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Supplementary for waste Heat Recovery in Electrical Power Generation

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Abstract— In industries such as oil, gas plant and steel plants be accompanied among large amount of heat and that may not be utilized for the plant operation. This wasted heat energy is able to be utilized for supplementary power production. The water flow system over the heating unit may produce the steam and is used for supplementary power production. During this process, high quantity of coolant in the plant is circulated under low temperature and it may reduce the frequency level in the system when the turbine speed decreases. In this project, the flywheel mechanism is suggested to beat this trouble. Flywheel is an automatic machine that can responds in short time and is used to store turning force. The energy storage flywheel is planned to connect on breaker, which will compensate the variation frequency, and it will be maintained as constant. The proposed method will be verified with MATLAB/Simulink model.

Keywords— Turbine, waste heat energy, flywheel storage energy, simulation.

I. Introduction

Many of Indian company waste heat in the environment waste heat reserve the net energy that necessarily plants lost within on hand method after integration, heat pipe exchanger technology very economic reasons. Waste heat energy plants a method lost within independent this flywheel energy technology choice made inside the method. Among the steel power plant generating the electricity co- cycle power plant comparison steam power plant individually have greater efficiency.

The energy efficiency combined co cycling energy efficiency of waste heat mending WHR set to upgrade vapor power plant performance partial re powering system. In this WHR steam turbine or turbine instead small boiler this idea is useful for power plant maximum power generation burners generate the heat This paper suggests magneto thermal power device recycling waste heat form oil and gas plants [1]. designed with double pressure warm mending vapor generator [2]. Energy management algorithms based on pointer manage technique for flywheel storage device [3]. Proposed method adopts double closed loop manage saturate stability of the dc bus voltage minted by according flywheel battery [4]. Cooled before the gas treatment unit via warm exchanger or adding fresh air based on waste warm mending system [5]. The waste warm energy recovery utilized stripling engines or mechanical device gamma type waste warm recovery [6]. To the dives for recycling the waste warm from cement company utilization waste heat source [7]. According the double method twin loop manage FES outer loop of speed plus indoor loop voltage and current speed regulation mode outer loop voltage plus inner loop Of current under voltage regulation [8] get charge and discharge method of flywheel through battery modifiable flywheel speed without changing the circuit [9]. Most of engineering, natural processes, including steel plant with a big quantity heat that is not traditional way is ineffective since low temperature variation And warm and ice sores. Renewable energy power generation technologies greatly developed exhaustion trend relic energy increased resources, environmental, power system directly due to inherent random fluctuation. Mainly effective method resolves kind involuntary machinery. Stored mechanical energy rotating flywheel energy required completely other conventional storage methods as the maximum level of energy density.

Normally, all steel plant steel melting used for high electricity that time more heat will be produced, maximum level 1050.C minimum level 850.C range of heat required. That time steel melting process some of heat come out that heat based an electrical power generation technology for supplementary electrical power production from Waste warm recovery. The supplementary electrical power production time maximum waste heat level for a 470'C minimum range for 140’C normally maintained. The heat range compact means, power generation will be reduced. That time I am use flywheel application. Flywheel functioning for three part motor/generator power exchange device.The volume of kinetic strength saved in a rotating purpose is role of its mass and rotating speed.The minute of lethargy in need on the mass and geometry of the rotating object. mounting the rim speed, the speed at the surface end

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of the wheel, is more effective order to store additional kinetic energy than mounting mass of flywheel.

II. OPERATION

Normally twin method waste heat recovery system will be maintained one for direct heating second for reheating those two methods i am using here The heat pipes exchange will high efficiency and best thermal conductors in this design of WHR approach temperature difference include measured 140.C Using energy equation for steam/water and gas in WHR various sections their ability to transfer heat hundred times more than copper Steel industry 25kg/s estimations additional mechanical subsequence electrical one generated secondary heat energy utilization thermomagnetic engines up to 3.5mw This heat pipe mainly use renewable force technology heat pipes mainly used space application compared to anther heat observing method this single of the best methods Measures hotness by correlate the confrontation of the confrontation temperature detector CTD factor with temperature they maintained 50'c to 600'c.

III. Full operation and working method block Diagram:

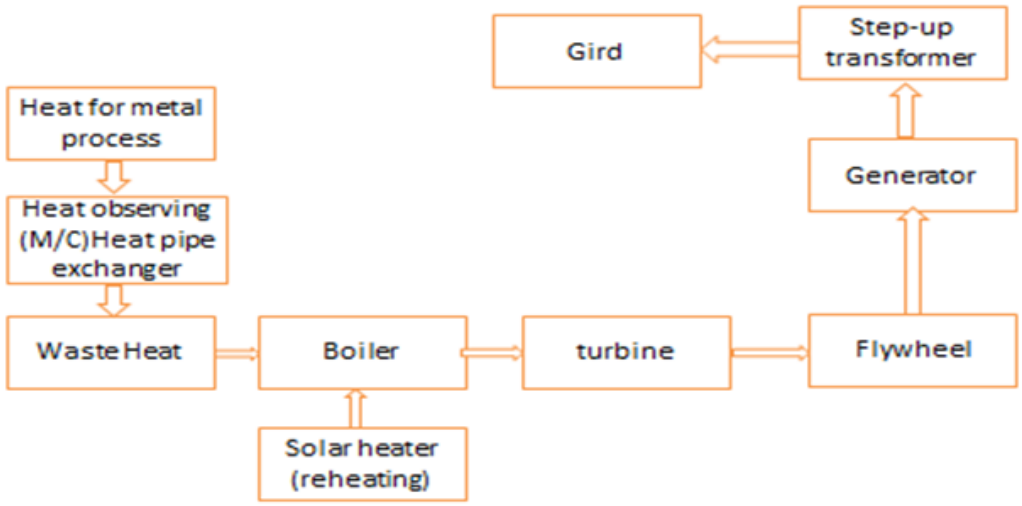

Fig. 1. Conceptual diagram of the proposed scheme

Waste heating method:

A. Waste heating without flywheel,
B. B. Waste Heating with flywheel

A. Waste heating without Flywheel method:

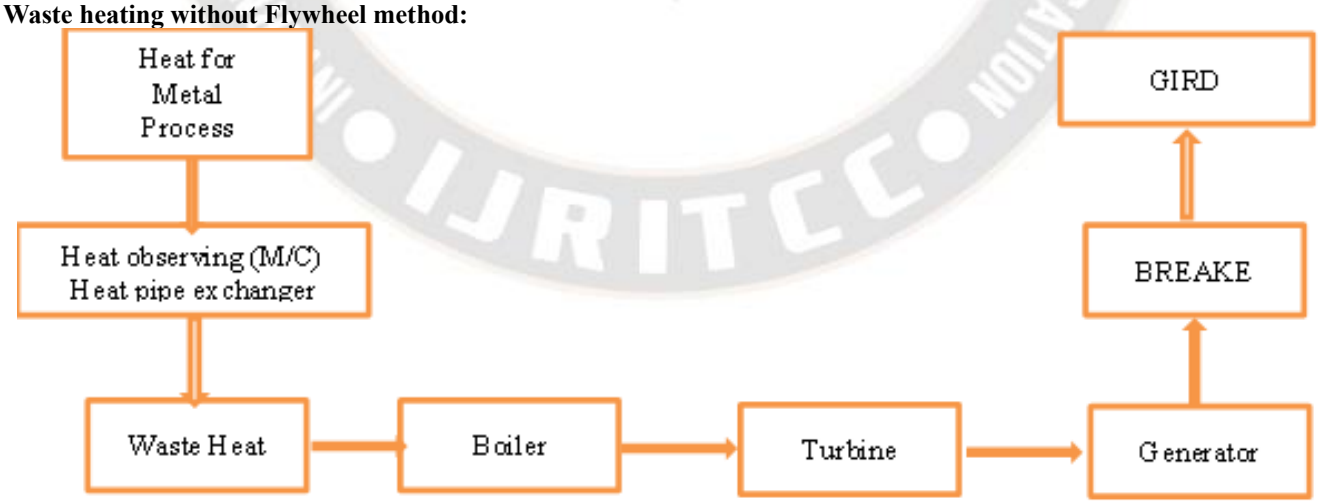

Fig. 2. Conceptual diagram of the proposed scheme

In this direct heating method steel melting station to through observing waste heat inject to turbine this heat 190'C to 360'C coming out, this method called as a direct heating method.

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B. Waste Heating with flywheel:

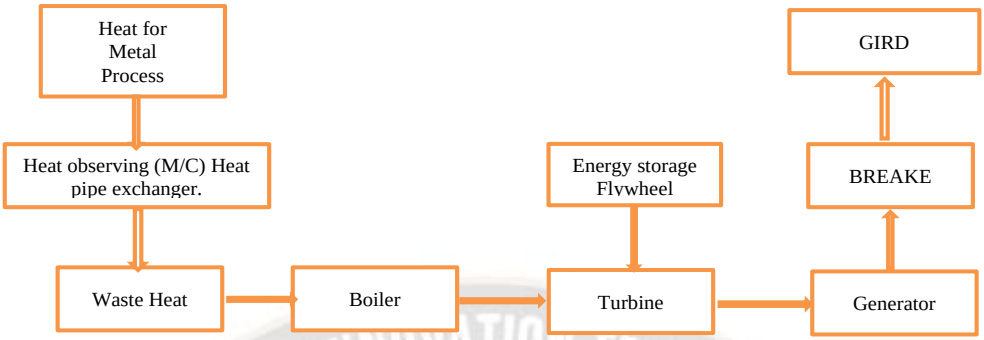

Fig. 3. Conceptual diagram of the proposed scheme

In this direct heating method steel melting station to through observing waste heat inject to turbine this heat 190'C to 360'C coming out, this method called as a direct heating method. Sometimes very less temperature accord that time we are using energy storage flywheel technology. This technology very helps in high-efficiency power generation.

- **Re-heating method:**
  A. Re-Heating with flywheel,
  B. Re- Heating without flywheel

A. Re-Heating without flywheel

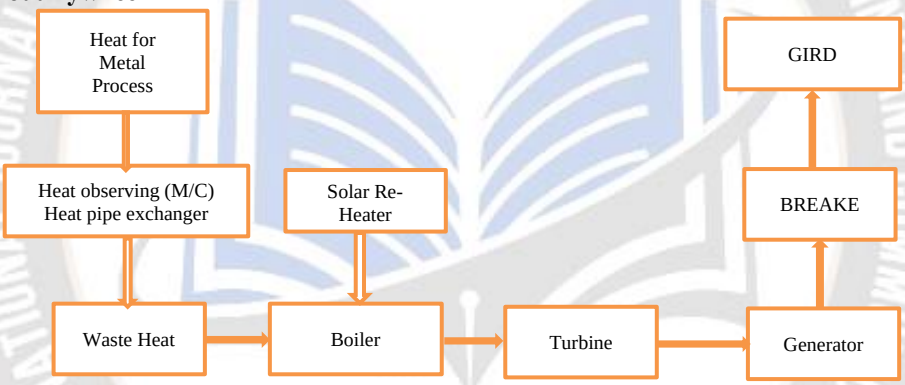

Fig. 4. Conceptual diagram of the proposed scheme

That time steel melted, after a steel melting process some of heat come out that heat based an electrical power production technology for supplementary electrical power production from waste warm improvement. The auxiliary electrical power manufacturing time most waste warmness level for a 470'C minimum range for 140'C typically maintained. The warmth range compact way, energy generation can be decreased.

B. Re- Heating with flywheel

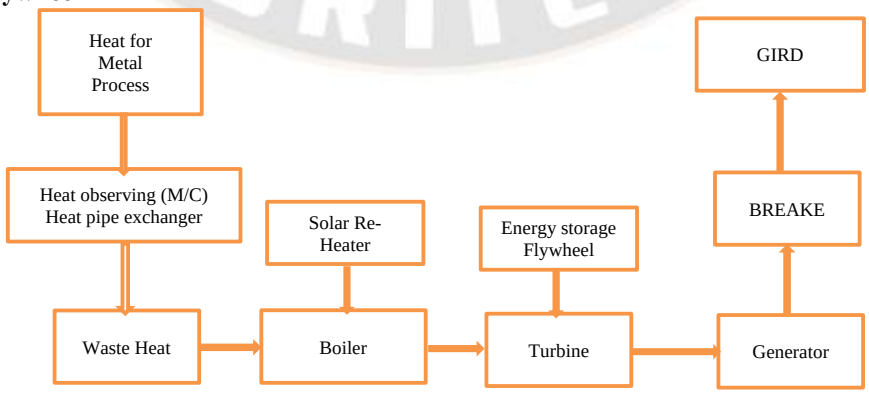

Fig. 5. Conceptual diagram of the proposed scheme

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That time steel melted, after a steel melting process some of heat come out that heat based an electrical power production technology for supplementary electrical power production from waste warm improvement. The auxiliary electrical power manufacturing time most waste warmness level for a 470'C minimum range for 140'C typically maintained. The warmth range compact way, energy generation can be decreased. That time I am use of flywheel utility. Flywheels functioning for 3 elements are motor, generator electricity alternate device.

Equations

Air Compressor

$$T_B = T_A[1 + \frac{1}{\eta AC}(r_c \frac{\gamma_{a-1}}{\gamma_{a-1}})]$$

(1)

$$\dot{W} = \dot{m}\, aCp, a(T_B.T_A$$

(2)

C_P, a has been define as a function of temperature.

$$CP = 1.048 - (\frac{3.83}{10^4}) + (\frac{9.45^2}{10^7}) + (\frac{5.490^3}{10^{10}}) + (\frac{7.929^4}{10^{14}})$$

(3)

- Heat Recovery Steam Generation (HRSG)

In design of HRSG approach temperature difference have been considered 140·C using energy equation for steam/water and gas in HRSG varins sections following equations

T_{gt}, out, per, eva= ^{T}pre, eva+ DELTA_ Tpre, pinch (4)

T_{gt}, out, hp, eva = Thp,eva+ DELTA_ Thp, pinc (5)

GAS [stream turbine]

Power generated by steam turbine

$$\dot{W}st = \varepsilon stages\dot{m}\, st, in(h_{st}, in\_hst, out$$

(6)

Frequency calculation

The principle for frequency, when agreed wavelength and the rapidity of the wave, is in print as:

$$f = V / \lambda$$

(7)

In this formula, f represents frequency, V represents the velocity of wave, and λ represents the wavelength of wave.

Energy Storage Flywheel Charging Method

A flywheel wants bag force to originate it off so it needs a lot of might to make it stop as an outcome when it is revolving at elevated speed to keep on revolving. Which means it can store a grand deal of kinetic power. Things moving in an immediate line have impetus, and kinetic energy since of their crowd and their speed. During the matching system, turning clothes have kinetic power because they have what has called a second of collapse and a rangy velocity. Instant of torpor is the equivalent of mass for rotary matter, while rangy velocity is like usual swiftness only going around in a circle.

Just as the kinetic energy of an purpose affecting in a directly line is given by this equation

$$E = ½mv2$$

(8)

(Where m is mass and v is velocity), so this one gives the equivalent, kinetic energy of a spinning object:

$$E = ½Iω2$$

(9)

(Where I is the moment of inertia and ω is the angular velocity).

Flywheel function

Flywheel electricity storage FSE operates by approach improved speed of a blade flywheel toward maximum speed level maintaining the power in the method. As rotational electricity. However electricity is take out as of the system the flywheel's rotating speed is declined as a consequence of the rule of conservation of power adding power To the system similarly consequences in an growth within the speed for flywheel Maximum FES methods consumption power to improve and sluggish down the flywheel then implements that traditional use mechanical energy are being residential Greater FES systems have blades product of excessive electricity carbon fiber composite balanced With the aid of compelling bearing with rotating speeds from 20 000 up to 50 000 rpm in a vacuity enclosure . Such flywheels to the mark in a count number of mines attaining their energy capacity a plentiful extra quickly than some new categories of storage.

Methodology

The switch can be damaged constant power control method considering variable voltage variable frequency VVVF characterized slow response speed Low control static Dynamic performance the manage disk. Power conversion device flywheel through the motor / generator achieves charge and discharge process flywheel Battery energy numerical method results constant torque control suitable biggest strutting current. The energy storage space produced open area of the speed inertia flywheel increasing enhances the quantity of stored energy the higher flywheel speed usually special required flywheel battery.

IV. USING THE TEMPLATE

A. Waste / stream properties

The flywheels to collect electricity starting the ship power deliver for fast discharge keen on the electromagnetic system. The flywheel energy device cannot lying on its have deliver the excessive power transients. Every of one rotors will keep 121 mj 12kg on 6400 rpm and discharge it in 2 3 seconds. The flywheel power densities are 28 kg including the stators and instances this comes right down to 18 1kg except for the torque frame.

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Table 1. stream conversion method.

Temp(C)	Pressure (Bar)	Mass Flow (Kg/s)	Turbine RPM
470.3	104.84	61.86	1437
392.8	86.38	54.18	1378
365.6	85.01	51.00	1294
315.8	61.7	46.89	1225
403.0	97.06	48.73	1414
365.6	84.37	38.83	1397
466.5	99.22	59.88	1330
132.9	6.72	6.84	754
144.6	16.24	7.24	879
400.6	82.11	57.63	1364
365.6	81.17	49.84	1326
316.2	76.82	43.61	1118
214.7	63.42	39.89	998
286.3	65.87	26.37	1206
186.9	33.61	10.81	893

B. Water /stream flow chart

The chart showing the flow of temperature and pressure weight age of stream those thinks focus.

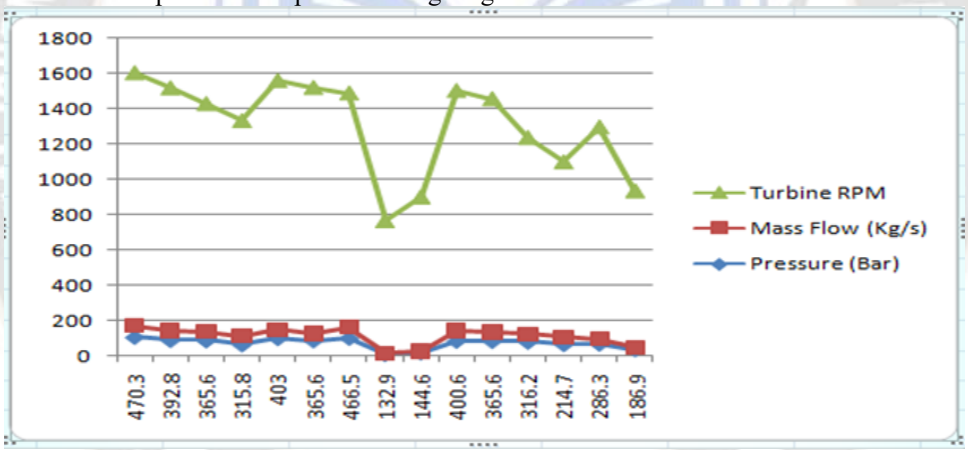

Chart 1. Turbine input chart title.

V. PROPOSED SIMULINK FUNCTION

A. Waste heating without flywheel:

This Simulink diagram that supplementary power generation two type of methods I using one for direct heating and reheating methods. The flywheel force storage dives also attached. The supplementary power generation using most of steps first for heat for metal melting process that place to obscure waste heat and again apply for re heating process that output giving to small turbine in medial one sensor inserted that one for heat sensor after parallel connected direction control that direction control when this sensor give low temperature in the circuit switch on that time this flywheel run. The energy storage flywheel connect in turbine parallel any time both thinks running. This turbine coupled generator.

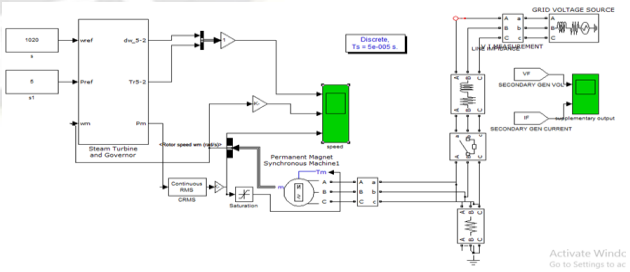

Fig.6: Wasted heating without flywheel proposed scheme.

This direct heating method very less power output and most of level fluctuation. Waste heating observing temperature range 204. C only, this system steam weight also very less.

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B. Waste heating with flywheel

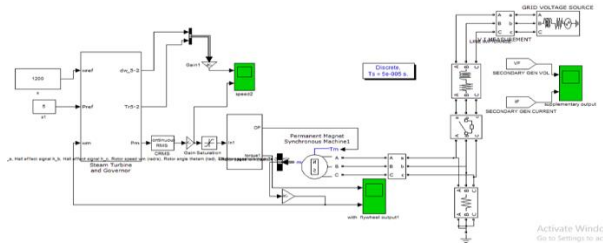

Fig.7 Waste heating with flywheel proposed scheme.

Waste heating with flywheel adapting method very high-level efficacy and also comparable power generating technology. This kind of method didn't use outside of industries.

A. Reheating without flywheel method

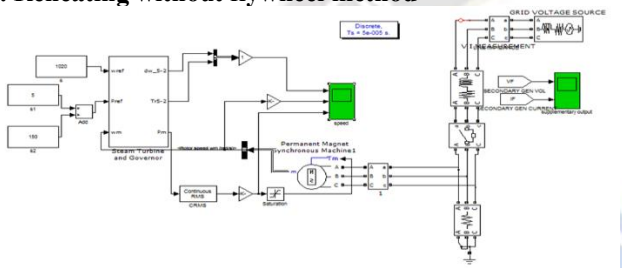

Fig. 8. Reheating without flywheel proposed scheme.

Reheating method ones observing the heat energy into the steel melting place to after that heat Appling reheat method. This system very help full for power generation. After reheating that temperature will be increase that temperature range for 320. C around maintained.

B. Reheating with flywheel method

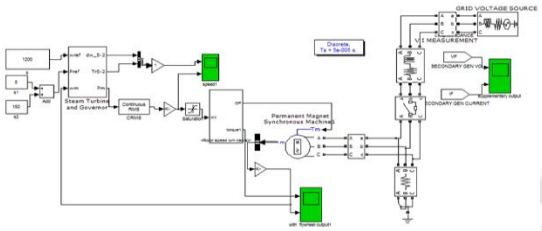

Fig. 9. Reheating with flywheel proposed scheme.

The flywheel energy storage dives also attached. The supplementary power generation using most of steps first for heat for metal melting process that place to obscure waste heat and again apply for re heating process that output giving to small turbine in medial one sensor inserted that one for heat sensor after parallel connected direction control that direction control when this sensor give low temperature in the circuit switch on that time this flywheel run.

C. Flywheel Simulink Block

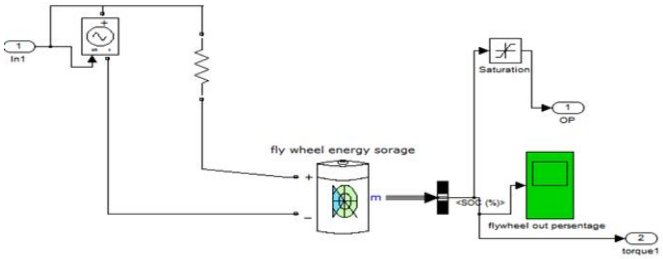

Fig. 10. Flywheel Simulink block

In this flywheel working for like battery but this flywheel two type of storage system available one for input mechanical energy means that storage also mechanical energy, but output electrical energy, incase my input electrical means that storage also electrical energy, but this outputs mechanical energy.

VI. SIMULINK RESULTS

A. Flywheel energy charging and discharging method

The output wave form of a flywheel energy storage method. Its shows the percentage range energy respect to time for the system. From the obtained results it is fount that the average value of energy.

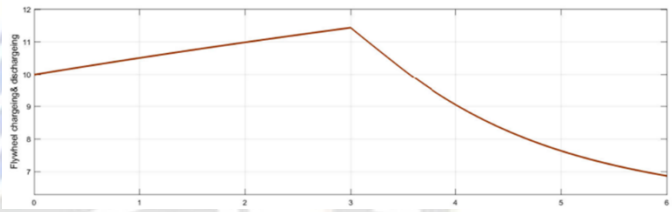

Fig. 11. Flywheel charging and discharing

This output showing the flywheel charging and discharging function that scaling noted percentage of energy storage, with in 4 sec running this machine 13%of level is energy will be stored here showing.

B. Waste heating without flywheel:

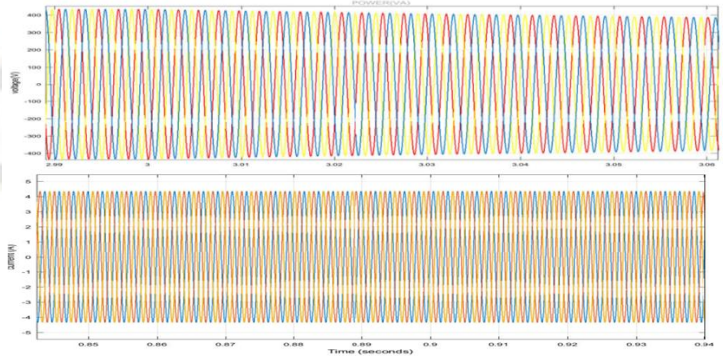

Fig. 12. Waste heating without flywheel voltage and current.

This out showing the value first stared this direct heating without flywheel power generation working normally. The output wave form of a direct heating without flywheel method. It shows the voltage characteristic with respect it is

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fount the system from the obtained result it is found that the average value of voltage is 11000V.This out showing the value first started this direct heating without flywheel power generation working normally. It showing the current characteristic with respect to time for the system, from the obtained results it is found that the average value of current is 84amps.

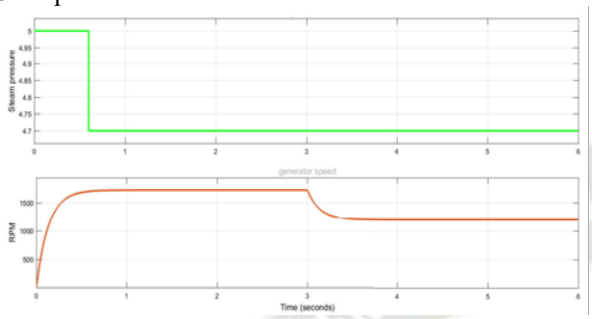

Fig. 13. Waste heating temp.

The output wave form of a direct heating temperature. It shows the characteristic with respect in time for the system, from the obtained result it is found that the value of temperature 135'C to 425'C. At the same time respect steam range 5Kg to58Kg showing the characteristic. The output wave form of a direct heating without RPM. It shows the characteristic with respect to time for the system from the obtained results is found that the average value of rotor speed is 822 RPM.

C. Waste heating with flywheel method

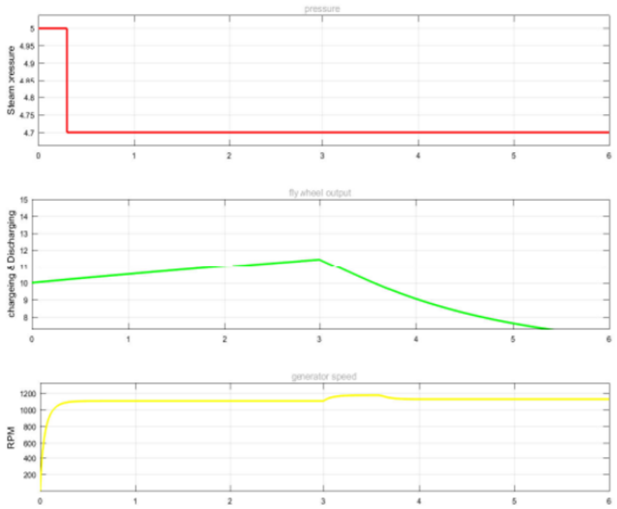

Fig. 14. Waste heating with flywheel RPM.

The output wave form of a direct heating temperature. It shows the characteristic with respect in time for the system, from the obtained result it is found that the value of temperature 135'C to 425'C. It showing the characteristic energized flywheel technology also applying this system, flywheel with in 4sec at the same time respect steam range 5Kg to58Kg showing the characteristic. The output wave form of a direct heating without RPM. It shows the characteristic with respect to time for the system from the obtained results is found that the average value of rotor speed is 1218 RPM.

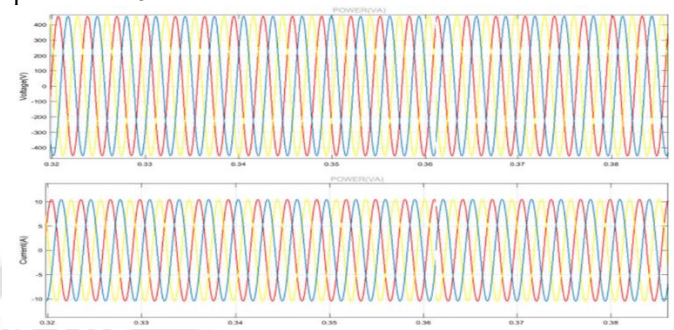

Fig. 15 Waste heating with flywheel voltage

This out showing the value first stared this direct heating with flywheel power generation method working normally. The output waveform of a direct heating with flywheel method smooth and some level power will be increase. It shows the voltage characteristic with respect it is fount the system from the obtained result it is found that the average value of voltage is 11000v.This out showing the value first started this direct heating with flywheel power generation working normally. The power output flywheel method smooth and get more power compare to without flywheel method. It showing the current characteristic with respect to time for the system, from the obtained results it is found that the average value of current is 173 amps.

D. Reheating without flywheel method

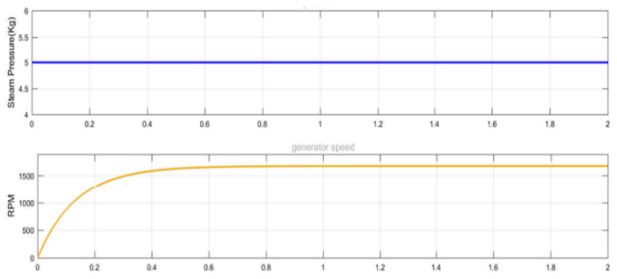

Fig. 16. Reheating temp

The output wave form of a direct heating temperature. It shows the characteristic with respect in time for the system, from the obtained result it is found that the value of temperature 120'C to 470'C. At the same time respect steam range 5Kg to 64Kg showing the characteristic. The output wave form of a direct heating without RPM. It shows the characteristic with respect to time for the system from the obtained results is found that the average value of rotor speed is 1131 RPM.

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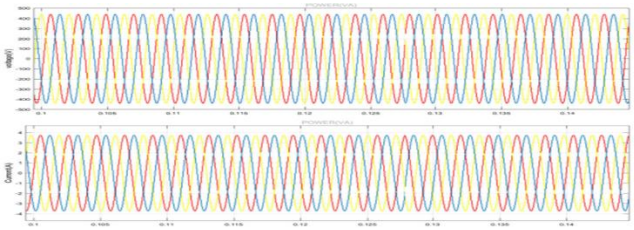

Fig.17. Reheating without flywheel voltage.

This out showing the value first stared this Reheating without flywheel power generation method working normally. The output wave form of a Reheating method some level power will be increase. It shows the voltage characteristics with respect it is fount the system from the obtained result it is found that the average value of voltage is 11000V.This out showing the value first started this Reheating without flywheel power generation working normally. The power output get more power it showing the current characteristic with respect to time for the system, from the obtained results it is found that the average value of current is 154 amps.

E. Reheating with flywheel method

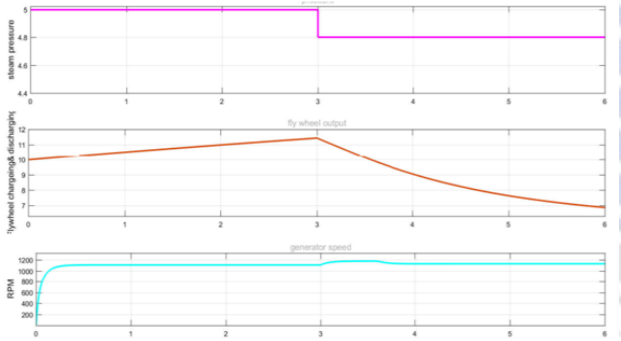

Fig. 18. Reheating with flywheel RPM.

The output wave form of a direct heating temperature. It shows the characteristic with respect in time for the system, from the obtained result it is found that the value of temperature 120'C to 470'C. It shows the characteristic energized flywheel technology also applying this system, flywheel with in 4sec At the same time respect steam range 5Kg to64Kg showing the characteristic. The output wave form of a direct heating without RPM. It shows the characteristic with respect to time for the system from the obtained results is found that the average value of rotor speed is 1458 RPM.

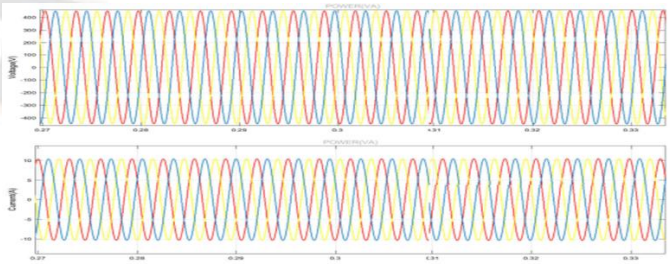

Fig. 19. Reheating with flywheel voltage.

This out showing the value first stared this Reheating with flywheel power generation method working normally. The output waveform of a Reheating with help of flywheel method smooth and some level power will be increase. It shows the voltage characteristics with respect it is fount the system from the obtained result it is found that the average value of voltage is 11000v.This out showing the value first started this Reheating with flywheel power generation working normally. The power output flywheel method smooth and get more power compared to without flywheel method. It is showing the current characteristic with respect to time for the system, from the obtained results it is found that the average value of current is 208 amps.

F. Conclusion about those results:

Table 2. Stream conversion method

	Waste (direct heating)		Re- heating	
	Without flywheel	With flywheel	Without flywheel	With flywheel
Metal melting process heat range	1020'c	1020'c	1020'c	1020'c
Waste heat observed unit	5	5	5	5
Direct heating temp 'c	135 to 425	135 to 425	120 to 470	12 to 470
Pressure in KG/S	5 to 58	5 to 58	5 to 64	5 to 64
Generator range	500 KVA	500 KVA	500 KVA	500 KVA
Generator RPM	822	1218	1131	1458
Voltage range	440V	440V	440V	440V
Current range	84 A	173 A	154 A	208 A
Rotor resistance (ohm)	25	25	25	25
Power factor	0.97	0.97	0.97	0.97

Power generation in Hour/day (MW)	**0.88 MW**	**1.82 MW**	**1.62 MW**	**2.19 MW**

VII. Conclusion

In this paper supplementary power generation in capacity of power, 4.0MW by a unit is suffered with a wasted heat energy. This wasted heat energy can be utilized for supplementary power production. Paper represents the flywheel mechanism is suggested to overcome this problem. Flywheel is a mechanical device that can responds in short time and is used to accumulate rotating energy. The energy storage flywheel is planned to connect on breaker which will compensates the variation voltage and current and it will be maintained as constant. The energy storage flywheel is planned to connect on breaker which will compensates the variation voltage and current and it will be maintained as constant. These technologies for energy storage flywheel method have less time energy storage, which compensates the voltage problem, current, and frequency loss. The proposed method will be verified with MATLAB/Simulink model.

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