ACADEMIA | Letters

Turbo: energy efficient air blower

Ph.D., Ibar F. Anderson

Introduction and development.

The project consists of the design by electromechanical simulation by NI Multisim 14.0 software, re-design of the casing by CAD by Cfturbo 2020 R2.0 + SketchUp Pro 2017 software and rapid 3D prototyping by ABVieber 14.0 software + OverLord Pro 3D printer; for the design of a prototype centrifugal air blower for civil and commercial (non-industrial) use. The proposal corresponds to a single-phase alternating current (AC) motor electromechanically simulated by analogy with a bipolar stepper motor (Stepper) reconfiguring as a synchronous motor.

Design developed with the Design Thinking methodology within the Project (Code: B374) located in the Secretariat of Science and Technology (SCyT-FBA-UNLP) of the National University of La Plata, Department of Industrial Design. Whose title is: *«Integrated Management of Design and Innovation. Contributions for a theoretical-conceptual and methodological review»* is in charge of the Director: Mg. Federico del Giorgio Solfa.

The *"Turbo: eco-blower-air"* project aims to link the secondary level (Technical High School of the Argentine Republic) with the University system of the Argentine Republic (Technological profile careers), create development ties so that future graduates value the need and usefulness of knowledge with technological profiles of Industrial Design, Research + Technological Development (R&D), as described in the new Law of the Knowledge Economy (Law No. 27,570).

The work led to two previous publications: "Energy efficiency improvements (EE) in single-phase synchronous motors of 220 (VAC) / 50 (Hz), type PMSM", in the UIS Ingenierías magazine, Faculty of Engineering of the Universidad Industrial Santander (Colombia); and

Corresponding Author: Ph.D., Ibar F. Anderson, ibar.federico.anderson@gmail.com
Citation: Anderson, P.I.F. (2021). Turbo: energy efficient air blower. *Academia Letters*, Article 2161. https://doi.org/10.20935/AL2161.

"Eco-turbine. Electric turbo fan 200 (VAC) - 50 (Hz), low consumption: energy efficient "from the magazine Innovation and Technological and Social Development of the National University of La Plata (Argentina). For more information see bibliography.

Discussion:

The 256 (Ω) impedance PMSM type synchronous motor and ferrite permanent magnets (ceramic) is 2000 to 4000 (Gauss) or 0.2 to 0.4 (Tesla) magnetic field; although for a higher Energy Efficiency (EE), in the future it is planned to replace it with a rare earth neodymium (Nd2Fe14B), between 11000 and 14000 (Gauss) or 0.2 to 0.4 (Tesla) of magnetic field intensity . Which is a key factor in increasing energy efficiency (EE).

The activities carried out for the construction of the prototype were: (a) coupling a synchronous motor of the PMSM type (with a rotor of ferrite permanent magnets) or a self-excited motor, obtained from the rotor-stator of an electric dishwasher pump of 65 (watts) of nominal power; connecting it to (b) the six radial blades obtained from a rotor of an a-synchronous motor with shadow turns (frager turn or short-circuited turn), of a hair dryer.

Conclusion:

In order to obtain a voltage wave attenuator (Volts) and current intensity (Amps), which works as a limiter of the electric current simultaneously as an EMI (ElectroMagnetic Interference) filter, low-pass type (LPF) , or passive electromagnetic interference filter, whose topology is inductive-capacitive: LC (not to be confused with the LC resonant circuit, where both are connected in series). In this way, harmonic components of the fundamental current are avoided.

The RCL total circuit design (PMSM type motor together with EMI filter, low-pass, active power reduction) has shown to have very energy efficiency (EE) and quality of energy consumed due to low harmonic distortion and low factor of power (cosine of fi) close to unity (0.99), where it is sought to limit the harmonic current to <5% THD (Total Harmonic Distortion) immediately upstream of the installation point or common coupling point (PCC) according to the Standard IEEE 519.

According to the "Affinity Law" of the fans (specified in the UNE 100-230-95 Standard), the variables of power (Watts) and speed (RPM) are determined according to the international Standards ISO 5801-96 (E) and WD 13348-1998. This law applies to a-synchronous motors and does not apply to synchronous motors, such as the one used in the project; so the energy efficiency advantage (EE) is notably higher (and impossible to compare since there

Corresponding Author: Ph.D., Ibar F. Anderson, ibar.federico.anderson@gmail.com
Citation: Anderson, P.I.F. (2021). Turbo: energy efficient air blower. *Academia Letters*, Article 2161.
https://doi.org/10.20935/AL2161.

is no standard that establishes these comparison parameters). Therefore, in a conventional a-synchronous motor (single-phase induction), the speed of rotation of the blades should be reduced by 23.7% for a reduction of 56% of the active power (Watts) of the motor. But in the project developed here, the speed is not reduced because the motor is synchronous and maintains 3000 (RPM), as a consequence of the frequency of the alternating current: 50 (Hz).

The final data confirm the reduction in the "carbon footprint". Well, it went from consuming 202 (kwh) per year equivalent to 0.1 tons of CO2, to consuming 97 (kWh) per year equivalent to 0.05 tons of CO2 (which means a 50% reduction in the carbon footprint); that our prototype development leaves on Planet Earth.

For more information visit the website (in Spanish):

Controlling it mechatronically by the design of a circuit consisting of: (a) a 3 (μF) capacitor in parallel, to the two phases of the single-phase alternating current (AC) emf source of 220 (V) and 50 (Hz); (b) together with a 48 (Ω) inductive reactance magnetic ballast, in charge of processing the binomial expression of the impedance (Z = A + jB). The electromagnetic reactance used is energy classification (EE) is EEI = B2, according to the European standard EN 50294/1998.

As demonstrated with the ballast (inductive reactance) connected in series to one phase and with the capacitor connected in parallel to the two phases. The motor exhibits a drop in motor power rating of 29 (Watts) with the Energy Efficiency (EE) circuit "off", when "turned on" it was reduced to 18 (Watts) on the total RCL circuit (not to be confused with the 7.9 (W) of power only in the motor). Without losing speed in the rotation of the centrifugal turbine (6 radial blades); that is, without lowering the ability to perform mechanical work (Joules) on the blades of the centrifugal turbine. This is what is known as energy efficiency (EE).

In effect, when the R-L-C circuit is on with the capacitor connected in parallel and the inductive reactance connected in series to one of the phases; This set operates by increasing the impedance in ohms, reducing the active power in watts. Therefore lowering the active energy consumption in kilowatt-hours (kWh) of electrical energy, which is equivalent to energy efficiency (EE).

Additionally, it acts by filtering harmonics or Total Harmonic Distortion (THD) and correcting the power factor (cosine of fi), which reduces current circulation (amperage) through the wiring and motor windings (avoiding vibrations, reducing noise in decibels and the consequent loss of energy due to parasitic heat).

For more information visit the website (in Spanish): https://ecoblowerair.wixsite.com/eco-blower-air/a-inicio

Corresponding Author: Ph.D., Ibar F. Anderson, ibar.federico.anderson@gmail.com
Citation: Anderson, P.I.F. (2021). Turbo: energy efficient air blower. *Academia Letters*, Article 2161. https://doi.org/10.20935/AL2161.

Bibliography

Anderson, IF. (2019). "Mejoras de eficiencia energética (EE) en los motores monofásicos sincrónicos de 220 (VAC) / 50 (Hz), tipo PMSM". Revista UIS Ingenierías, Volumen 18, Issue 4, pp. 57-70. Colombia: UIS. Disponible en: https://revistas.uis.edu.co/index.php/revistauisingenierias/article/view/9300/9869 [Accedido: 27/12/2020].

Anderson, IF. (2019). "Eco-turbina. Turbo ventilador eléctrico 200 (VAC) – 50 (Hz), de bajo consumo: eficiente energéticamente". Revista Innovación y Desarrollo Tecnológico y Social, Volume 1, Issue 1, pp. 1-28. La Plata: UNLP. Disponible en: https://revistas.unlp.edu.ar/IDTS/article/view/6270/7812 [Accedido: 27/12/2020].

Corresponding Author: Ph.D., Ibar F. Anderson, ibar.federico.anderson@gmail.com
Citation: Anderson, P.I.F. (2021). Turbo: energy efficient air blower. *Academia Letters*, Article 2161. https://doi.org/10.20935/AL2161.