To all whom it may concern:

Be it known that we, Roy H. Brownlee and Roy H. Uhlinger, citizens of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, and individually, have invented certain new and useful Improvements in Processes of Making Nitrogen and Carbon Dioxid, of which the following is a specification.

Our invention consists of an improved method or process of making nitrogen and carbon dioxide by utilizing the products of combustion of internal combustion or explosion engines, whereby to produce the nitrogen and carbon dioxide as by-products of the original fuel, in the manner more fully hereinafter described.

While the process of the invention may be carried out in connection with various designs of mechanism, it will be rendered clear by reference to the accompanying diagrammatic drawing, showing the principal elements employed.

In practising the process any suitable fuel is used, as natural, producer, water, coal, or other carbonaceous gas or volatile oil or other suitable carbonaceous substance or hydro-carbon and is first mixed with a suitable amount of air, then compressed, and exploded in the explosion chamber or chambers of an internal combustion gas or oil engine, for the production of power, in a well-known manner.

The explosive mixture as supplied to the engine may be so proportioned as to its air content, that when combustion has occurred, there will be left in the resulting products of combustion a minimum excess of oxygen and combustible gases. This may be readily effected by adjustment of the mixer. However, the proportions of air to fuel used in the explosive engine may be varied between wide limits, so that equivalent proportions or an excess of either may be used. When required, a sufficient quantity of additional air or a mixture of gas and air is supplied to the products of combustion from the engine, and complete combustion of the resulting mixture is then brought about by bringing it into intimate contact with a mass of suitable hot refractory material, as broken bricks, pottery, or similar substance. These gases, after such treatment and further combustion are converted into nitrogen and carbon dioxide, and are then passed into and through chambers or absorption towers wherein the carbon dioxide is absorbed for making chemical compounds. This may be done as a means for separating the gas from the nitrogen, or it may be separated by passing through towers containing calcium oxide and hydroxid (as lime) from which practically pure carbon dioxide may be recovered by heating, or as a step in the manufacture of useful carbonates. The gaseous mixture may be passed through towers containing lime and carbon dioxide, and then compressed in the carbon dioxide liquefied, by suitable treatment in appropriate mechanism, and thus separated from the nitrogen.

By either of the above treatments or steps practically pure nitrogen is produced as the remaining product, and may be utilized in any desired manner.

Figure 1 is a sectional diagrammatic view of an installation adapted to carry out the process herein. Fig. 2 is a detail view showing a compressor and coil.

Referring to the diagrammatic drawing, Fig. 1, 2 is an internal combustion engine to which the explosive mixture in suitable proportions is supplied in the usual manner from a mixer 3. The products of combustion pass by waste or exhaust pipe 4, to chamber 7 containing refractory material 8, through which the gases pass, effecting complete combustion. A branch pipe 5 furnishes additional reducing gas and a branch pipe 6 furnishes additional air to the products of combustion passing through conduit 4. These pipes are valve-controlled, and the amount of air, or air and gas, may be accurately regulated to effect complete combustion to produce a maximum amount of carbon dioxide. It will be understood that it is necessary to maintain the mass of incandescent material 8 in a highly heated condition. This is done, in the present case, by the combustion of a certain amount of fuel, quite independent of the remaining unconsumed gases coming over from the preliminary combustion, such fuel and air being supplied by the means just described. The resulting carbon dioxide and nitrogen pass from chamber 7 by conduit 9 to one or more chambers or towers 10 provided with a
water spray pipe 11 and suitable absorbent 12, where the carbon dioxide is absorbed, as described.

It will be understood that the invention is not limited to the utilization of the products of combustion of an explosive engine, but may be carried out with products of combustion from any other suitable source, as the furnace of a boiler, coke oven, etc.

In Fig. 2, the mixture from the refractory chamber 7 may pass through a cooling coil 13 and into a compressor 14 for liquefaction of the carbon dioxide and resulting separation from the nitrogen. While the separation of the carbon dioxide and nitrogen are ordinarily desirable, such steps are not essential in all cases. Thus, the mixture, prior to separation, consisting approximately of 90% nitrogen and 10% carbon dioxide, may be used in place of pure nitrogen, for example in fixation of pure nitrogen with hydrogen to make ammonia, when a part of the ammonia will appear as ammonia carbonate, which is a valuable commercial product.

What we claim is:

1. The process of making carbon dioxide and nitrogen consisting in mixing a suitable carbonaceous substance with air in equivalent proportions to support eventual complete combustion of the mixture and exploding the mixture in an internal combustion engine, adding fuel gas to the products of combustion, and then effecting subsequent complete combustion of the mixture by passing it through a mass of highly heated refractory material with just sufficient air to effect complete reaction of the gases to produce a maximum proportion of carbon dioxide, and then separating the carbon dioxide and nitrogen.

2. The process of making carbon dioxide and nitrogen consisting in mixing a suitable carbonaceous substance and air, effecting combustion of the mixture in an internal combustion engine, adding fluid fuel to the products of combustion and effecting subsequent complete combustion of the mixture by passing it through a mass of highly heated refractory material with just sufficient air to effect complete reaction of the gases to produce a maximum proportion of carbon dioxide.

In testimony whereof we hereunto affix our signatures in the presence of two witnesses.

ROY H. BROWNLEE.
ROY H. UHLINGER.

Witnesses:
C. M. CLARKE,
FRED'K STAUB.