delayed, on account of the low temperature which must be maintained in the reducer. It is necessary, in such a case, to re-smelt the residues before proceeding with the extraction of the nickel and copper. The following are analyses of the deposited nickel:

	I.	II.
	Per cent.	Per cent.
Nickel	99.82	99.43
Iron and (Al_2O_3)	0.10	0.43
Sulphur	0.0068	0.0099
Carbon	0.07	0.087
Insoluble residue	....	0.026

The experimental plant at Smethwick has been working for some time, and about 80 tons of nickel have already been extracted in it from different kinds of matte. The results obtained were quite satisfactory, and they point to the conclusion that the process is fully able to compete with any other process at present in use for the production of metallic nickel.

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