

Efficiency Enhancement of Electrical Inverter



Engineering

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ABSTRACT

Inverter converts DC power into the AC power. A sine wave with 120 degree per phase total 3 phase system are used in transmission power grid. So the equipment directly converts DC power in to AC power with minimum loss. This machine is very useful in Renewable energy source nonconventional power generation by solar technology (PV cells). In this system Power generation is directly in DC power form low voltage and low current. It is not suitable for grid connection. Currently we use Electronics Invertors and it is used in bank form for high voltage and high current alternate frailer and need to repair and component replace. But we have permanent solution by Electro-Mechanical inverters. It is high efficient, low maintenance easy to installation long life cycle. 100% power transfer on grid viability with minimum loss. Any amount of DC power converts to pure AC sine wave best quality power for on line grid connection.

2. INTRODUCTION

An inverter is an electrical device that converts Direct Current (DC) to Alternating Current (AC) the converted AC can be at any required voltage and frequency with the use of appropriate transformer, switching, and control circuits. Solid-state inverters have no moving parts and are used in a wide range of applications, from small switching power supply in computers, to large electricity utility high voltage direct current applications that transport bulk power. Inverters are commonly used to supply AC power from DC sources such as solar panel or batteries. The inverter performs the opposite function of a rectifier.

0.1 Square wave

The square wave output has a high harmonic content, not suitable for certain ac loads such as motors or transformers. Square wave units were the pioneers of inverter development. Modified sine wave the output of a modified square wave/quasi square/modified sine wave inverter is similar to a square wave output except that the output goes to zero volts for a time before switching positive or negative.

It is simple and low cost and is compatible with most electronic devices, except for sensitive or specialized equipment, for example certain printers ease of Use Laser printer, florescent lighting, and audio equipment. Most AC motors will run off this power source albeit at a reduction in efficiency of approximately 20% multilevel inverter is power electronic systems that synthesize a desire voltage from several levels of direct current voltage as inputs. The advantages of using multilevel topology include reduction of power ratings of power devices and lower cost. There are three topologies - diode clamped inverter flying capacitor inverter and cascaded inverter. Pure Sine Wave: A pure sine wave inverter produces a nearly perfect sine wave output (less than 3% total harmonic restoration) that is essentially the same as utility-supplied grid power. Thus it is compatible with all AC electronic devices. This is the type used in grid-tie inverters. Its design is more complex, and costs more per unit power. The electrical inverter is a high-power electronic oscillator. It is so named because early mechanical AC to DC converter was made to work in reverse, and thus was "inverted", to convert DC to AC Grid-Tie Inverter (GTI): It is a special type of inverter that converts Direct Current (DC) electricity into Alternating Current (AC) electricity and feeds it into an existing electrical grid. GTIs are often used to convert direct current produced by many renewable energy sources, such as solar panels or small wind turbines into the alternating current used to power homes and businesses. The technical name for a grid-tie inverter is "grid-interactive inverter". They may also be called synchronous inverters. Grid-interactive inverters typically cannot be used in standalone applications where utility power is not available. Residences and businesses that have a grid-tied electrical system are permitted in many countries to sell their energy to the utility grid. Electricity delivered to the grid can be compensated in several ways. "Net metering", is where the entity that owns the renewable energy power source receives compensation

from the utility for its net outflow of power. So for example, if during a given month a power system feeds 500 kilowatt-hours into the grid and uses 100 kilowatt-hours from the grid, it would receive compensation for 400 kilowatt-hours.

0.2 Worm gear

Worm gears resemble screws. A worm gear is usually meshed with a spur gear or a helical gear, which is called the gear, wheel, or worm wheel as shown in Fig. 1. Worm-and-gear sets are a simple and compact way to achieve a high torque, low speed gear ratio. For example, helical gears are normally limited to gear ratios of less than 10:1 while worm-and-gear sets vary from 10:1 to 500:1. A disadvantage is the potential for considerable sliding action, leading to low efficiency. Worm gears can be considered a species of helical gear, but its helix angle is usually somewhat large (close to 90 degrees) and its body is usually fairly long in the axial direction; and it is these attributes which give it screw like qualities. The distinction between a worm and a helical gear is made when at least one tooth persists for a full rotation around the helix. If this occurs, it is a 'worm'; if not, it is a 'helical gear'. A worm may have as few as one tooth. If that tooth persists for several turns around the helix, the worm will appear, superficially, to have more than one tooth, but what one in fact sees is the same tooth reappearing at intervals along the length of the worm. The usual screw nomenclature applies: a one-toothed worm is called single thread or single start; a worm with more than one tooth is called multiple threads or multiple starts. The helix angle of a worm is not usually specified.



Fig. 1 Worm and gear set

Instead, the lead angle, which is equal to 90 degrees minus the helix angle, is given. In a worm-and-gear set, the worm can always drive the gear. However, if the gear attempts to drive the worm, it may or may not succeed. Particularly if the lead angle is small, the gear's teeth may simply lock against the worm's teeth, because the force component circumferential to the worm is not sufficient to overcome friction. Worm-and-gear sets that do lock are called self locking, which can be used to advantage, as for instance when it is desired to set the position of a mechanism

by turning the worm and then have the mechanism hold that position. An example is the machine head found on some types of stringed instruments. If the gear in a worm-and-gear set is an ordinary helical gear only a single point of contact will be achieved. If medium to high power transmission is desired, the tooth shape of the gear is modified to achieve more intimate contact by making both gears partially envelop each other. This is done by making both concave and joining them at a saddle point this is called a cone-drive.

0.3 Single phase alternator

A generator that produces a single, continuously alternating voltage is known as a Single phase alternator (Fig. 2). All of the alternators that have been discussed so far fit this definition. The stator (armature) windings are connected in series. The individual voltages, therefore, add to produce a single-phase ac voltage. Above figure shows a basic alternator with its single-phase output voltage. The definition of phase as you learned it in studying ac circuits may not help too much right here. Remember, "out of phase" meant "out of time." Now, it may be easier to think of the word phase as meaning voltage as in single voltage. The need for a modified definition of phase in this usage will be easier to see as we go along. Single-phase alternators are found in many applications. They are most often used when the loads being driven are relatively light. The reason for this will be more apparent as we get into multiphase alternators (also called polyphase). Power that is used in homes, shops, and ships to operate portable tools and small appliances is single-phase power. Single-phase power alternators (Fig. 2) always generate single-phase power. However, all single-phase power does not come from single-phase alternators. This will sound more reasonable to you as we get into the next subjects.

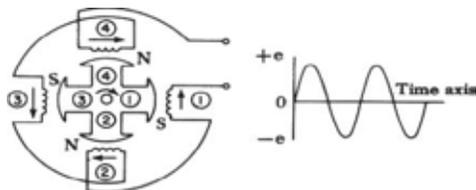


FIGURE 9-35. Single-phase alternator.

Fig. 2 Single phase Alternator

0.4 Change over switch

The change over switch (Fig. 3) is very useful to power transmission at online single phase or three phases at the time of on line change to grid line to users line and generator line to grid line. Over grid line is three phase all the time on and our power plant line is also on time to connection with power grid for power transmission. Without change over switch we cannot make connection to the power grid. Whether it is manually operated or by automatically operated. This change over switch is use to protect the power plant also by circuit breaker between the power grid and power plant.



Fig. 3 Change over switch (3 phase)

3. EFFICIENCY ENHANCEMENT OF ELECTRICAL INVERTER

Inverters take DC power and invert it to AC power so it can be fed into the electric utility company grid. The grid tie inverter (GTI) must synchronize its frequency with that of the grid (e.g.

50 or 60 Hz) using a local oscillator and limit the voltage to no higher than the grid voltage. A high-quality modern GTI has a fixed unity power factor, which means its output voltage and current are perfectly lined up, and its phase angle is within 1 degree of the AC power grid. The inverter has an on-board computer which will sense the current AC grid waveform, and output a voltage to correspond with the grid. Grid-tie inverters are also designed to quickly disconnect from the grid if the utility grid goes down. This is an NEC requirement that ensures that in the event of a blackout, the grid tie inverter will shut down to prevent the energy it produces from harming any line workers who are sent to fix the power grid. Properly configured, a grid tie inverter enables a home owner to use an alternative power generation system like solar or wind power without extensive rewiring and without batteries. If the alternative power being produced is insufficient, the deficit will be sourced from the electricity grid.

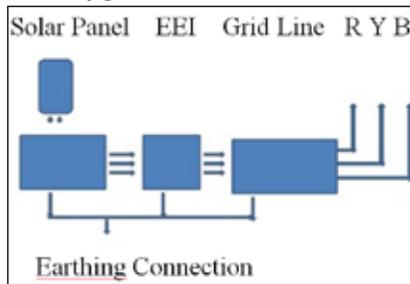


Fig. 4 Flow chart for electromechanical mechanism of Inverter.



Fig. 5 Three phase Inverter

In India three phase four wire grid connection system work and its color codes are indicated as (R)phase – Red, (Y)phase –Yellow and (B)phase – Blue, and (BL) Black is Earthing connection is Neutral(Black) as shown in Fig. 4. Three phase alternator 120 degree phase difference as per RYB phase and Neutrals is connected to earth. By help of Earthing plate copper metals.

4. CONCLUSION

We can maintain rpm of alternator with the help of the Mechanical Governor to control the speed of prime mover In three phase power output and at low speed auto circuit break and concern cover-up required speed automatic closed the circuit and power transfer to the grid and vice versa.

Enhanced efficiency Inverter (EEI) is used to low power generation power plant to connect directly to the Low Power Grid. This power generates by renewable energy sources Solar / Wind or any other Vibration and Tide energy sources. These are all low electro motive force produce power plant (EMF). So ideal for high efficiency and highest safety required and the all circumstance in EEI.

Commercially Renewable power generation in low and high power transmitter with low cost and good power quality can be developed. This Electromechanical Inverter is very useful to Solar Wind Hydro Hybrid (SWHH) power plant to connect directly on grid.

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