

DESCRIPTION

of the industrial invention bearing the title:

5 ELECTRO-PHYSICAL APPARATUS FOR THE ACTIVATION OF NITROGEN PERFORMING
CONVERSION OF NITRIC OXIDE CONTAINED IN THE EXHAUST GAS OF AN INTERNAL
COMBUSTION ENGINE

Among the pollutants present in the emissions of engines at internal combustion,
the nitrogen oxides (mix of NO and NO₂), generally known as NO_x, represent an
10 extremely worrying factor for both the intrinsic toxicity of the mixture and the
difficulty in removing them.

The latest restrictive regulations on the maximum amount of NO_x in the exhaust,
pose additional challenges to vehicle manufacturers since the usual devices
currently used do not guarantee so limited values and especially do not have the
15 ability to maintain tight parameters in run time.

To solve the problems of the different systems currently used, the attention has
been focused on a technological solution articulated in a serial-phases treatment.
The first phase will be carried out by means of a special device, which is the subject
of this invention, which performs the conversion of nitric oxide NO to nitrogen
20 dioxide NO₂.

Such conversion allows an easier and safer interception during further treatment
stages, which may employ catalytic converters and systems with more ability
effectiveness in NO₂ sequestering.

The apparatus, subject of this invention, operates electro-physically using only
25 single-phase alternating currents (A.C.) at high frequency and voltage.

Figure 1 displays the single-phase alternating current generator (ref. 9) that is
driven by pulley (ref. 6) through transmission belt (ref. 5) controlled by flywheel
(ref. 4).

The instant position speed detector (ref. 7) sends data to the position control system (ref. 8). Greater the rotation speed of the engine at internal combustion (ref. 1), greater is the volume of exhaust gases emitted through the conduit (ref. 2). Having to process a flow rate growing with the number of revolutions (R.P.M.) of the engine at internal combustion (ref. 1), it will necessary to have growing values of single-phase alternating currents for the circuits powered by single-phase alternating current generator (ref. 9).

The single-phase alternating current generator (ref. 9) is a multipolar type at high frequency and the single-phase alternating currents that it will generate will be proportional to the number of revolutions (R.P.M.), condition that allows the satisfaction of the devices working at different of revolutions (R.P.M.) of the engine at internal combustion (ref. 1).

The single-phase alternating current generator (ref. 9) supply the primary inductive circuit (ref. 10), that is connected to the secondary circuit (ref. 11). The ratio between inductances (ref. 10 and ref. 11) chokes, determines a high rise of voltage at the capacitor (ref. 12) terminals. The capacitors (ref. 13, ref. 14 and ref. 15) are connected to the inductances (ref. 16 and ref. 17) that constitute the primary inductance of high frequency resonant circuit.

The inductance (ref. 18) connected with the inductances (ref. 16 and ref. 17) supply a high voltage at high frequency to the terminal of the apparatus (ref. 3) subject of this invention.

The apparatus (ref. 3) subject of this invention supplied with single-phase alternating current at frequencies higher than 100 kHz and voltages higher than 20kV is capable of making a significant transformation of the molecular nitrogen included in the engine (ref. 1) exhausts to nitrogen N (atomic number 7) at active status.

Figure 2 displays the section of the apparatus (ref. 3 of **Fig. 1**) subject of this invention that is composed by two symmetrical cases (ref. 21); the latter acting as supports and insulation for the crossing metallic ducts.

The exhausts coming out from manifold (ref. 2 of **Fig. 1**) are subdivided into multiple parallel metallic ducts (i.e. four as the ones shown in **Fig. 2**). Each metallic duct (ref. 20 of **Fig. 2**) has the first segment with convergent conical shape followed by straight ferromagnetic tubes (ref. 23 of **Fig. 3**) surrounded by high intensity magnetic rings (ref. 25 of **Fig. 2**). The second segment of each metallic duct (ref. 20 of **Fig. 2**) has a divergent conical shape with angle α (ref. 27 of **Fig. 2**) that slows down the flow of crossing exhausts and raises the pressure before they merge into the convergent conical shape of the terminal part of the second segment of each metallic duct (ref. 20 of **Fig. 2**). Also, the second segment is followed by straight ferromagnetic tubes (ref. 23 of **Fig. 3**) surrounded by high intensity magnetic rings (ref. 25 of **Fig. 2**). The final segment of each metallic duct (ref. 20 of **Fig. 2**) has a convergent conical shape with angle β (ref. 28 of **Fig. 2**) lesser than angle α (ref. 27 of **Fig. 2**) to allow a further pressure increase at the end of each metallic duct (ref. 20 of **Fig. 2**).

The central axis of each metallic duct (ref. 20 of **Fig. 2**) is crossed by electrical wire (ref. 24 of **Fig. 2**) connected to the terminals of high frequency and high voltage circuit (ref. 18 of **Fig. 1**). Around the electrical wire (ref. 24 of **Fig. 2**), supplied with single-phase alternating current at frequencies higher than 100 kHz and voltages higher than 20kV, inside the two sections of straight ferromagnetic tubes (ref. 23 of **Fig. 3**) surrounded by high intensity magnetic rings (ref. 25 of **Fig. 2**), it is generated a rotating electric discharge. Under such conditions, in the two sections of straight ferromagnetic tubes (ref. 23 of **Fig. 3**) surrounded by high intensity magnetic rings (ref. 25 of **Fig. 2**) occurs the ionization of the molecular nitrogen included in the engine exhausts transforming it in nitrogen N (atomic number 7) at active status.

Figure 3 displays in details the device (ref. 22 of **Fig. 2** and **Fig. 3**) that convert the exhausts flow from laminar to a turbulent through a rotating whirling motion Ω . Such device is place inside both the two sections of straight ferromagnetic tubes (ref. 23 of **Fig. 3**) surrounded by high intensity magnetic rings (ref. 25 of **Fig. 2**).

5 The electrical wire (ref. 24 of **Fig. 2**) is in the center of the two sections of straight ferromagnetic tubes (ref. 23 of **Fig. 3**) surrounded by high intensity magnetic rings (ref. 25 of **Fig. 2**). In that area a condition of low pressure suitable for the activation of molecular nitrogen at optimal physical conditions (low pressure – high voltage – high frequency –strong magnetic field) occurs.

10 The active molecular nitrogen N^* , generated by the electrical discharges in the second section of straight ferromagnetic tubes (ref. 23 of **Fig. 3**) surrounded by high intensity magnetic rings (ref. 25 of **Fig. 2**), reacts with the nitric oxide NO that is inside the engine exhausts transforming it to nitrogen dioxide NO_2 as per formula:



15 The mix $NO_2 + N_2$ is collected in the outlet manifold (ref. 30 of **Fig. 1**); inside the manifold is installed a measuring sensor connected to a plug (ref. 19 of **Fig. 1**) placed on the outer surface of the same manifold. To such plug it is possible to connect an instrument to measure the percentage of NO_2 and N_2 .

With the apparatus (ref. 3 of **Fig. 1**) subject of this invention, we obtain the
20 conversion of nitric oxide NO to nitrogen dioxide NO_2 .

For making the catch of nitrogen oxides, generally known as NO_x , from exhausts it appears easier to catch the nitrogen dioxide NO_2 , consequently the apparatus of this invention has a convenient application as first stage of a treatment of integral catch of nitrogen oxides, generally known as NO_x , both with catalytic systems or
25 absorption on chemical solutions.

CLAIMS

1. We claim an electro-physical apparatus working at high frequency in a high voltage circuit (ref. 3 of **Fig. 1**) characterized by the ability to determine an ionization and activation of molecular nitrogen to obtain nitrogen N* which reacts selectively with nitric oxide NO that is inside the engine exhausts, transforming it to nitrogen dioxide NO₂ as per formula:



the apparatus comprising a ceramic insulation body (ref. 21 of **Fig. 2**) , inside which multiple parallel metallic ducts (ref. 20 of **Fig. 2**) are placed: within each duct an electrical wire is placed (ref. 24 of **Fig. 2**); each parallel metallic duct has two segments consisted by straight ferromagnetic tubes (ref. 23 of **Fig. 3**) surrounded by magnetic rings (ref. 25 of **Fig. 2**); upstream of each straight segment is a convergent conical shaped segment; in each convergent conical shape segments (ref. 27 and ref. 28 of **Fig. 2**) of metallic ducts, a device (ref. 22 of **Fig. 2** and **Fig. 3**) that converts the exhausts flow from laminar to a turbulent through a rotating whirling motion Ω , is placed.

2. We claim an electro-physical apparatus **as claimed in claim 1** which comprises an inductive capacitive circuit resonant at high frequency with increasing values from the first stage of mutual inductance to the second stage of mutual inductance to power the apparatus

3. We claim an electro-physical apparatus **as claimed in claim 2** characterized by the adoption of a single-phase multipolar alternating current generator (ref. 9 of **Fig. 1**) with variable rotation speed between 800 and 5000 RPM to power the inductive capacitive circuit

4. We claim an electro-physical apparatus **as claimed in claim 3** which comprises a position control system (ref. 8 of **Fig. 1**) that measures, controls and manages in synchronism with the generator and continually varies the excitation current in function of rotating speed.

5. We claim an electro-physical apparatus **as claimed in claim 3** where the operational value of frequency of the current generator is in the range from 10 kHz to 1000 KHz, but most preferably between 80 kHz and 100KHz.

6. We claim an electro-physical apparatus **as claimed in claim 2** where the value of the circuit output voltage is between the 15KV and 50KV, but most preferably between 20 KV and 30 KV

7. We claim an electro-physical apparatus **as claimed in claim 1** where the body is composed by two symmetrical cases (ref. 21 of **Fig. 2**) acting as supports and insulation for the crossing metallic ducts (ref. 20 of **Fig. 2**)

8. We claim an electro-physical apparatus **as claimed in claim 1** characterized by multiple parallel metallic ducts (ref. 20 of **Fig. 2**) at variable shape along their length according to the sequence convergent – straight – divergent – convergent – straight – divergent

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