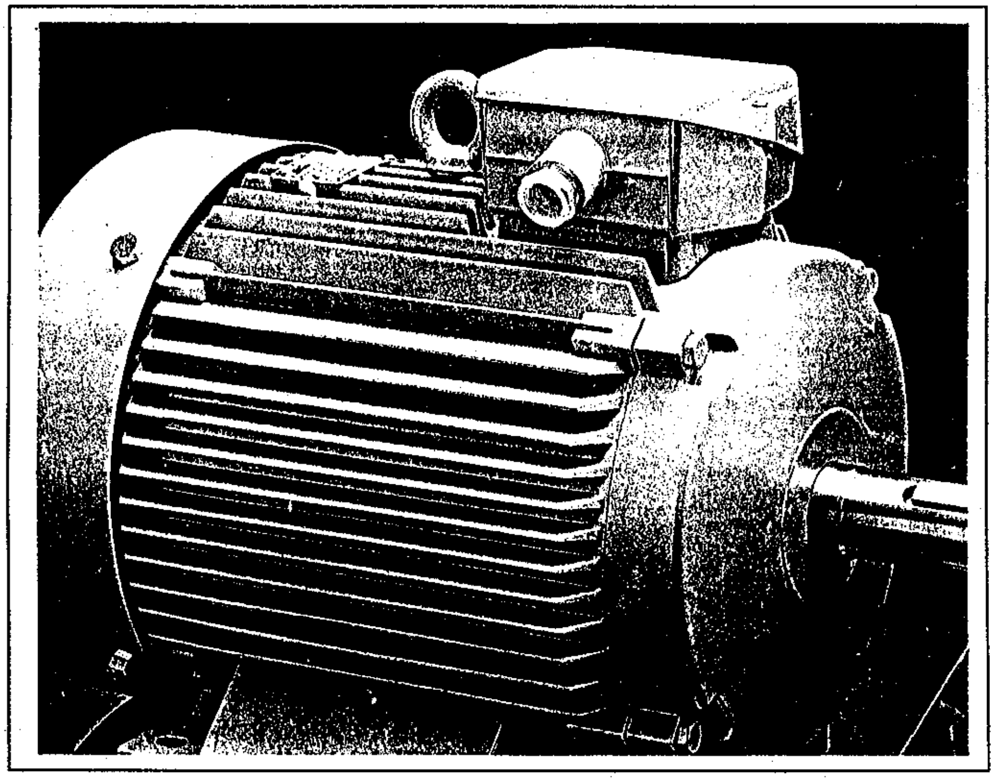
MATCHING ASYNCHRONOUS GENERATORS

TO SMALL WINDMILLS



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CONCLUSION.

According to the testing carried out in a lathe with asynchronous motors of the sizes showed in the tables, it is possible to use this kind of generators direct driven in battery chargers with transformers in the range of 1 - 2 KW approx. The windmill designed with asynchronous generator is stall regulated, it means almost constant rotational speed.
These motors can be used without transformers only in the case of smaller battery chargers, in the range of 150 W approx., for 48 V battery.

The following step is matching an asynchronous motor to a windturbine and to study a practical application, e.g.:

1-1.5 KW Battery charger.

We use table 1 as guide and chose 4 KW motor, 6 poles, 380/660V. There are several methods to design a stall regulation windmill. We start with the RPM and consider empirically a rotor of 3 m diameter and a wind speed of 6 m/s. We choose λ=8 because the rotor has two blades:

$\lambda = 2\pi RPMr/60/V$ thus $RPM=60V/2\pi r=19.1V/D = 19.1x8x6/3= 306$
RPM=306

Now can check the power.

$P = 1/2\ Cp\ V3\ \delta\ A$ We consider: nominal wind speed= 12 m/s

the best Cp= 0.48

where: P: power in W
Cp: power coefficient
V: wind speed in m/s
δ: air density in Kg/m3
A: windmill area in m2

The best Cp is only with λ=8, at 306 RPM
At 12 m/s λ= 4 means that the Cp is lower, about 0.3 according to the test of a 3 blades rotor (Risø M-2282, Rotor gear og generator tilpasning for stall reguleret vindmølle, page 13)

P=1/2x0.3x1728x1.23x7=2231 W
The efficiency of the generator is about 0.65%, thus the electrical power is 2.23x0.65=1.45 KW

Blades.

The blades can be the NACA 4415/24, Cl = 0.8 at 5 deg.of attack and we consider $\lambda = 8$.

Chord = 8 x π x r (1-cos ϕ) / B x Cl

λr	r(m)	ϕ	β	1-cos ϕ	chord(cm)
0.8	0.2	34	29	0.18	56
2	0.5	18	13	0.047	37
3.2	0.8	11	6	0.017	21
4.4	1.1	8.4	3.4	0.01	17
5.6	1.4	6.6	1.6	0.007	15
6.8	1.7	5.5	0.5	0.0048	13
8	2	4.7	0	0.0034	11

λr: tip speed ratio in different radius
r: radius
ϕ: angle between Vtip and V
β: pitch angle
B: number of blades
Cl: lift coefficient

The β angle and the chord have to linearized before the manufacturing.

This conclusion is not finished. After testing a windmill like this one we want to build I will add more experience in another report.