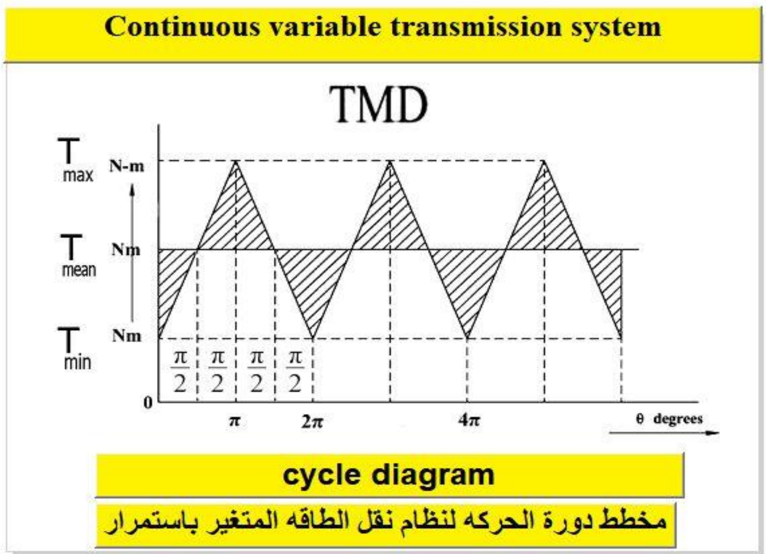
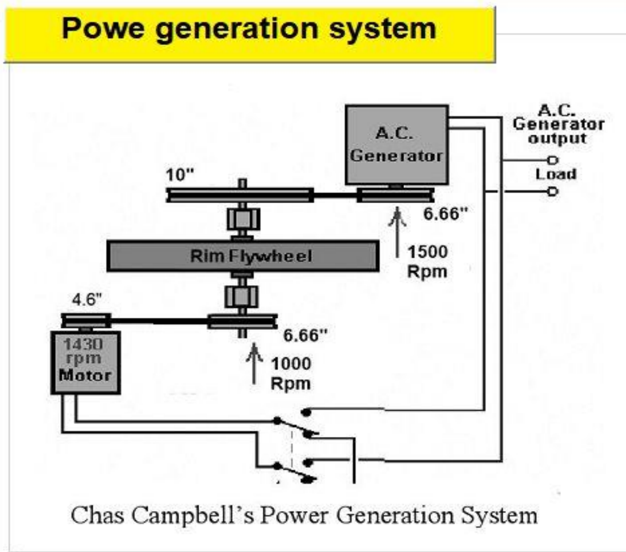
flywheel free energy generators

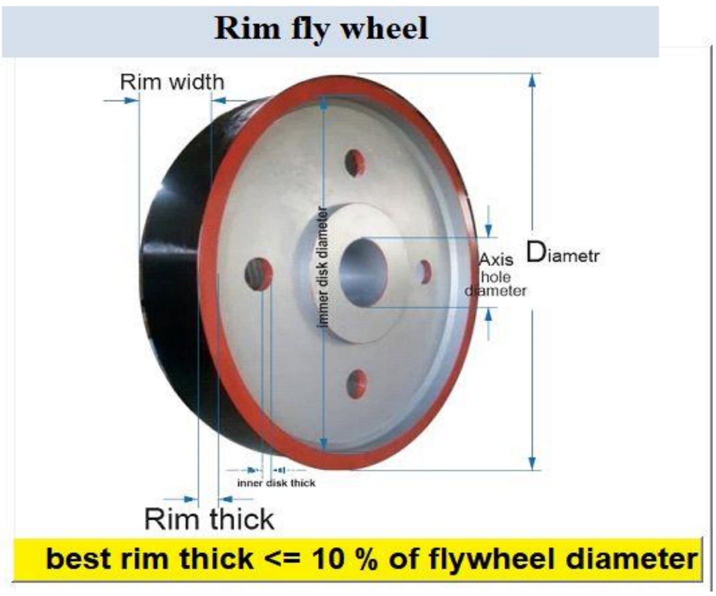
practical guide

to build successful free energy

flywheel generators







Flywheel calculations

A = Rim width * Rim thick

Rim type flywheel, Volume=$\pi D(A)$

multi Flywheel calculations system

wheel power (40 cm width) = 2 * wheel power (20 cm width)

Fly wheel generators world wide

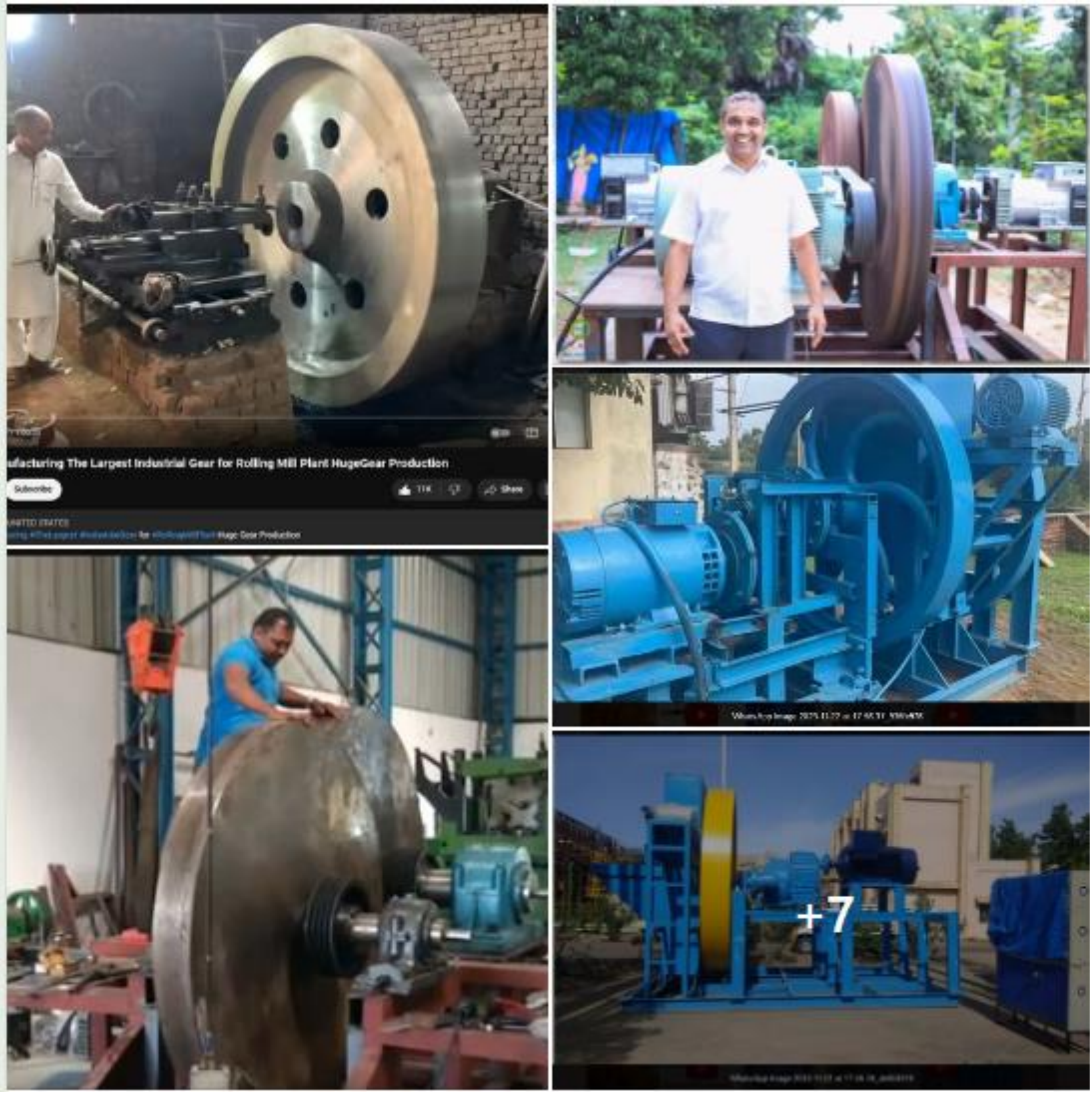
India now the world leader in flywheel generators manufacturing
there are also companies to sell commercial flywheel generators of different power
>>>>

from 10kw to 10 megawatts

>>>>

with very good experiences ......

youtube.com/watch?v=Bzy6GLKmd3M



facebook.com/groups/505531574899958

!!!!!!! NOW NOW NOW !!!!!!!!!!

world first commercial flywheel Energy generators

0% input 100% output (world first machine)

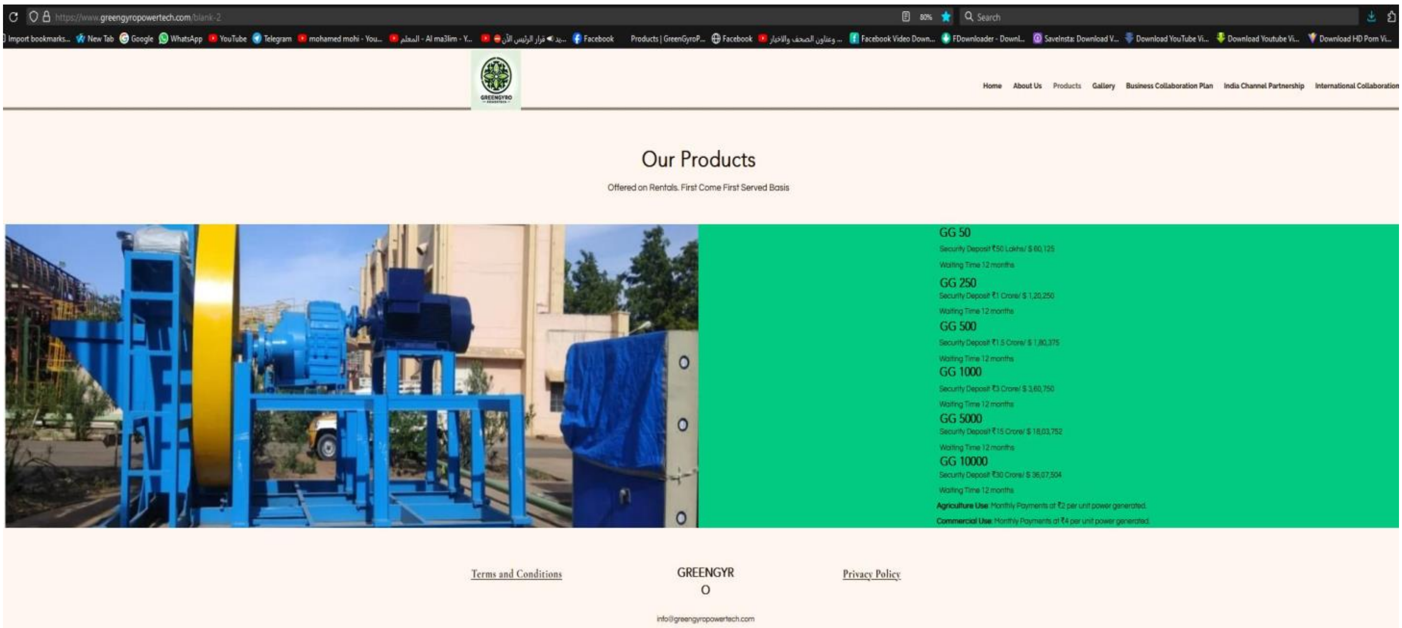
every one need free energy off grid generator working for at least 30 years

now for sale

youtube.com/watch?v=bligjAejTDE&list=RDCMUCvxzOyRGLMx24zEvZyqI2-g&start_radio=1

youtube.com/watch?v=Z4WZRDDVIb8&t=47s

List price for ready to sell generators from India



greengyropowertech.com/blank-2

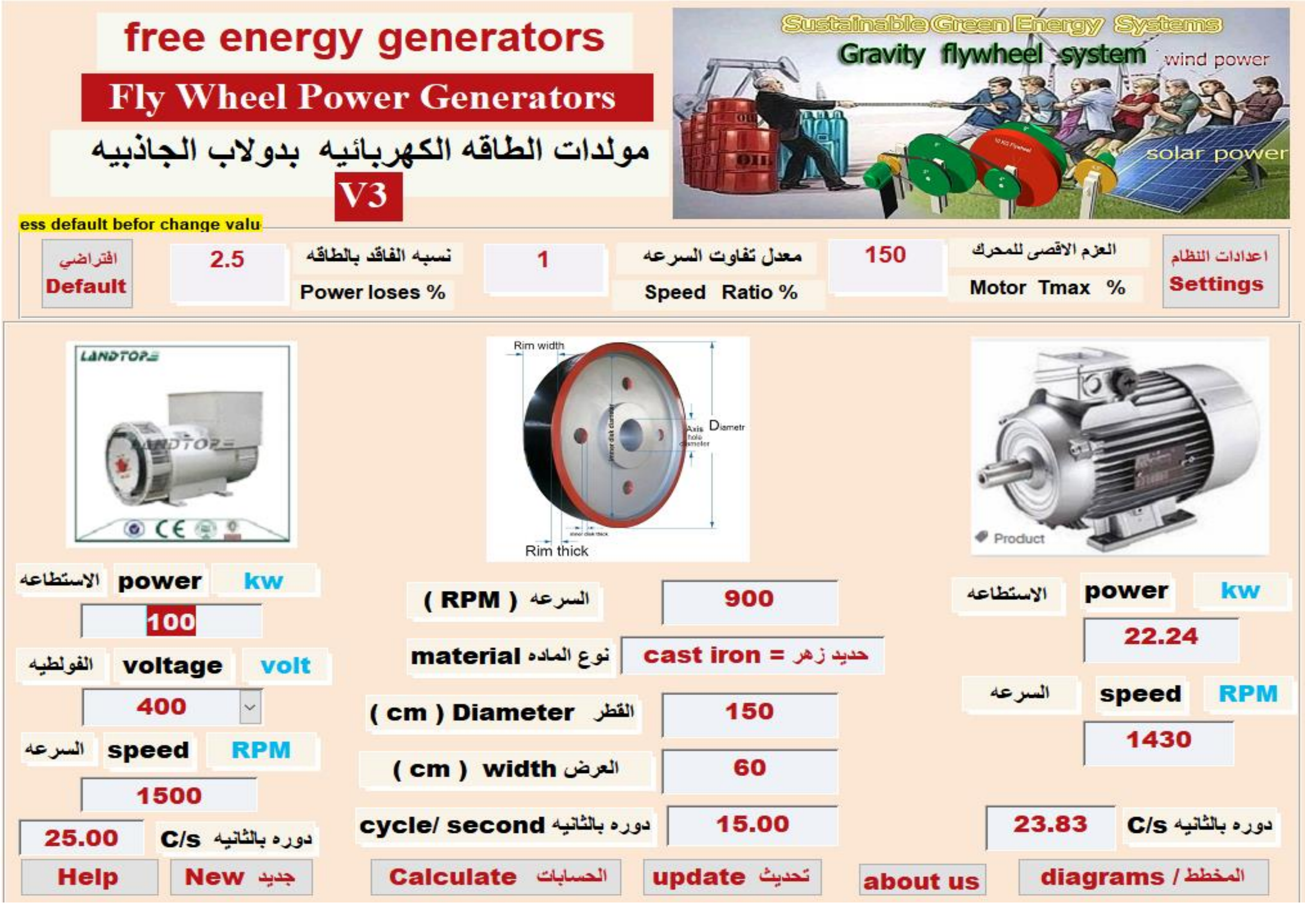
flywheel system designer program

the first program to calculate fly wheel specifications & different generation system calculations

its free for all >>> using and freely distribution ....

>> database works with office 2019 or later <<

https://app.box.com/s/pl95xsvwblry723dh7l39mpka00h3qau



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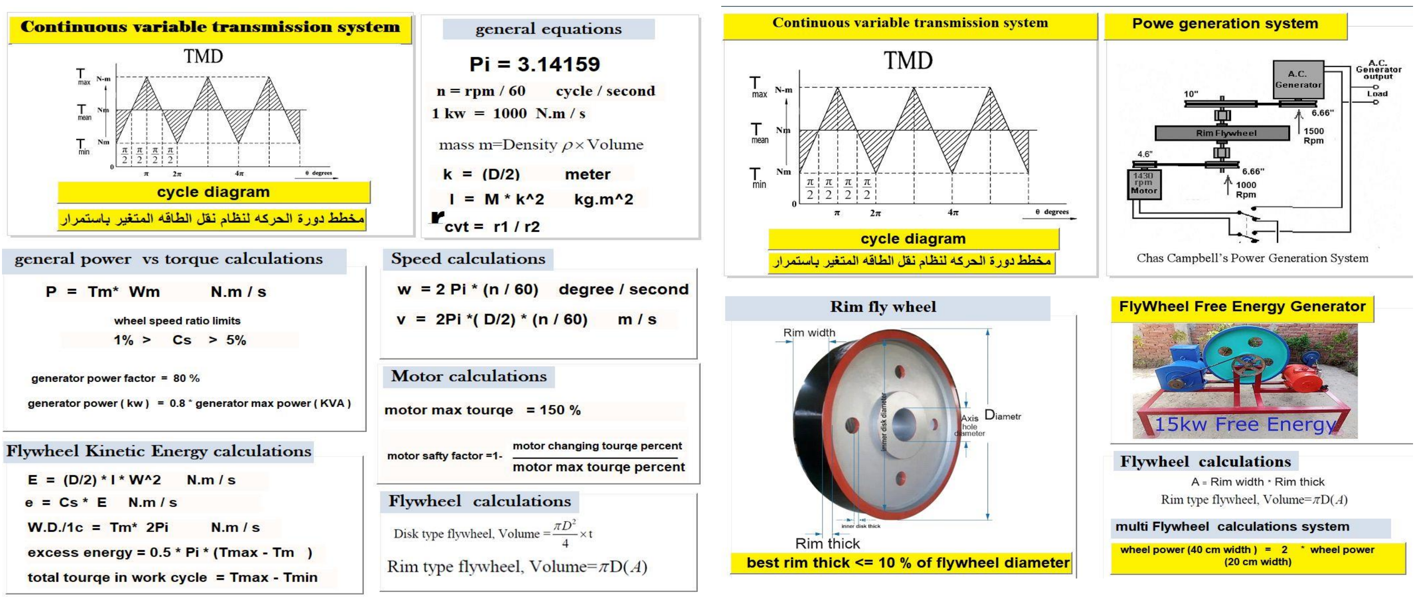
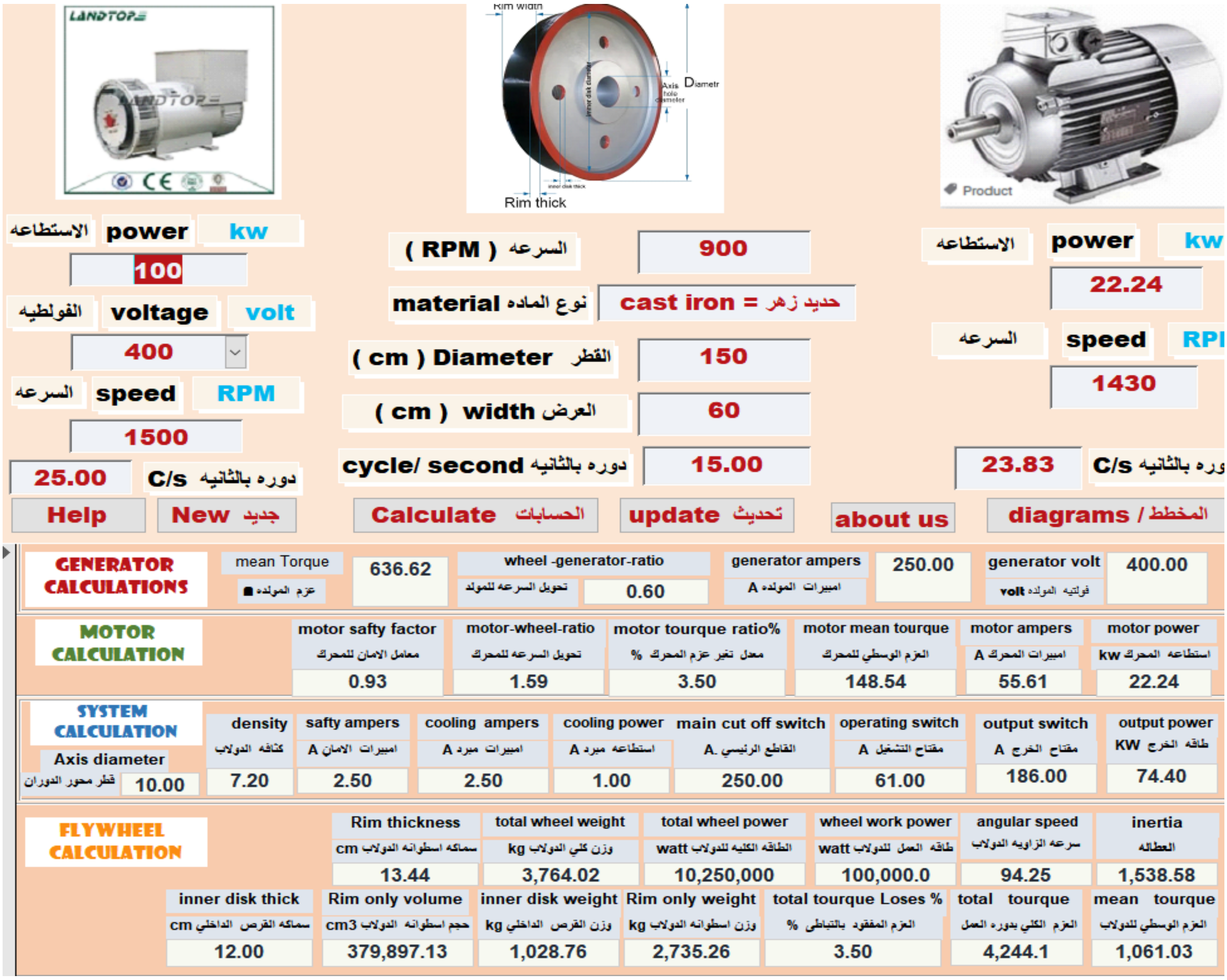




.yes…

flywheels are energy storage

>>>>>>>with with with with with with

>>>>> huge inertia !!!

>>>> that's mean ::: speed only decreases at steady decreasing percent because of losing torque percent during working cycle …

(((flywheel total energy > 100 times generator power !!!!!!)))

>>>> So, when we compensating torque loses of the flywheel

>>> then flywheel energy reaches its maximum again

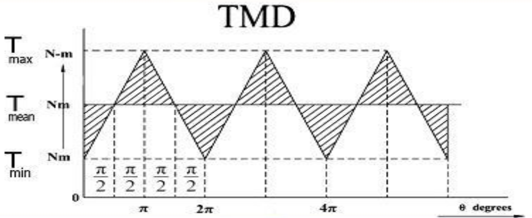
>>>>> and working cycle repeating again and again !!!!

. >>>> Flywheel cycle diagram <<<<

…………………. in details ………………..

Continuous variable transmission system

TMD



cycle diagram

مخطط دورة الحركه لنظام نقل الطاقه المتغير باستمرار

general equations

Pi = 3.14159

n = rpm / 60 cycle / second

1 kw = 1000 N.m / s

mass m=Density $\rho \times$ Volume

k = (D/2) meter

I = M * k^2 kg.m^2

r cvt = r1 / r2

general power vs torque calculations

P = Tm* Wm N.m / s

wheel speed ratio limits

1% > Cs > 5%

generator power factor = 80 %

generator power (kw) = 0.8 * generator max power (KVA)

Flywheel Kinetic Energy calculations

E = (D/2) * I * W^2 N.m / s

e = Cs * E N.m / s

W.D./1c = Tm* 2Pi N.m / s

excess energy = 0.5 * Pi * (Tmax - Tm)

total tourqe in work cycle = Tmax - Tmin

Speed calculations

w = 2 Pi * (n / 60) degree / second

v = 2Pi *(D/2) * (n / 60) m / s

Motor calculations

motor max tourqe = 150 %

motor safty factor =1- $\frac{\text{motor changing tourqe percent}}{\text{motor max tourqe percent}}$

Flywheel calculations

Disk type flywheel, Volume $= \frac{\pi D^2}{4} \times t$

Rim type flywheel, Volume$=\pi D(A)$

Flywheel cycle diagram …. has been studied accurately and efficiently

since engines widespread used to run vehicles.

the key in flywheel useful energy is

THE BIG INERTIA

$I = m * k^2$ (kg * m^2)

inertia = mass * square exponent (radius of the wheel)

Big inertia (mass and volume of the flywheel)

> supports rotating movement and decrease variations in speed

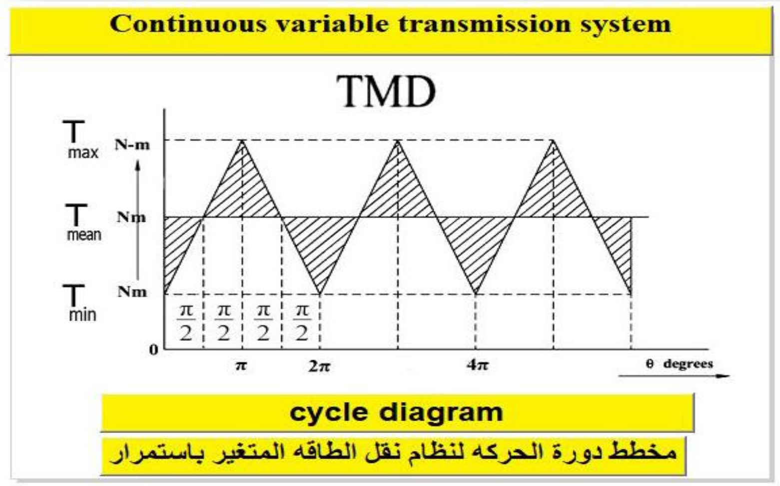
> due to variation in torque during rotation cycle .

Note > for specific inertia needed >> increase the wheel diameter

>> will cause huge increasing in flywheel kinetic energy >> help us to lower flywheel mass

(but we must now the biggest diameter we could have machining in our town …)

We need to study the working cycle diagram of the Flywheel To UNDERSTAND the mechanism of flywheel in conservating and transmission power to another attached machine.



We need to study the >>> **FLUCTUATION OF THE TORQUE** <<< in each working cycle to know speed and torque variations then calculate the energy

---

$P = T_M * W_M$ ((Power = **mean** torque * **mean** radial speed {cycle / second}))

$W_m = 2 \text{ pi} * (n / 60)$ ((radial speed = 2 * 3.14159 * (RPM / 60)))

(Pi = 3.14159 , RPM { cycle / minute })

1st * flywheel consume power <<<<< **when** >>>> external torque enhances wheel speed ((continuously <<<< or >>> with repeating pushes))

2nd * flywheel reaches its maximum speed point >> above the mean speed << and will has >> excess energy <<

here it reaches the >>> maximum torque T_{max} << above the mean torque .then it transmits power to output shaft to run other machine !!

((the work done here **THE TRIANGLE AREA** under the diagram line **)))**

... causing drop in flywheel energy { although torque and speed } and will be at >> minimum torque T_{min} << {accurately defined}

>>> total torque used in the working cycle to run the generator = (T_{max} - T_{min}) > generator T_{mean}

3rd * " BIG " inertia supports rotation >> speed only decrease in small percent of its maximum speed

<< the same >> torque also decrease in small percent of its total value

---

the key factor to design all system

' Cs '>>> SPEED RATIO % <<<

We must indicate >>> speed ratio <<<< at best **minimum** value

>>> to prevent over-decreasing in wheel speed during working cycle ..

((this may cause drop in system speed and voltage if motor torque couldn't support flywheel enough to reach its maximum speed and continue the working cycle)))

"""Practically"""

Speed ratio " 'in general " varying between **3 % < Cs < 1 % .**

- In small power systems (up to 30 kw) we can use higher percent >>>> to reduce flywheel mass but we have to increase the wheel volume to generate much torque ......
- In medium power systems (up to 500 kw) **Cs = 1%** is good (Kinetic energy ___""100"" ____times bigger than working energy >>> used to rotate the generator at maximum output

>>>>>> full load <<<<<<

---

e = Cs * E

(e : work power= generator power)

(Cs : speed and power ratio %)

(E : maximum flywheel Kinetic energy power)

>>>> **E = 100 * e** <<<<

fly wheel kinetic energy 100 times the working transmitted power

then we can.>>> calculate flywheel mass ..

- >> In huge power stations (in megawatts) **Cs < 1%** may required

>> to preserve energy and prevent drop in speed and voltage at intensive load .

' Ls '>>> LOSES RATIO % <<<

system design and quality of components is very important …. To preserve system energy

Friction >> can affects the speed and spin of rotating shafts , flywheels , gears and belts used to transform power to output generator ..(belts preferred than gears << less friction)

this >> negative forces reduce speed and cause torque loses ????

Also >> weight and volume of the flywheel nay affect bearings

>>>friction causes negative forces and overheating in high speed <<<

And >> multi stages system has much loses ..

L_S >> **5 % > Ls > 1 %**

>>> loses percent of flywheel energy >>> speed and torque <<<

so this loses must be included in calculations to prevent any drop in speed at maximum load

---

4th * the external torque of the motor (or any other rotating method used)

>>> compensating torque loses >>>> enhance wheel speed <<<

Motor torque = total torque (in working cycle) * total torque loses percent

MOTOR TORQUE = (T_{MAX} - T_{MIN}) * (C_S + L_S

>> wheel reach's its maximum speed and power again !!!!

>>> working cycle repeat again and again <<<

The main aspect design

In flywheel generators

- huge power of flywheel >>>Vs <<< working power -
- reduce Cs >>> and <<< reduce torque loses -
- enable us to >>> reduce <<< external torque -

---

so we can use smaller motor power .... to run the system even at full output

See :: 50 kw system designed in

>>>>> flywheel system design program <<<<<<<<

C_s = 1.5 ; L_s = 1.5 : gives us accepted calibration to run the system efficiently

(enable us to define flywheel max power and torque loses ,)

so we can calculate flywheel mass and volume needed , also the motor power needed)

PRACTICALLY : after we build the system we need to calibrate it at full load ..

(we can increase power by slightly increasing the speed 5% >> 10 % faster ..)

youtube.com/watch?v=Z4WZRDDVIb8&t=47s

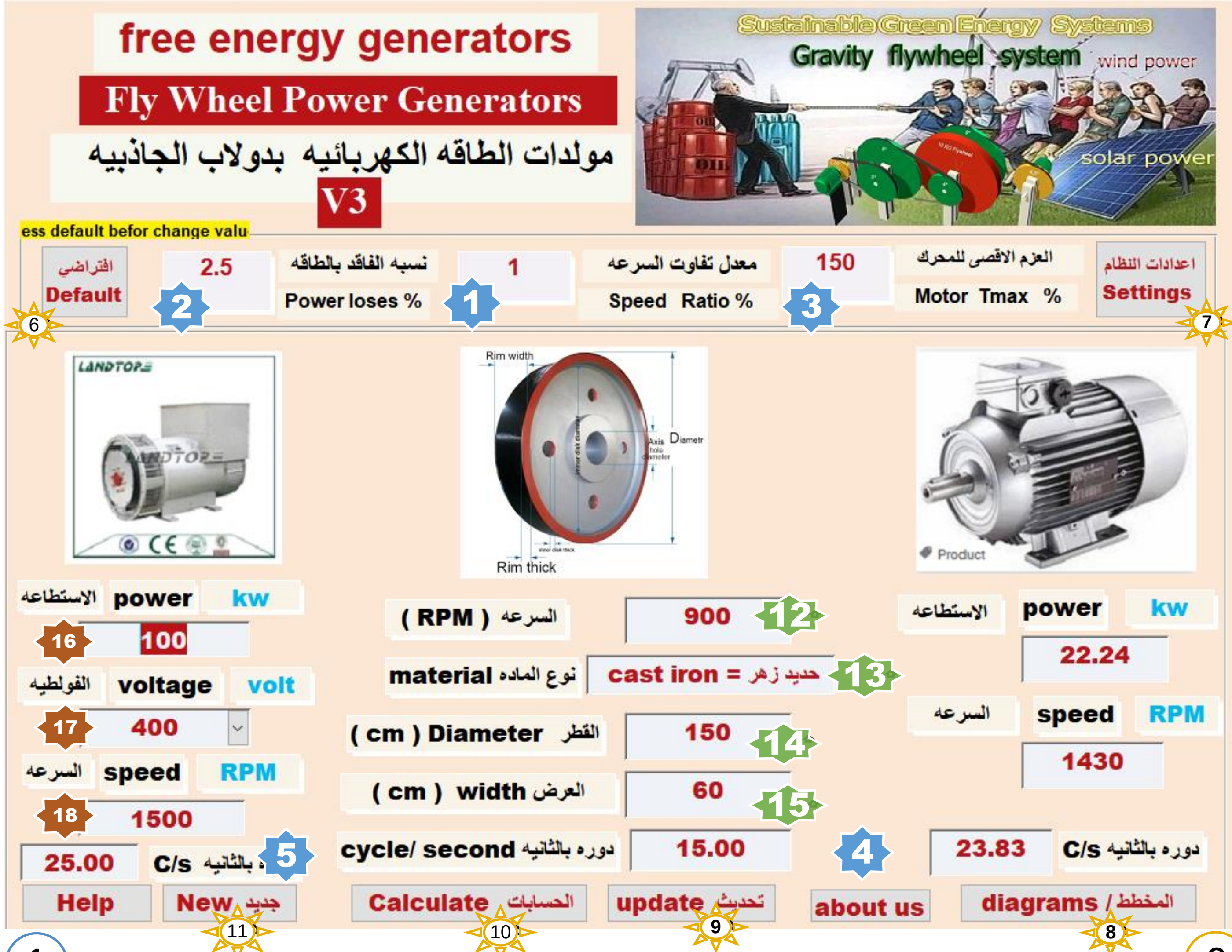
50 kw generator with 10 kw motor >>>> has efficient power
((flywheels of : 1000 rpm speed ; 2000 kg weight ; 1.4 m diameter))

---

100 kw generator with 22 kw motor >>>> has efficient power
((flywheels of : 900 rpm speed ; 4000 kg weight ; 1.5 m diameter))

FLYWHEEL SYSTEM DESIGNER PROGRAM

V3



1	Cs : speed ratio % .. define wheel power	the default value for 50 kw syncronous generator ...	6
2	Ls : loses ratio % .. define extra torque loses	the cycle diagram and equations ... necessary to calculate all system values	7
3	motor Tmax ... define maximun torque alowed	general system design diagram and flywheel specifications	8
4	To calculate :: $r$cvt :: motor to flywheel speed conversion	Re calculate system values after changing defaults	9
5	To calculate :: $r$cvt :: flywheel to generator speed conversion	the full calculations for 20 kw generator (as sample calculations)	10
12	Flywheel speed >> almost 1000 RPM give us good torque with high kinetic power	clear all fields to input new personal system design values	11
13	Flywheel material >> cheapest cast iron > density = 7.2 (g /cm3)	common syncronous power generator	16
14	flywheel diameter :bigger diameter gives us much power and lower mass	generator voltage : 220v signal face or 400 v three face	17
15	flywheel rim width >> can be divided to several smaller wheels	typical syncronous generator speed : 1500 rpm	18

SYSTEM CALCULATIONS

GENERATOR CALCULATIONS

1	generator volt	volt فولتيه المولده	400.00
2	generator ampers	A اميرات المولده	250.00
3	wheel -generator-ratio	تحويل السرعه للمولد	0.60
0	mean Torque	عزم المولده	636.62

MOTOR CALCULATION

4	motor power	kw استطاعه المحرك	22.24
5	motor ampers	A اميرات المحرك	55.61
7	motor mean tourque	العزم الوسطي للمحرك	148.54
8	motor tourque ratio%	معدل تغير عزم المحرك %	3.50
6	motor-wheel-ratio	تحويل السرعه للمحرك	1.59
9	motor safty factor	معامل الامان للمحرك	0.93

SYSTEM CALCULATION

16	output power	KW طاقه الخرج	74.40
15	output switch	A مفتاح الخرج	186.00
14	operating switch	A مفتاح التشغيل	61.00
13	main cut off switch	A. القاطع الرئيسي	250.00
10	cooling power	A استطاعه مبرد	1.00
11	cooling ampers	A اميرات مبرد	2.50
12	safty ampers	A اميرات الامان	2.50
18	density	كثافه الدولاب	7.20
17	Axis diameter	قطر محور الدوران	10.00

FLYWHEEL CALCULATION

19	inertia	العطاله	1,538.58
23	angular speed	سرعه الزاويه الدولاب	94.25
24	wheel work power	watt طاقه العمل للدولاب	100,000.0
25	total wheel power	watt الطاقه الكليه للدولاب	10,250,000
26	total wheel weight	kg وزن كلي الدولاب	3,764.02
29	Rim thickness	cm سماكه اسطوانه الدولاب	13.44

20	mean tourque	العزم الوسطي للدولاب	1,061.03
21	total tourque	العزم الكلي بدوره العمل	4,244.1
22	total tourque Loses %	العزم المفقود بالتباطئ %	3.50
27	Rim only weight	kg وزن اسطوانه الدولاب	2,735.26
30	inner disk weight	kg وزن القرص الداخلي	1,028.76
28	Rim only volume	cm3 حجم اسطوانه الدولاب	379,897.13
31	inner disk thick	cm سماكه القرص الداخلي	12.00

Generator calculations :

1 system voltage >230v or 400 v

2 generator max amperes

3 r_{cvt} : flywheel (c/s)/ generator(c/s)

Motor calculations :

4 calculated motor power (kw)

5 motor ampers

6 r_{cvt} : motor (c/s) / wheel (c/s)

7 motor mean torque (Tm)

8 torque variation in work cycle

9 motor safty factor calculation

Major system calculations :

10 cooling unit power (1 kw)

11 cooling unit ampers (1 kw)

12 safty preserved ampers (1kw)

13 main cut-off switch ampers

14 operating cut-off switch ampers

15 system output cut-off switch ampers

16 the system output power

17 axis diameter >to select bearings

18 wheel material density (7.2 g/m³)

Flywheel calculations :

19 the flywheel INERTIA

20 flywheel mean torque (Tm)

21 total flywheel torque (Tmax - Tmin)

22 total flywheel torque loses Percent

23 flywheel angular speed

24 flywheel working power N.m/s

25 flywheel total power N.m/s

26 flywheel total weight (kg)

27 flywheel rim weight (kg)

28 flywheel rim volume (Cm³)

29 flywheel rim thick (Cm)

30 interior wheel disk weight (kg)

31 interior wheel disk thick (Cm)

SAMPLE SYSTEM CALCULATION

project :: 100 kw flywheel generator

Generator : synchronous alternator

- 100 kw = (0.8 * 125 kva)
- 400 v (3 phace)
- 1500 Rpm

Flywheel : cast iron (density = 7.2 g / cm^3)

- Diameter = 150 Cm
- Speed = 900 Rpm
- Rim type ((with full interior disk)

Motor : general synchronous motor

- Speed = 1430 Rpm
- Voltage = 400 v three phase
- Motor max torque = 150 %
  (from catalogue)

System difenitions :

- Speed ratio = 1 %
- Loses ratio = 2.5 %
- cast iron (density = 7.2 g / cm^3)

CALCULATE >>>

- Maximum free energy output (kw)
- Flywheel total weight and >> width , thick
- Best number of separated flywheels
- Steel axle diameter
- Motor power
- Motor safty factor

The results >>>>

- Maximum free energy output = 75 kw
- Flywheel total weight = 4000 kg
- Flywheel width = 4 * 15 cm
  (150 cm diameter +15 cm width + 15 cm thick)
  (3 cm internal disk thick)
- Best number of separated flywheels = 4
- Motor power = 22 kw
- Motor safty factor = 0.93
- Bearing of 10 cm pore diameter
- Axle is solid steel with 10 cm diameter

FULL SYSTEM CALCULATIONS

1) **Generator power = 100 * 1000 = 100,000 N*m / s**
2) **Generator power = T_m * W_m >> Tm = 100000 / (2*3.14159*1500/60) = 636.62**
3) **e = Cs * E >> E = e / Cs = 100,000 / 0.01 = 10,000,000**
   E_{total} = E + (Ls * E) = 10,000,000 + 250,000 = 10,250,000

basic speed variation ratio = 1 %

extra speed loses ratio = 2.5 %

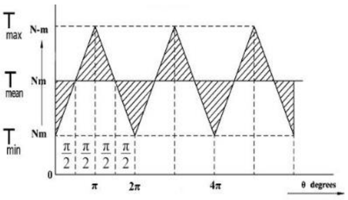
4) **W = 2 * 3.1415 9 * (900 / 60) = 6.283 * 15 = 94.2477**
5) **E = (D/2) * I * w^2 = (1.5 / 2) * I * (94.2477)^2**
6) **I = 2 E / D * w^2 = 20500000 / (1.5 * 8882.6289) = 1538.5835**
7) **I = M * k^2 >> M = I / k^2 =1538.58 / (0.75)^2 >> M = 2735.26 kg**

flywheel effective rim weight

8) **Density U = M / V >> V = M / U >> V = 2735.26 / 7.2 >> V = 379897.169 cm^3**
9) **V = pi * D * A >> (A = t * d) >> V = 3.14159 * D * d * t**

d = rim width , t = rim thik

10). **d = 60 cm >> t = 379897.169/(3.14159 *150*60) > t = 13.44 cm**
11). **internal disk diameter = 150 – (2 * 13.44) = 123.12 cm**
12) **internal disk thick t_{in} = d / 5 = 60 / 5 = 12 cm**
13) **internal disk colume V_{in} = pi (123.12 /2)^2 * 12 = 142865.7 cm^3**
14) **internal disk weight = 1,028,6 g = 1,028 kg**
15) **Total disk weight = 3763.26** kg
16) **FlyWheel weight = 4000 kg best to support rotation and prevent losses in speed and voltage >> thick of rim == 15 cm**
17) **Axis diameter = 10 cm >> bearing of 10 cm pore suitable for wheel of 1 ton**
   (Wheel of 150 cm diameter+ 1 ton weight + 1000 rpm speed >> huge dynamic forces)
   >> so we can use 4 wheels of 1 ton weight
   (150 cm diameter +15cm width + 15 cm thick +++ 3 cm internal thick)
18) **Flywheel speed = 900 rpm = 15 cycle / second**
19) **Work done in 1 cycle >> W. $D_{/1c}$ = T_m * 2Pi**
20) **Tm= (100,000 / 15) /(2 * 3.14159) >> Tm = 1061**



cycle diagram

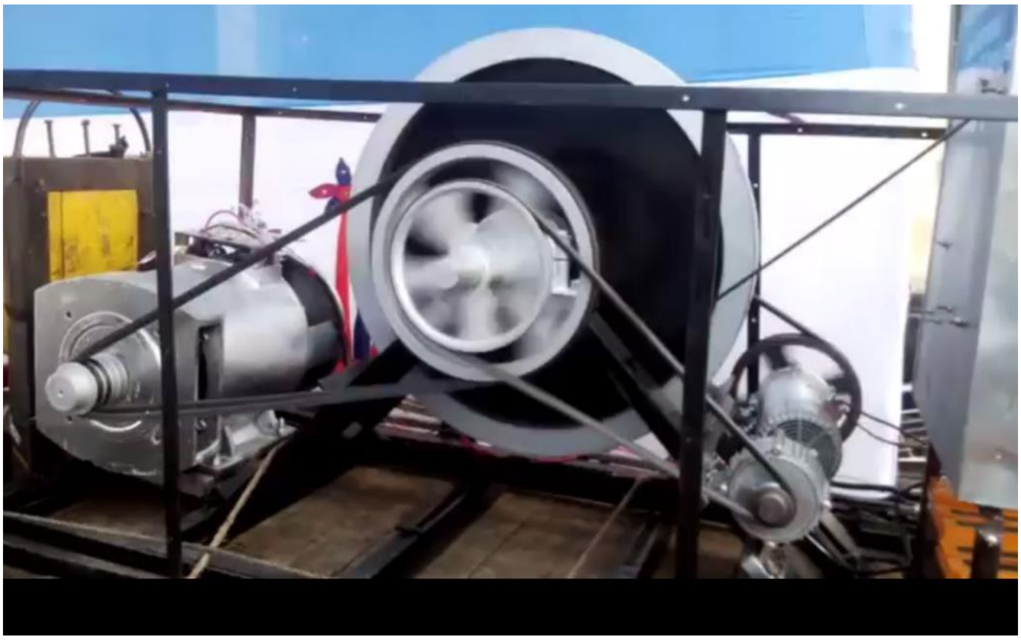
21) **Generation cycle diagram is regularly repeated >> at full load**
   excess energy = 0.5 * W. $D_{/1c}$ = 0.5 (100000 / 15)
   excess energy = 0.5 * 3.14159 * (Tmax – T m) { chart }
   Tmax = 2122 + Tm = 3183
22) **Lower energy = 0.5 * W. $D_{/1c}$ = 0.5 (100000 / 15)**
   Lower energy = 0.5 * 3.14159 * (Tm – T min) { chart }
   Tmin = Tm – 2122 = - 1061
23) **Total torque in cycle >> Tmax – Tmin = 3183 – (- 1061) = 4244**
24) **Total speed and torque loses = 3.5 %**
25) **Motor torque = 4244 * 3.5 = 148.5**
26) **Motor power = T_m * W_m = 148.5 * (2 * 3.14159 * 1430 /60)**
   Motor power = 22 . 24 kw
27) **Motor safty factor = 1 - (torque variation percent / max torque variation percent)**
   S_{motor} = 1 - (3.5 / ({150 -100 } / 100) = 1 – (3.5 /50) >> S_{motor} = 0.93
28) Generator max ampers = 100000 / 400 = 250 ampers
29) Safty ampers preserved = 2.5 A >> 1 kw
30) main cut-off switch =< 250 ampers
31) Cooling fans ampers = 2.5 A >> 1 kw
32) Motor ampers = 22240 / 400 = 55.6 ampers
33) operational ampers (safty) cut-off switch = 60 ampers
34) Output ampers = 250 - 60 – 2.5 = 187 maximum ampers alowed
35) **output cut-off switch ampers < 187 ampers .**

FLYWHEEL GENERATOR GENERAL DIAGRAM

single stages flywheels system

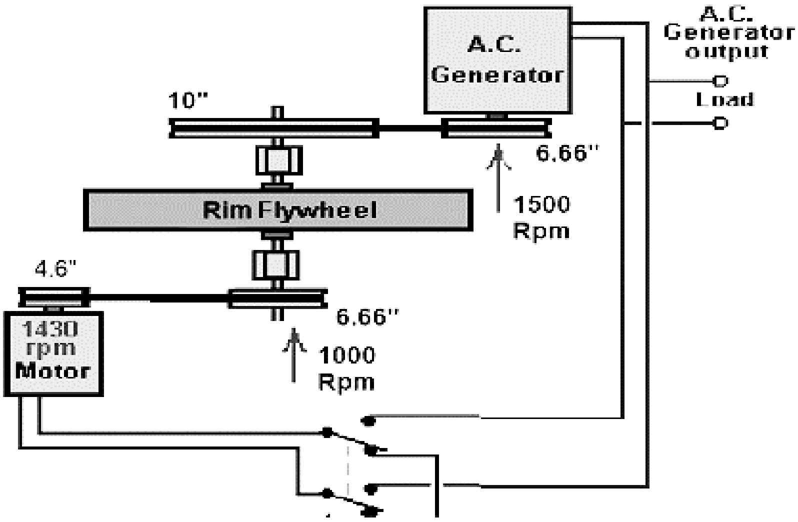
flywheel generators can be build of 1 stage (flywheel-s on one axis) to make power transformation and rotate the generator at output shaft

https://www.youtube.com/watch?v=m-Xs34GHqJI&t=9s



https://www.youtube.com/watch?v=iL05tE7-P5Q.

MAIN DIAGRAM



Chas Campbell's Power Generation System

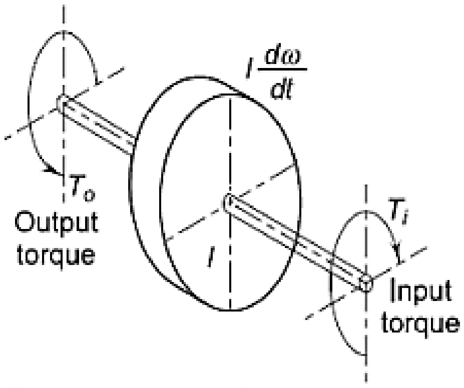
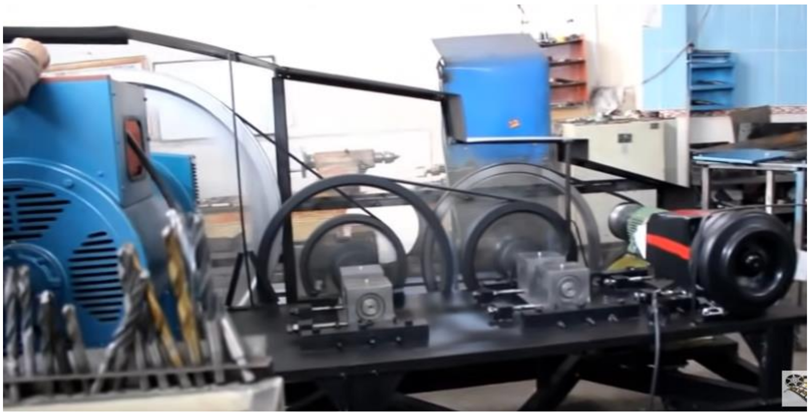


Fig. 1
Torque on Flywheel Shaft

This simple diagram is efficient and good for small power generators >> up to 100 kw …

Multi stages flywheels system

For bigger power generators multi-stages generators can be used to preserve huge power needed to run the generator at maximum load : i.e. >>> 250 kw generator or more



https://www.youtube.com/watch?v=PQa206Zn14c

Also if small size flywheels only available >> we can use many units to run the system

https://www.youtube.com/watch?v=YLXYLLEvYYY

the using of belts is preferred on gearbox

>>> belts more flexible and cause less friction loses

>> although much easier in maintenance and replacement

>> and also cheaper and can be founded every where …

https://www.youtube.com/watch?v=5LYnXJ3UIt0

BEARINGS AND AXLE

bearings is very important part of the system …

it must be selected of best quality

the main type to use >>> **Ball bearings** <<<

PRACTICALLY :

>> we must choose axle diameter considering to flywheel diameter and weight

(not only weight)because the huge radial forces on the rotating axle and vibrations ..

>> we must consider long life of the axle and bearings …..

in spite of continuous radial forces and vibrations

>> also maintenance and even replacement .. to do by the easiest way ..

>> the more bigger diameter of axle the more axle safety and resistance of vibrations and forces

>> Best Axle diameter …. Up to 10% of Flywheel diameter …(+ considering the weight)

>> flywheel of 150 cm diameter up to 1 ton weight >> minimum axle of 10 cm solid steel rod

….. if weight is bigger >> steel axle rod must increased up to 14 or 15 cm wide …

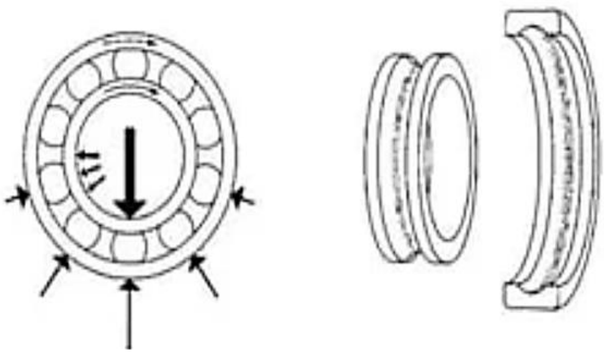
{{{ As so it is preferred to use wide axle diameter like : >>> wide engraved cylinder <<<

even In less wheel diameter and weight }}} >> more STABILITY ..

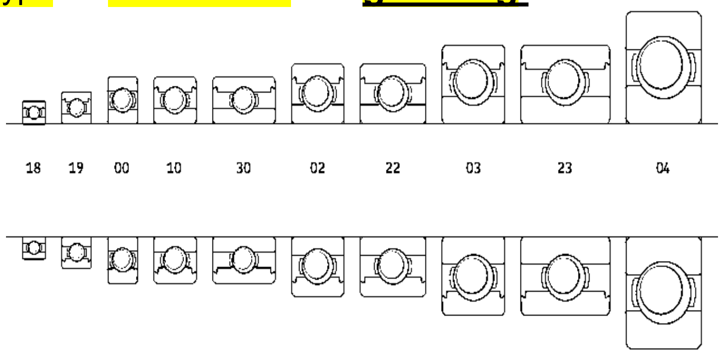
>> bearings pore must fit the axle diameter

>> bearing seat size can help in safety and resisting vibrations ,

>> it is preferred to choose the easiest open type for maintenance and **greasing.**



Radial forces on bearings



ball bearings types

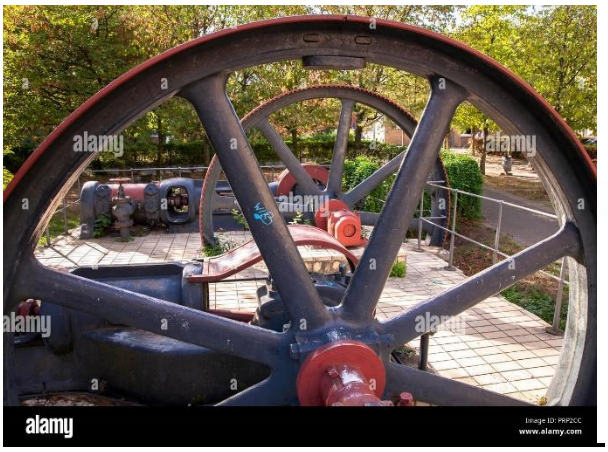
FLYWHEEL DESIGN

There are many designs of Flywheels …

- Disk type Flywheels….
  This is basic type …for heavy weight and higher speed
  Disk volume formula $V = 0.25 * pi * D^2 * t$
  { D … diameter ;; t … thick)
  Disk balancing is perfect !!
  May be used in huge power stations ..

- Rim type Flywheel ….
  This is the preferred type …for All generators !!!
  Has much effective weight on peripheral rim ++
  And less interior weight
  Disk volume formula $V = pi * D * t * d$
  { D … diameter ;; t … thick ;; d … width)
  Disk balancing is very good !!

- Arm type Flywheel …….
  Has minimum weight in the middle
  and maximum effective weight on the peripheral cylinder
  Disk balancing is good …
  May be used in medium and low speed wheels
  To reduce over all weight of the wheel



FLYWHEEL BALANCING

The maximum important step in system design is balancing the flywheel to eliminate vibrations and prevent damages to the bearings ….

forces should be concentrated at the center of axle

- in unbalancing wheels ??

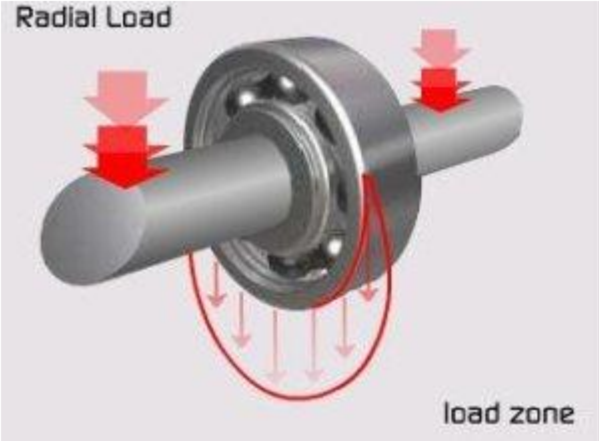
>>> forces will be apart from bearing center

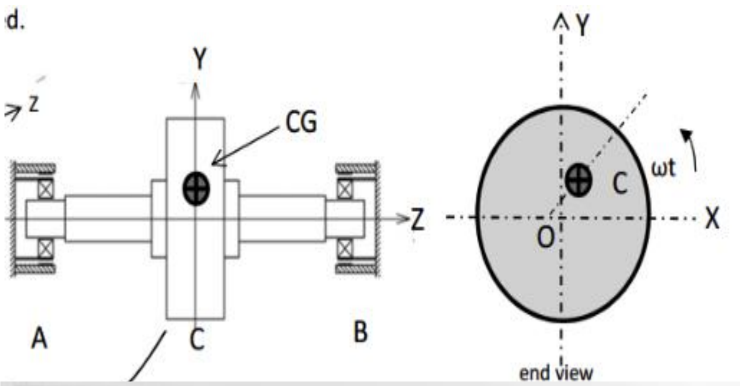
>>>causing much vibrations ..

>>> may cause serious damage to the bearings

FLYWHEEL MUST BE BALANSED .

at maximum speed alowed .

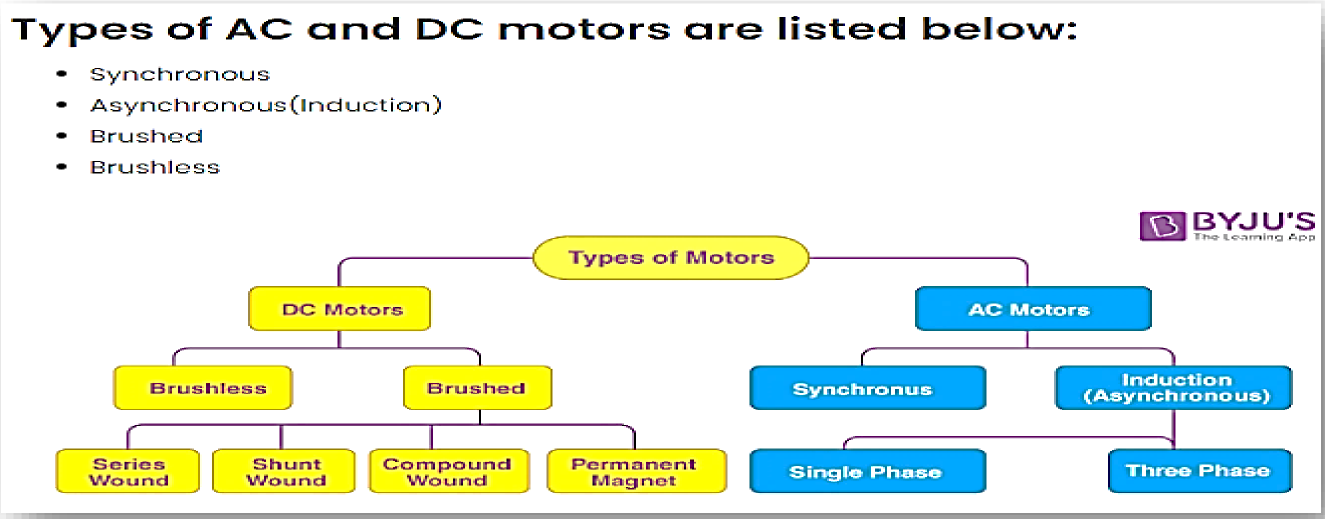




MOTORS TYPES

There are many types of motors …

Ac synchronous motors , Dc motors , and Ac permanent magnet .



To start the rotation from 0 point we need to use speed controller device

(3 phase motor Vfd inverter >> 220V or 400 V) or (BLDC motor controller)

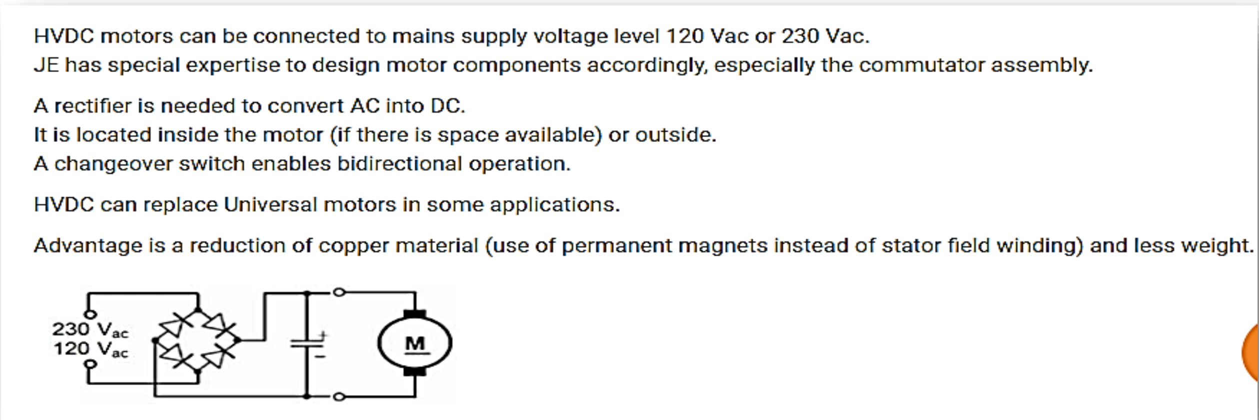
- single phase Ac motors of (220 volts/50 Hz ~ or ~ 120 v / 60 Hz)
  cannot be controlled by inverters so **not to be used** to start from 0 speed ….
- 3 phase Ac motors of (220 volts (50 / 60 Hz ~ or 400 volts)
  Can be controlled by Vfd inverters to start speed from 0 up to mean motor speed
- Dc motors can be controlled by dc controller to start from 0 up to mean motor speed

>>> A high voltage/low current Dc motor is often considered >>>

better than a low voltage/high current motor for several reasons:

* improved efficiency, * reduced conductor size, * safety benefits, and * stability

>>> even if they have the same wattage rating << as>> low voltage/high current motors.<<<<


HVDC motors can be connected to mains supply voltage level 120 Vac or 230 Vac.
JE has special expertise to design motor components accordingly, especially the commutator assembly.

A rectifier is needed to convert AC into DC.
It is located inside the motor (if there is space available) or outside.
A changeover switch enables bidirectional operation.

HVDC can replace Universal motors in some applications.

Advantage is a reduction of copper material (use of permanent magnets instead of stator field winding) and less weight.

@ Dc high voltage specifications >>>. From manufacturer catalogue >>>>

Motor >>> <> Voltage <> Power <> speed <> torque <> current

Style number	Voltage(V)	Power(w)	no-load speed (rpm)	rated speed (rpm)	rated current (A)	rated torque (N.m)	peak torque (N.m)	no-load current (A)	motor length L(mm)
DB130-36-2500-30S	36	2500	3300	3000	86.80	7.96	23.87	< 33.3	190
DB130-48-2500-30S	48	2500	3300	3000	65.10	7.96	23.87	< 25	190
DB130-72-2500-30S	72	2500	3300	3000	43.40	7.96	23.87	< 16.6	190
DB130-310-2500-30S	310	2500	3300	3000	10.08	7.96	23.87	< 3.9	190
DB130-48-3000-30S	48	3000	3300	3000	78.13	9.55	28.65	< 30	190
DB130-72-3000-30S	72	3000	3300	3000	52.08	9.55	28.65	< 20	190
DB130-310-3000-30S	310	3000	3300	3000	12.09	9.55	23.87	< 4.3	190
DB130-48-3500-30S	48	3500	3300	3000	91.14	11.14	33.43	< 30.4	240
DB130-72-3500-30S	72	3500	3300	3000	60.76	11.14	33.43	< 20.3	240
DB130-310-3500-30S	310	3500	3300	3000	14.11	11.14	33.43	< 4.7	240
DB130-48-4000-30S	48	4000	3300	3000	104.16	12.73	38.19	< 37.2	240
DB130-72-4000-30S	72	4000	3300	3000	69.44	12.73	38.19	< 24.8	240
DB130-310-4000-30S	310	4000	3300	3000	16.12	12.73	38.19	< 5.8	240
DB130-48-4500-30S	48	4500	3300	3000	117.18	14.33	42.99	< 41.4	240
DB130-72-4500-30S	72	4500	3300	3000	78.13	14.33	42.99	< 27.6	240
DB130-310-4500-30S	310	4500	3300	3000	18.15	14.33	42.99	< 6.4	240

@ Ac induction motor specifications >>>> From manufacturer catalogue >>>>

Motor >>> Power <> speed <> torque <> Frequency <> current <> efficiency

Model	Seat No.	Power KW	Speed RPM	Torque N.m	Frequency Hz	Current A	Energy Efficiency
PM-Y2-6314	63	0.2		0.635		0.6	
PM-Y2-6324		0.4		1.27		1.2	
PM-Y2-7114	71	0.75		2.4		1.7	88.6
PM-Y2-7124		1.1		3.5		2.45	89.8
PM-AW90S1-4		1.5		4.8		3.3	90.9
PM-AW90S2-4		2.2		7		4.7	91.8
PM-AW90S3-4		3		9.55		6.4	92.6
PM-AW112M1-4	112	4	3000	12.8	100	8.6	93.3
PM-AW112M2-4		5.5		17.5		11.6	94
PM-AW112M3-4		7.5		24		16	94.5
PM-AW132S1-4	132	11		35		22	95
PM-AW132S2-4		15		47.75		30.9	95.3
PM-AW160M1-4	160	18.5		59		37.8	95.6
PM-AW160M2-4		22		70		45	95.9
PM-AW160M3-4		30		95.5		61	96.1
PM-Y2-6334	63	0.2		1.27		0.6	...
PM-Y2-6344		0.4		2.54		1.2	...
PM-Y2-7134	71	0.75		4.8		1.7	85.6
PM-Y2-7144		1.1		7		2.45	87.4
PM-AW90L1-4	90	1.5		9.6		3.3	88.1
PM-AW90L2-4		2.2		14		4.7	89.7
PM-AW90L3-4		3		19.1		6.4	90.3
PM-AW112M4-4	112	4	1500	25.5	50	8.6	90.9
PM-AW112M5-4		5.5		35		11.6	92.1
PM-AW112M6-4		7.5		47.8		16	92.6
PM-AW132M1-4	132	11		70		22	93.6
PM-AW132M2-4		15		95.5		30.9	94
PM-AW160L1-4	160	18.5		117.8		37.8	94.3
PM-AW160L2-4		22		140		45	94.7
PM-AW160L3-4		30		191		60	96.6

OVER ALL SYSTEM DESIGN

Considerations

1)))) **System power needed** :

We must first define our needs >>> the maximum power output to do jobs …

Sample : 50 kw power (indoor 230 volts , signal phase >> with 220 amperes)

>> in this case OUTPUT cut-off safety switch must be **220** amperes { power limit }

>> As so we need to consider maximum power withdraw from generator = 85 %

{ To prevent over load and over heating >> to prevent serious problems }

This is very important for long time operation >> we do not need to stop generator

To make it cooler in case of getting over heating …

>> the great aspect here is that widespread manufactured >> Ac Synchronous alternators <<

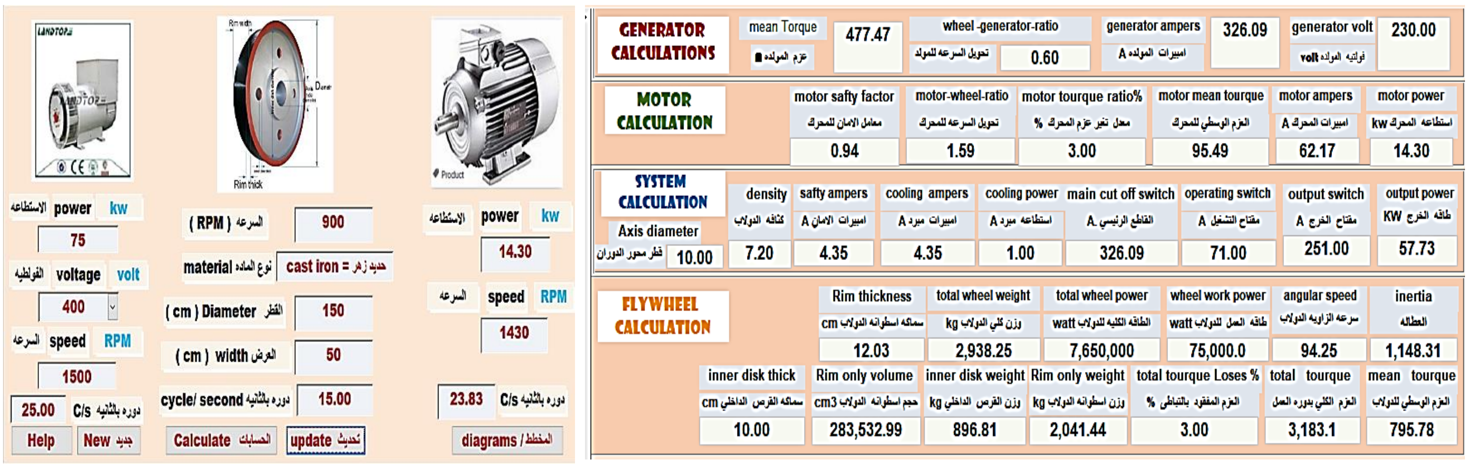
&&& Is very much cheaper than full set Like diesel generators &&&

>> this enable us to use bigger dynamo with much preserved unused safety power <<

>> we can define **** 1 kw _ up to 10 kw *** safety un-used power .. ******

>> **BLDC motor** >>> almost 15 kw =~ 20 horse power <<< >>> 65 amperes

“” program calculations for 75 kw generators “””” (power = 50+10+15 = 75 kw)



>> the operations cut-off safety switch is >> 75 amperes (17 KW)

****(++ 5 amperes of 1 kw for cooling system if needed + 5 amperes margin overload) ********

>> the output cut-off safety switch ** 50 kw ** >> 220 amperes or less ..

The Conclusions

>>> we need 75 kw generator >>> 100 kvA - 230V / signal phase (325 amperes) <<<

2)))) Motor type and controllers:

*** We need to use controllers to start motor >>> from 0 speed to operational speed <<<<

*** we **can not use** signal phase Ac asynchronous induction motor ???

*** we **can use** 3 phase Ac asynchronous induction motor with suitable motor Vfd inverter

(20 horse power) to start from 0 speed to working speed

** we can not switch to generator single phase current ??? .. when reaching suitable speed

** we need to run motor by the invertor >> this cause excessive usage of Vfd invertor

** Also we need to use dc to Ac inverter to feed the invertor

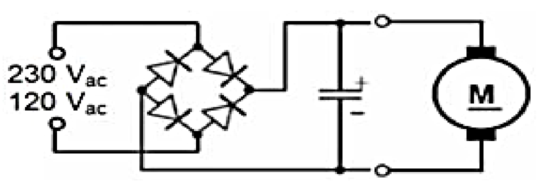
(this must be 2 stages inverter (24 v to 230 v) transformer-less)

(both for starting from batteries and continuously operation)

So .. brushless Dc motor (high voltage { 48v} or{ 72v } or { 310 v } >>> is best choice)

/// DC motors { 310 v } >> can be connected to generator voltage supply

(230 v – Ac-r.m.s = = 311 v -dc)



> **in this case** we need to use dc-dc converter (to boost voltage from 48 v batteries > to 310 v)

To feed BLDC controller for starting -up the DC motor (batteries bank <<< >>> off-grid <<<)

Then switching to generator main current supply .>>> DC rectified current <<<<

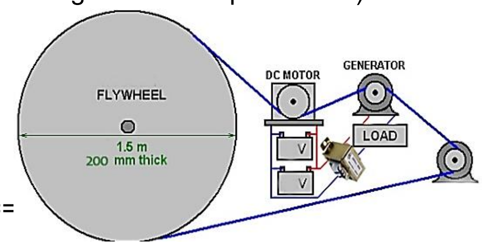
/// DC motors { 48 v / 72 v } >> can be starting -up directly by feeding controller from batteries bank

>> Then we can switch to suitable transformer output (feeding from the generator oupit current)….

>> operating transformer must give suitable output power ::

230v Ac – r.m.s >>>> 34 v AC – r.m.s == 48 v -dc

230v Ac -r.m.s >>>> 51 v AC – r.m.s == 72 v dc



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For >>>> 3 phase system Ac synchronous generators >>>

the generator and motor will be of the same voltage +++ motor Vfd invertor

we **can** switch to alternator current directly >>> controller only for starting operation …!

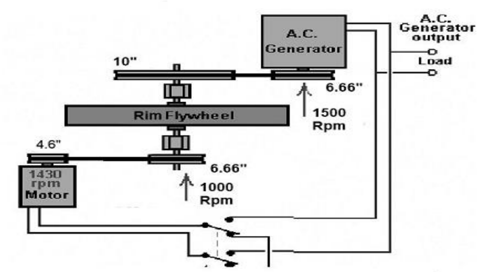
*** We need to use power inverter (Dc to Ac power inverter) to feed the Vfd motor inverter

To start the system from the baterries bank >>> off-grid <<<

---

3)))) r_{cvt}(r_1 speed / r_2 speed) ratio : (percent of speed)

(((. $r_{cvt} = r_{motor} / r_{flywheel}$))) is very important ratio >> to calculate shaft wheel diameter for **motor vs flywheel**



Chas Campbell's Power Generation System

$r_{cvt\ (motor / flywheel)}$ = 1430 / 1000 = 1.43

Asynchronous motor speed 1430 rpm

Motor shaft wheel diameter = 4.6 " inches = 11.50 cm

>>> 1 inches = = 2.5 cm <<<

Flywheel speed 1000 rpm >>

Flywheel input shaft wheel diameter = 1.43 * 11.5 = 16.5 cm = 6.6 " inches

>> Also <<

(((. $r_{cvt} = r_{flywheel} / r_{generator}$))) is very important ratio >> to calculate shaft wheel diameter for flywheel vs generator

$r_{cvt\ (flywheel / generator)}$ = 1000 / 1500 = 0.666

flywheel shaft output wheel diameter = 10 " inches = 25 cm

Asynchronous generator speed 1500 rpm

generator shaft wheel diameter = 0.666 * 25 = 16.65 cm = 6.66 " inches

---

>> Also <<

>> torque is proportional to speed >>

When we uses motor ((3000 rpm speed <> 22 kw) >> torque = 70 N.M

>>> motor rotate 3 cycle vs every 1 cycle of the 1000 rpm flywheel <<<

For flywheel >> Work done / 1 cycle >>> motor rotating torque = 3 * 70 = 210 N.M torque

This is very useful when calculating motor power ….

>>> r_{cvt} Ratio must be considered >>> when motor speed multiply flywheel speed <<< (3000 Vs 1000)

>>> if motor speed nearby flywheel speed we can consider ratio = 1 (1430 Vs 900)

==

>> Also <<

When we uses generator ((125 low rpm speed <> 100 kw) >> torque = 7650 N.M

>> flywheel (750 rpm) rotate 6 cycle Vs every 1 cycle of the 125 rpm generator (125 Vs 725)

This is very useful when calculating flywheel power … >>> ((speed ; weight ;torque) <<< …

So we can use suitable wheel with low speed and max torque .

When generator speed nearby flywheel speed >> we can consider ratio = 1 (1000 Vs 1500

Low speed permanent magnet generator >>>> specifications >>>>

from manufacture catalogue

Power	AC voltage	speed	poles	frequency	Rated torque	current	efficiency	weight
2.5kw	400V	273rpm	22	50Hz	88Nm	16.9A	93.80%	72kg
5 kw	400V	273rpm	22	50Hz	176Nm	16.9A	93.80%	122kg
8 kw	400V	250rpm	24	50Hz	306Nm	16.9A	93.80%	186kg
16 kw	400V	500rpm	12	50Hz	306Nm	16.9A	93.80%	186kg
12 kw	400V	250rpm	24	50Hz	460Nm	16.9A	93.80%	260kg
24 kw	400V	500rpm	12	50Hz	460Nm	16.9A	93.80%	260kg
15 kw	400V	214rpm	28	50Hz	670Nm	16.9A	93.80%	320kg
30 kw	400V	428rpm	14	50Hz	670Nm	16.9A	93.80%	320kg
20 kw	400V	187.5rpm	32	50Hz	1020Nm	16.9A	93.80%	420kg
40 kw	400V	375rpm	16	50Hz	1020Nm	16.9A	93.80%	420kg
30 kw	400V	187.5rpm	32	50Hz	1530Nm	16.9A	93.80%	720kg
60 kw	400V	375rpm	16	50Hz	1530Nm	16.9A	93.80%	720kg
35 kw	400V	125rpm	48	50Hz	2700Nm	16.9A	93.80%	1260kg
70 kw	400V	250rpm	24	50Hz	2700Nm	16.9A	93.80%	1260kg
105 kw	400V	375rpm	16	50Hz	2700Nm	16.9A	93.80%	1260kg
140 kw	400V	500rpm	12	50Hz	2700Nm	16.9A	93.80%	1260kg
80 kw	400V	125rpm	48	50Hz	6120Nm	16.9A	93.80%	1680kg
160 kw	400V	250rpm	24	50Hz	6120Nm	16.9A	93.80%	1680kg
200 kw	400V	375rpm	16	50Hz	6120Nm	16.9A	93.80%	1680kg
320 kw	400V	500rpm	12	50Hz	6120Nm	16.9A	93.80%	1680kg
100 kw	400V	125rpm	48	50Hz	7650Nm	16.9A	93.80%	2800kg
200 kw	400V	250rpm	24	50Hz	7650Nm	16.9A	93.80%	2800kg
300 kw	400V	375rpm	16	50Hz	7650Nm	16.9A	93.80%	2800kg

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