Rural wind turbine

By:

François Gagnon
Abstract

This presentation is a specific application based on the principles of the patent pending ‘Wind turbine with wind concentrator’.

Rural wind turbine will need to satisfy similar requirement as urban wind turbine\(^{(1)}\) but as they will not be install over or to close to habitation, design criteria can be reduce. Here is their main objectives:

- They must be able to supply all the energy require by a farm, including some houses, cowsheds, greenhouses and eventually electric cars and tractors.
- They must be relatively economical as a network of it will be require to satisfy demands.
- They should work with a low noise level, their sound should merge with naturals noises at 100 meters or less.
- They should not need large or complex foundation, ideally it does not use any cultivated area.
- Visual aspect should not be awkward; ideally they do not show any movement at 100 meters.
- When require, they should be harmless to wildlife.

The designs principles detailed in the presentation of the patent pending ‘Wind turbine with wind concentrator’ can be used to achieve all those objectives.

\(^{(1)}\) We suggest the reader has read the ‘urban wind turbine’ presentation before this document.
Rural wind turbine

Context

Cultivated field are good place to install mid range wind turbine as land are relatively flat and vegetation present a very low resistance to wind. What we call rural wind turbine could also have been call industrial wind turbine as industrial park have also a lot of potential to install wind generators that may produce a sound level from 5 to 10 decibels more than an urban wind turbine.

We will keep the designation rural wind turbine as giant tri-blade generator are already call industrial wind turbine. We do not want to be associate to the very well organize opposition they received, in fact we want to propose the rural wind turbine as an alternative that can be accepted by everybody.

The basic model

Fig. 10 shows a cross-section of a good design for a rural wind turbine. In this figure, the center of the turbine is completely cut-out to permit the utilization of concentrated wind emanating from all three directional axes. The concentrated wind from area 14 attacks the turbine at an angle that favors its passage through the open center and its expulsion in area 17. The concentrated wind in area 16 approaches the turbine at an angle that is more direct and is ejected in area 19 without having to pass by the center.

Fig. 11 illustrates the lower cross-section of the apparatus where the back and underside of the machine is cut out to facilitate the expulsion of air. The apparent concentration factor\(^{(2)}\) in this case is:

\[
\frac{(D + E + F)}{G}
\]

In this particular figure, the concentration factor is approximately 8.5. We note that the blades of the turbine have a width of G and that this same dimension is utilized by each of the incoming concentrated wind flows.

(2) As discuss in urban wind turbine presentation.
Rural wind turbine

The dimension $H$ can vary from one apparatus to another. The more the turbine is enclosed, the lower the levels of aerodynamic noise will be. On the other hand this will decrease the efficiency of the turbines since there will be a smaller opening to exhaust the residual wind.

Still referring to Fig. 11, the pivot point 20 is located at the front of the apparatus. Such a position permits a natural alignment of the apparatus with the direction of the wind. This movement can also be mechanized by using a pivoting point near or behind the center of mass. This mechanism will be more expensive, but a better spread of both static and dynamic charge may lighten the structure and the foundation.

Fig. 12 illustrates a cross-sectional view along ‘A-A’ of the Fig. 11. Two electrics generators 23 are installed in the inside of the turbine blades. Those generators can also be installed on the bottom or on the top of the apparatus. We note that the inferior part 22 of the structure is open to favor the expulsion of air, this avoid also sand and snow accumulation. The lines 21 demonstrate the difference in the opening when the dimension $H$ (see Fig. 11) is at minimum or maximum.

Fig. 13 illustrates a series of rural wind turbines installed in cultivation field ditches. This provide an easy access to the wind turbine, and no cultivatable land is sacrificed. Each apparatus could capture 15 to 25 square meters of wind at a height of five to ten meters from the ground. A farm exploiting several square kilometers of land could install a hundred of these wind turbines and benefit from an electrical potential in the order of the megawatt; with a yield of only 25%$^3$ this could justify an investment of two to three millions dollars.

With similar thinking, all rural roads, highways and railway can be lined with these wind turbines at a level of fifty to one hundred machines per kilometer depending on the exploitability of the average wind speed. Installing wind turbines along road will reduce implantation cost as there will be no road to build, and no cultivated or wild land will be use.

$^3$ As explain previously, the comparative efficiency we propose include both a better harnessing of the energy of the wind with a more efficient apparatus, and a wider range of wind speed that can be use. In same conditions, a standard tri-blades will produce significatively less KW/h per year.
**The minimalist model**

*Fig. 26* show a top cut view of what could be a simplify solution for the rural wind turbine.

To harness the same surface of wind as the basic model, the apparatus must be a little larger as turbine are at each end. The length of the central deflector must also be longer as he is alone to redirect the wind. On the other hand, the flow of wind on the turbine is unidirectional, which allow the use of a close centre turbine that will use 100% of the harness wind.

For presentation purpose, we show the machine with 2 different levels of compression. On side 43, the real level of compression is 6.5, on side 44 it is 9.5.

Deviation angle and level of compression must be study in wind tunnel to optimize arrangement in function of several average wind speed. We note that compare to the basic model, this version will be more sensible to variation of wind direction; if mechanize, the positioning will need to be faster.

*The fig. 27* show a simple structure of sound deflectors 45 that could be added in option. This system will not be as efficient as the one propose for the urban wind turbine, but it may reduce sound of few decibels when required.

*The fig. 28* show a rural wind turbine that is painted in a way that it will merge in the landscape. The visual insertion could even be better if deflectors is made of transparent Plexiglas.
Conclusions

On an industrial basis, for example at the scale of a large car factory, the production cost of a rural wind turbine harnessing 20 square meters of wind will be between 2 to 3,000$. It is reasonable to expect that it could then be ship and install in large quantity for an amount bellow 10,000$ each. That way it is possible to deliver a nominal power of 1 megawatt for approximately one million dollars.

This lead the following conclusions:

1- With a low installation cost and an efficiency adapted to the implantation site, it is not necessary anymore to chose with minutiae the location for wind turbine, they can be installed everywhere a road lead us.

2- As all roads lead to a city or a village, the electricity will be use beside the production site. That will significatively reduce the lost of power in transportation network.

3- As the potential power of the network is of same order as the one supply by the giant wind turbines, the implantation of those machines can be move where they will not bother anybody.

4- When farm and industry will be able to produce their home energy at low cost, they will turn significatively more competitive in international market.

With according investment, the designs proposed here can change the world of clean energy in a relatively short period.

François Gagnon  ing.
Fig. 10
Rural wind turbine

Fig. 11

[Diagram showing a rural wind turbine with labeled parts: A, H, G, E, F, D, G, and 20.]

Concepts and designs by Francois Gagnon
Intellectual property managed by ‘Goudreau Gage Dubuc’ of Montréal.
Rural wind turbine

Fig. 12
View A-A
Rural wind turbine

Fig. 13
Fig. 26
Fig. 27
Rural wind turbine

Fig. 28