

P. WINAND.
 APPARATUS FOR DECOMPOSING OXIDS OF NITROGEN AND THE LIKE.
 APPLICATION FILED JULY 22, 1908.

1,059,584.

Patented Apr. 22, 1913.

2 SHEETS—SHEET 1.

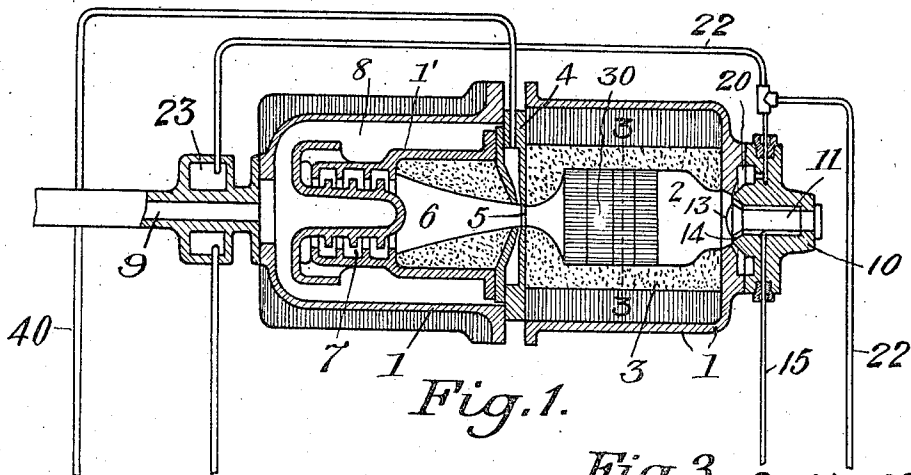


Fig. 2.

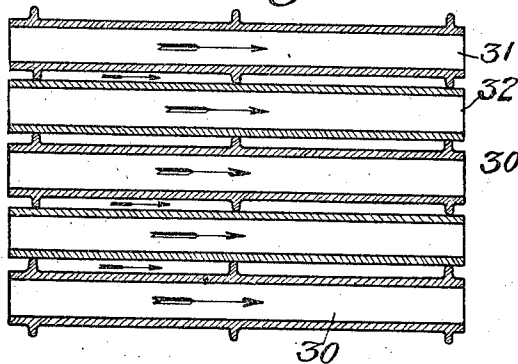


Fig. 3.

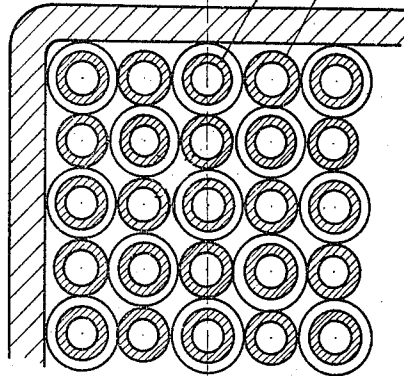


Fig. 4.

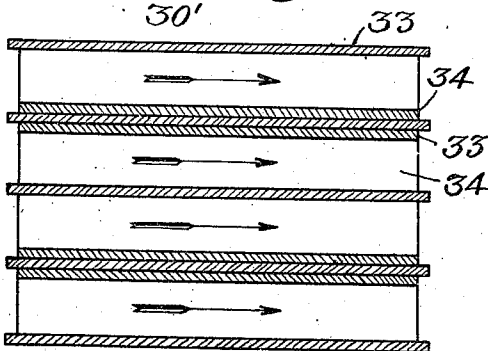
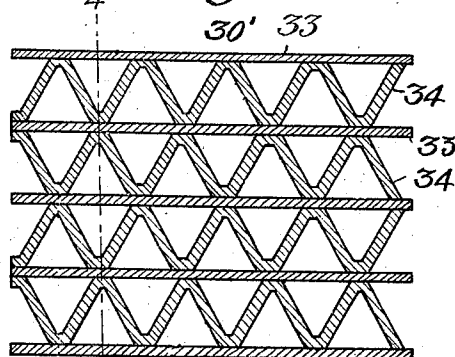


Fig. 5.



Witnesses:

[Signature]
 J. C. Schueren and

Inventor:

Paul Winand,
 by *[Signature]* Louis Goldbrough & O'Neill
 Attys

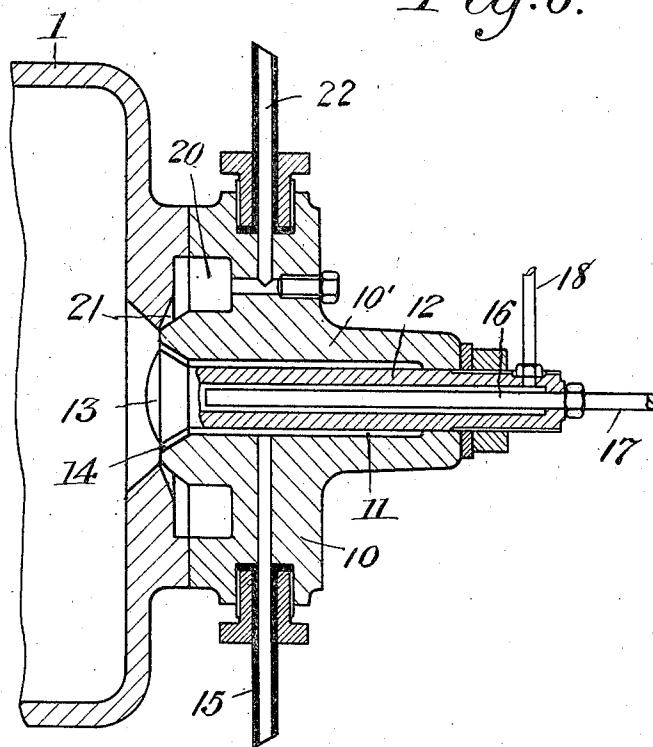
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2 SHEETS—SHEET 2.

Fig. 6.



Witnesses.

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APPARATUS FOR DECOMPOSING OXIDS OF NITROGEN AND THE LIKE.

1,059,584.

Specification of Letters Patent.

Patented Apr. 22, 1913.

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To all whom it may concern:

Be it known that I, PAUL WINAND, engineer, a subject of the King of Belgium, residing at 1 Sudermannstrasse, Cologne-on-the-Rhine, Germany, have invented certain new and useful Improvements in Apparatus for Decomposing Oxids of Nitrogen and the Like; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an improved process and apparatus for breaking up oxygen compounds such for example as the oxids of nitrogen, into gaseous mixtures which are rich in oxygen, by means of partial combustion with a fuel.

The invention is particularly applicable for use in connection with internal combustion engines installed on board submarine vessels or in inclosed spaces. In such cases it is necessary to supply the oxygen required to effect combustion of the explosive in the engine by means of concentrated oxygen carriers, instead of from the atmosphere, and for this purpose the liquid dioxid of nitrogen has been found particularly useful and efficient, but this compound, however, must be split up into its gaseous constituents before being admitted to the engine cylinder, otherwise it would seriously injure the engine.

The object of the present invention is to provide a simple and efficient method and apparatus, whereby oxygen compounds and more particularly dioxid of nitrogen, can be broken up into its constituents in a convenient, effective, and economical manner.

For the purpose of illustrating the invention, and exemplifying a type of apparatus suitable for carrying out the process aforesaid reference may be had to the accompanying drawings, in which,

Figure 1 is a longitudinal section of the apparatus, Fig. 2 is a longitudinal section on the line 2—2 of Fig. 3, Fig. 3 is an enlarged vertical section on line 3—3 of Fig. 1, Fig. 4 is a longitudinal section on line 4—4 of Fig. 5, Fig. 5 is a vertical section through Fig. 4, illustrating a modified form of catalytic apparatus, and Fig. 6 is an enlarged sectional view through one end of the apparatus illustrating the burner and its appurtenant parts.

Referring to the drawings, which are in-

tended to illustrate an efficient type of apparatus for carrying out the invention, 1 indicates a generally cylindrical casing of metal or the like, which is divided by a vertical partition, intermediate its ends, into two sections or chambers. The forward chamber 2 is provided with a lining of refractory material 3 and is in communication at its inlet end with a burner 10, to be hereinafter more fully described, and at its outlet end with a discharge opening 5 centrally disposed in the dividing partition 4, which latter also constitutes a spraying nozzle for cooling fluid, as will be explained. The second or rearward chamber formed in the casing 1 is divided into two sections, the first or inner section 6 being formed within a receptacle 1 secured to the intermediate partition 4, the initial portion of the chamber 6 being lined with refractory material so disposed as to produce a flaring effect in the chamber 6 toward a tortuous annular outlet 7 formed by a series of intermeshing baffles, which outlet 7 discharges into an outer chamber 8, which in turn connects with the pipe 9 leading to the internal combustion engine.

Located within the chamber 3 is a catalytic agent 30, which preferably consists of a body of silver substantially filling the rear portion of the chamber 2 and provided with longitudinal channels through which the gases may readily pass. This catalytic medium may, of course, be constructed in any desired or convenient form, and two satisfactory forms are illustrated in Figs. 2 to 5 inclusive. In the examples shown in Figs. 2 and 3 the catalytic consists of thin tubes of silver 31, 32, arranged in bundle like form of sufficient size to substantially fill the rear end of the combustion chamber 2, the bundle of tubes being held together by surrounding it at appropriate intervals with bands of silver wire. The tubes 31 are provided with peripheral flanges which serve as distance pieces to space them from the alternating plain tubes 32. The bundle of tubes is disposed in the chamber 2 with the axes of the tubes in the direction of the current of gases flowing through the apparatus.

Secured to the forward end of the casing 1 is a burner 10 adapted to supply fuel and the oxygen carrier to the apparatus. The burner, shown in detail in Fig. 6, comprises a nipple-like portion 10' suitably secured to the end of the casing 1, which nipple has a

central channel 11, the inner or discharge end of which is flared outwardly, and in said channel 11 there is located a central pin or stud 12 having a flared end or head 13, adjustable within the flared end of the channel 11 to form a flaring inlet discharge opening 14 into the combustion chamber 2. Concentrically disposed with respect to the channel 11 and the discharge opening 14 is a chamber 20, formed partly in the nipple 10' and partly in the end of the casing 1, and provided with an inwardly directed or converging outlet 21 adjacent to the discharge opening 14. Connected with the channel 11 and chamber 20 are supply pipes 15 and 22 respectively, for the fuel and the oxygen carrier. As indicated in Fig. 6, the central stud or pin 12 is preferably hollow in order to permit the same to be maintained cool by means of a circulation of water therethrough, which is effected by an inlet pipe 17 and an outlet pipe 18.

As hereinbefore indicated the chamber 1 is divided by a central partition 4, which latter is constructed as a hollow annulus with a central aperture 5 to permit the gases to pass from chamber 2 into chamber 6, said annulus having a discharge orifice adjacent the opening 5 to constitute a spraying nozzle for the purpose of cooling the gases, water being supplied to said spraying nozzle 4 by means of a pipe 40. The supply pipe 22 for the oxygen carrier may lead directly from the reservoir, containing the latter, to the chamber 20 in the burner, or in the alternative, it may be conducted through the hollow chamber 23 surrounding the outlet pipe 9 for the purpose of heating the material before it passes to the burner.

Instead of the particular form of catalytic device, illustrated in Figs. 2 and 3, the form shown in Figs. 4 and 5 may be employed, the latter comprising corrugated silver plates 34 separated by flat plates 33, the whole being so constructed as to substantially fill the rear portion of the combustion chamber 2 and afford a series of longitudinal channels through which the gases pass.

In carrying out the improved process, with the apparatus hereinbefore described, for the purpose of splitting up dioxid of nitrogen, for example, the fuel and the dioxid are introduced and commingled in the combustion chamber 2 by means of the burner 10, the fuel preferably being introduced as a liquid, such as fuel oil, supplied by pipe 15 and forced out of the burner in a divergent conical spray through the outlet 14 where it meets and commingles with the gaseous oxygen carrier supplied by a pipe 22 to the chamber 20 and directed into the combustion chamber 2 in the form of a convergent spray through the burner openings 21 adjacent to and surrounding the fuel outlet 14, whereby it breaks up and envelops the fuel and

is so commingled therewith that either complete or partial combustion may be effected, the temperature being regulated to the desired degree by means of water admitted by the pipe 40 to the jetting device 4.

As is well known in the art, dioxid of nitrogen, for example, may be completely broken up into its constituents by combustion, but this may be effected only at exceedingly high temperatures, something more than 1500° C. being required, and such temperature can only be effected by a considerable expenditure of fuel and dioxid of nitrogen. According to the present invention, however, the dioxid of nitrogen is partially broken up by a direct combustion in the chamber 2, the products being oxid of nitrogen (NO) and oxygen (O), the reaction taking place at the comparatively low temperature of 600° C. The oxid of nitrogen is subsequently split up into nitrogen and oxygen by means of the catalytic agent located in the combustion chamber. The preliminary breaking up of the oxygen carrier by direct combustion with a suitable liquid fuel is effected in the forward portion of the combustion chamber 2, and the gaseous products are then forced through the channels of the catalytic agent 30 where a complete dissociation of the NO is effected.

On account of the exothermic quality of the oxid of nitrogen the temperature is increased by the catalytic action. The silver tubes or plates constituting the catalytic agent being good conductors of heat serve to distribute the heat generated by this catalytic action uniformly throughout the body of the catalytic and thereby produce a relatively large hot zone in the combustion chamber, in which complete decomposition of the gases is effected. In order to effect an economical operation of the process and apparatus, it is desirable, of course, to maintain the temperature throughout the body of the catalytic at the critical point for effecting a breaking down of the oxid of nitrogen. The tubular form of the catalytic illustrated in Figs. 2 and 3 has been found quite satisfactory for this purpose, but the construction of the catalytic body illustrated in Figs. 4 and 5 is sometimes preferable, as this arrangement of alternate corrugated and flat plates of silver serves to produce a somewhat more regular and equable distribution of the heat, inasmuch as the heat generated by the catalytic action will be conducted throughout the body of the catalytic, both longitudinally and transversely by the peculiar arrangement of the plates, and the gases passing through the intermediate channels will be subjected at all points to a substantially or uniform heat sufficient to effect decomposition.

It will be particularly noted, in carrying out the process that the preliminary com-

bustion of the oxygen carrier with a fuel is effected at a relatively low temperature which serves to partially break up the oxygen carrier and that the subsequent or complete breaking up of the latter into its constituent gases is effected by the catalytic in which the necessary temperature to effect such complete decomposition is automatically maintained by the catalytic action.

10 The gaseous nitrogen and oxygen separated within the catalytic, as well as the products of the preliminary combustion, which latter comprise carbonic acid and water, pass through the central orifice 5 in the jetting apparatus 4, where atomized water admitted through pipe 40 and vaporized within the jetting device by the heat of the apparatus, serves to cool the gases to a temperature suitable to admit of their being used in the combustion engine. In the chamber 6 and labyrinth passage 7 a thorough mixing of the gases is effected and superfluous steam or watery vapor condensed, after which the mixture cooled to the desired temperature and diluted as required by means of steam or the like is conducted to the combustion engine or other desired point of use by means of pipe 9.

Although the invention has been described in connection with the particular form of apparatus illustrated, it will be understood that said invention is not limited to such apparatus but that the latter may be varied within wide limits without departing from the spirit of the invention.

What I claim is:—

1. In an apparatus for breaking up oxygen compounds such as dioxid of nitrogen into a gaseous mixture rich in oxygen, the combination with a combustion chamber, a catalytic therein, and a burner discharging into the said combustion chamber and having two passages respectively connected

with a fuel supply and with a supply of the compound to be decomposed and having concentric and mutually converging discharge ends.

2. In an apparatus for breaking up oxygen compounds such as dioxid of nitrogen into a gaseous mixture rich in oxygen, the combination with a combustion chamber, of a burner discharging into the said combustion chamber and having two passages respectively connected with a fuel supply and with a supply of the compound to be decomposed, and a catalytic located within the said combustion chamber and adapted to be traversed by the gases.

3. In an apparatus for breaking up oxygen compounds such as dioxid of nitrogen into a gaseous mixture rich in oxygen, the combination with a combustion chamber, of a burner discharging into the said combustion chamber and having two passages respectively connected with a fuel supply and with a supply of the compound to be decomposed, and a catalytic made up of a body of silver and having passages adapted to be traversed by the gases.

4. In an apparatus for breaking up oxygen compounds such as dioxid of nitrogen into a gaseous mixture rich in oxygen, the combination with a combustion chamber, means for supplying fuel and the compound to be decomposed in the form of spray into said combustion chamber, and a catalytic disposed in said combustion chamber and having a series of passages adapted to be traversed by the gases.

In testimony whereof I have affixed my signature, in presence of two witnesses.

PAUL WINAND.

Witnesses:

LOUIS VANDORN,
H. STELYER.