Power source selection criteria

Some General Terms to Understand

Insulation class- The temperature withstanding capability of the insulation materials.

Power factor- Ratio of active power used to the total power drawn from the system.

Efficiency- Power utility factor of the machine expressed as a % output to input. It accounts for losses in the system particularly transformer losses. In welding power sources 'no load' loss is a very important criteria because power source arc-on time is hardly 25% in a shop floor situation.

Ip classes define the degree of protection provided by the closure and is indicated by various 2-digit numbers such as 22,23,54 etc.

The first digit defines the degree of protection with respect to person and solid ingress.

The degrees range from, 0-6 where 0 means no protection & 6 means Dust proof.

The second digit defines the degree of protection with respect to harmful ingress of water. The degrees range from 0-8 where 0 means no special protection & 8 means protection against submersion (Hermetically sealed).

Power Source Selection Criteria General:

Copper or Aluminum conductors-A total non-issue class of insulation.

Input power - 3 phase or 2 line of 3 phase Duty cycle. pertaining, IP class, power factor, Efficiency.

Power source selection criteria SMAW:

Type of welding current-AC or DC or both amperage range determined by size & type of electrode.

Open circuit voltage (OCV) - high OCV desirable from the stand point of arc initiation & arc maintenance. But electrical hazard factors & high cost are to be considered. Welding positions - If vertical & overhead welding are planned, slope adjustment of the V-A curve is desirable.

Power source selection criteria MIG/MAG:

Maximum & minimum electrode wire diameter. Welding job thickness. welding position joining materials, Circularity of joints - Pulsed/non-pulsed, preciseness of parameter control-step-controlled or step less. Dip transfer/spray transfer, shielding Gas Inductance level required

Inverter its concept and application

Inverters: Mains voltage is rectified to DC. The inverter converts to the high frequency AC. The transformer changes the HF AC to suitable welding voltage. The AC is rectified. Various filters remove the disturbing frequencies and ripples in the DC current. The entire process is monitored by a control circuit. This gives the machine ideal static and dynamic characteristic. A CDC voltage is available for welding purpose through a microprocessor based real time adaptive process control.

Why inverters: Traditional power sources have the following disadvantages:

Higher weight due to low frequency of operation (50Hz) larger volume occupying more workspace. Features of, inverter power sources,

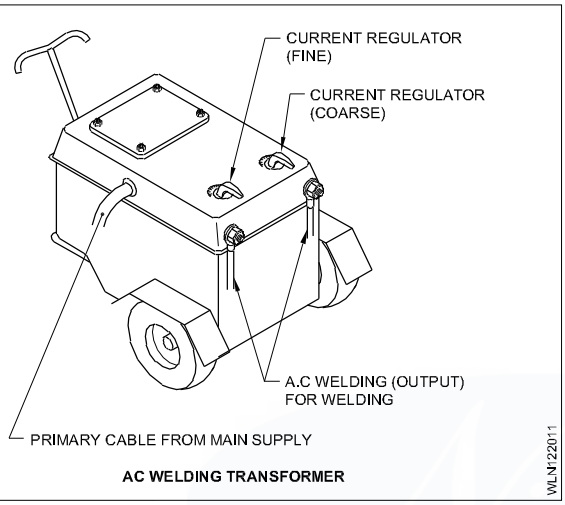
- Very light and compact-portable.
- Power consumption reduced by 40-50%
- Can quickly modify static, and dynamic output characteristics for multi-process capability.
- Excellent arc stability.
- TIG welding can be done at 1 ampere.
- Hot start and adjustable arc force for SMAW, GMAW-pulse and synergic MIG welding.
- Possible to achieve spray transfer at lower currents.
- High switching frequencies of 50,000 hertz facilitates microprocessor based real time adaptive process control.

A.C welding transformer and its construction

Objectives: At the end of this lesson you shall be able to
- **identify the features of an AC welding transformer, DC welding generator and welding rectifier**
- **explain the working principle of the above welding machines**
- **compare the advantages and disadvantages of an AC and a DC welding machine**
- **explain the care and maintenance of welding machines.**

AC welding transformer: This is a type of AC welding machine which converts AC main supply into AC welding supply. (Fig 1)

Fig 1



AC WELDING TRANSFORMER

AC main supply has high voltage-low ampere. AC welding supply has high ampere-low voltage.

It is a step down transformer, which:

- reduces the main supply voltage (220 or 440 volts) to welding supply open circuit voltage (OCV), between 40 and 100 volts
- increases the main supply low current to the required high output welding current in hundreds of amperes.

An AC welding transformer cannot be operated without AC main supply.

Constructional features: It consists of an iron core made out of a special alloy thin iron sheet stampings. Two coils of wire are wound over the iron core without any interconnection between them.

One coil, called primary winding, consists of a thin conductor and has more turns which receive energy from the mains. The second coil, called secondary winding consists of a thick conductor and less turns which supply energy for welding.

A current regulator is attached to the secondary output supply to adjust the amperes for welding suitable to the various sizes of electrodes.

Two welding cables are attached with the output terminals.

One is for the electrode and the other is for earth or job.

The transformer may be air-cooled or oil-cooled.

Working principle: The AC main supply (220-440 volts) is connected to the primary winding which produces a magnetic lines of force in the iron core.

The magnetic lines of force affects the secondary winding and induces high ampere-low voltage welding supply in it.

This action is called the principle of mutual induction.

The voltage at the primary coil is reduced in the secondary coil depending on the ratio of the No. of turns in the primary to that of the secondary.

Not suitable for:

Voltage at secondary coil =

$$\frac{\text{Voltage at primary coil} \times \text{No. of turns in the secondary}}{\text{No.of turns in the primary}}$$

Advantages

- Less initial cost
- Less maintenance cost
- Freedom from arc blow
- NO noise

The magnetic effect of DC disturbs the arc, the effect of which is called 'arc blow'.

Disadvantages

- welding of non-ferrous metals
- bare wire electrodes
- fine current setting in welding special jobs.

AC cannot be used without special precautions of safety.

Care and maintenance

Transformer body must be properly earthed.

Transformer oil must be changed after recommended period, in the oil cooled transformers.

Always follow the operating instruction manual to run and install the machine.

Do not run the machine continuously on its maximum capacity.

Switch off the main supply of the machine while cleaning internally or externally.

Do not change the current when welding is going on.

Always keep and install the machine on dry floor.

Give proper protection to the machine while working outside in rain or dust.

D.C welding generator

Necessity of DC welding generator

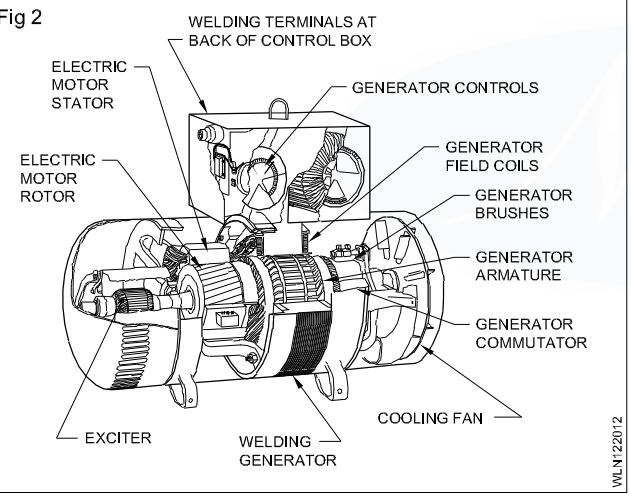
DC welding generators are used to:

- generate DC welding supply with the help of AC main supply
- generate welding supply where electricity (main supply) is not available, with the help of engine driven sets
- get relative advantages of polarity i.e. heat distribution between the electrode and the base metal and welding of non-ferrous metals.

Constructional features of DC welding generator (Fig.2)

A DC welding generator (Fig.2) consists of the following parts.

Fig 2



Main poles: These are connected to the body or yoke to produce magnetic lines of force, also called FIELD COILS.

Body or yoke: It is the body of the generator which covers all the parts and helps in completing the magnetic circuit to generate electricity.

Armature: It is a laminated steel drum with longitudinal stole which accommodate copper conductors.

It is mounted on a shaft which rotates in suitable bearing arranged at its ends.

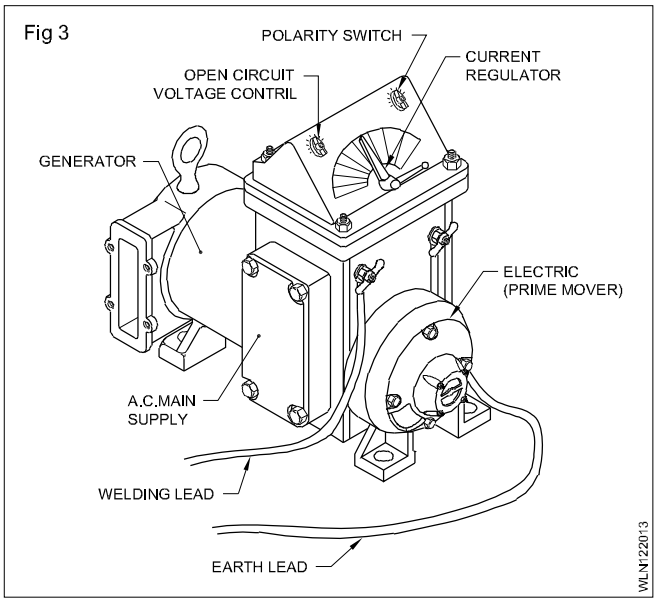
It is also mounted on the shaft along with the armature and is connected to the armature conductors.

Carbon brushes: These are mounted on the body to have contact with the rotating commutator and are connected to the output terminals.

Fan: It is meant for cooling the generator.

Prime mover: It is the driving source as motor or engine used to rotate the armature in the generator. (Fig 3)

Fig 3



Working principle of DC welding generator: The armature is made to rotate with the help of a prime mover between the main poles, where a strong magnetic field exists

The armature cuts the magnetic lines of force, generating emf in its conductors. The commutator, being connected to the armature conductors, changes the generated alternating current into DC. The generated DC is then taken to the generator terminals through the carbon brushes. Where the main supply electricity is available; a motor is used as a prime mover. For field work or where main supply is not available, petrol or diesel engine may be used as a prime mover.

care and maintenance of arc welding generators

To make the best use of the arc welding generator and to ensure its longer life the following checkpoints are to be observed.

Checkpoints for engine of an engine driven generator.

Check the water level in the radiator and the oil level in the engine daily.

Change the engine oil after running for 250 hrs.

Lubricate the fan bearing once in a week.

Check fan belts daily for their proper tightness.

Check petrol or diesel pipe unions leakage daily.

Checkpoints for motor driven generator

Blow out the dust from the inside of the generator with dry compressed air at 1.5 to 2.0 kg/cm^2 pressure after every three months.

Check every week the contact of the carbon brushes with the commutator to ensure it is in good condition without sparking.

Lubricate the shaft bearings after six months with good quality grease.

Guard the rotating parts with suitable covers.

Do not cover the air ventilation ducts.

Do not operate the polarity switch during arcing.

Ensure a proper working of the cooling fan.

Check the electrical connections and avoid loose connections.

Never run the motor on a weak phase.

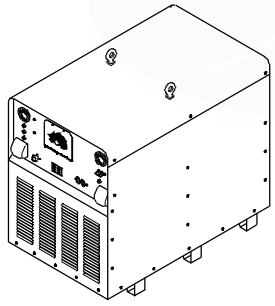
Ensure the electric motor is properly earthed.

AC/DC welding rectifier its construction

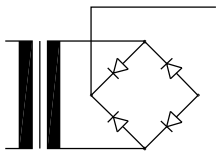
Constructional features of AC/DC welding rectifier: A welding rectifier set is used to convert AC welding supply into DC welding supply. It consists of a step down transformer and welding current rectifier cell with a cooling fan. (Fig, 1) The rectifier cell consists of a supporting plate made of steel or aluminium (Fig.2) which is plated with a thin layer of nickel or bismuth, sprayed with SELENIUM or SILICON. It is finally covered with an alloyed film of CADMIUM, BISMITH and TIN.

The coating of nickel or bismuth over the supporting plate serves as one electrode (ANODE) of the rectifying cell. The alloyed film (of cadmium, bismuth and tin) serves as another electrode (CATHODE) of the rectifying cell. The rectifier acts as a non-return valve and allows current to flow one side of it as it offers very little resistance and on the other side it offers very high resistance to the flow of the current. Hence the current can flow in one direction only.

Fig 1



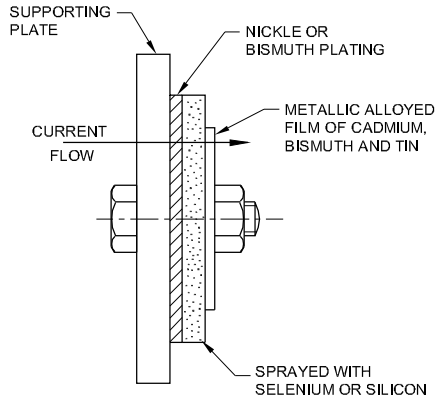
CONSTRUCTIONAL FEATURE OF A WELDING RECTIFIER SET



SYMBOLIC REPRESENTATION

WLN122021

Fig 2



WLN122022

Working principle: The output of the step down transformer is connected to the rectifier unit, which converts AC to DC. The DC output is connected to positive and negative terminals, from where it is taken for welding purposes through welding cables. It can be designed to provide either AC or DC welding supply by operating a switch provided on the machine.

Care and maintenance of rectifier welding set

Keep all the connections in tight condition.

Lubricate the fan shaft once in 3 months.

Do not adjust the current or operate the AC/DC switch when the welding arc is 'on'.

Keep the rectifier plates clean.

Check and clean the set at least once in a month.

Keep the air ventilation system in good order.

Never run the machine without the fan.

Inverters

Objectives: At the end of this lesson you shall be able to
- **describe the inverters**
- **state the advantage & disadvantage of inverter**

Inverters

Basic principle

inverter basically converts DC to AC

DC derived by rectification of AC voltage with high value electrolytic capacitors as filters

These DC is converted to AC by high frequency solid state switching (in KHz)

A small ferrite core is sufficient for converting several kilowatts of power

Output of this ferrite transformer is rectified by high frequency diodes and smoothened by a DC choke

The output is controlled with Sensors & suitable closed loop electronic circuitry.

Working principle

1 Main voltage is rectified to DC

2 The inverter converts the DC to high frequency AC

3 The transformer changes the HF AC to suitable welding current.

4 The AC is rectified

5 Various filters remove the disturbing frequencies and ripples in the DC current. There is also a filter which protects against exterior high frequency disturbances.

6 The entire process is monitored by a control circuit. This gives the machine an ideal static and dynamic characteristics.

7 A DC voltage is available for welding purpose

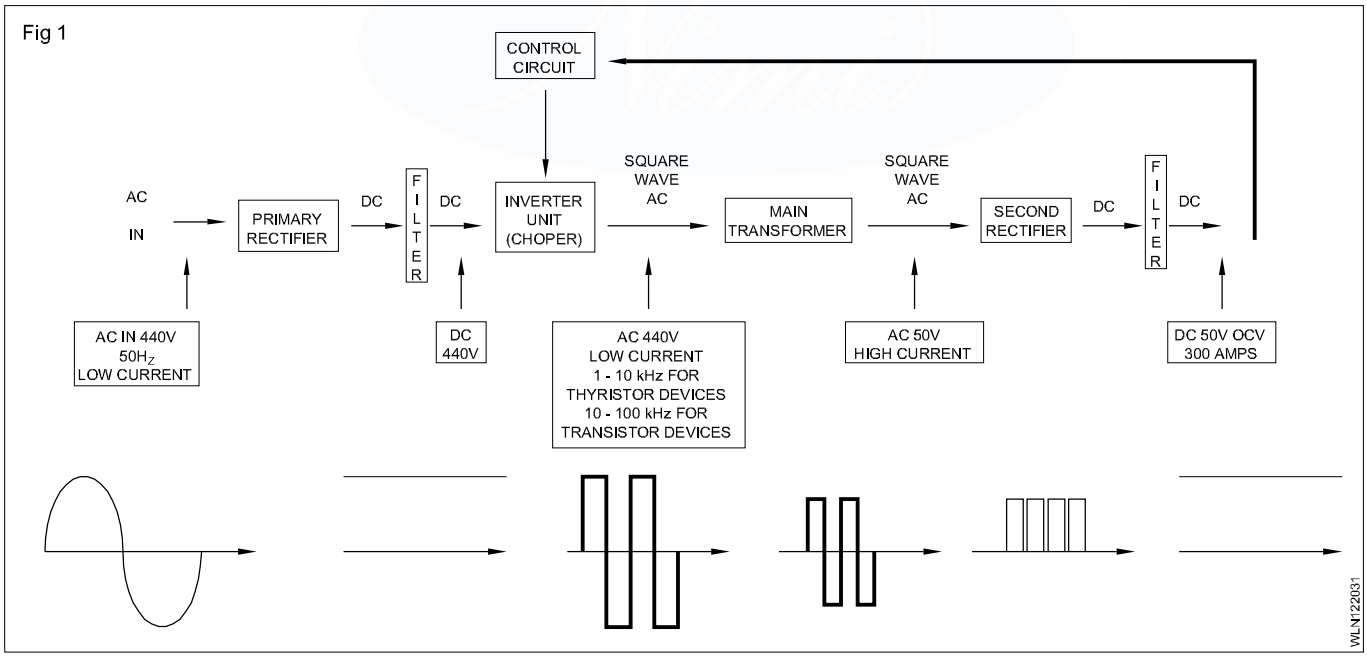
Advantage

- Compact and light weight
- easy to set
- precise setting

Disadvantage

- expensive
- difficult to repair
- sensitive to high currents

Fig 1



Advantages and disadvantages of AC and DC welding

Objectives: At the end of this lesson you shall be able to
- **compare the advantages and disadvantages of AC welding**
- **compare the advantages and disadvantages of DC welding.**

Advantages of AC welding

A welding transformer has:

- a low initial cost due to simple and easy construction
- a low operating cost due to less power consumption
- no effect of arc blows during welding due to AC
- low maintenance cost due to the absence of rotating parts
- higher working efficiency
- noiseless operation.

Disadvantages of AC welding

It is not suitable for bare and light coated electrodes.

It has more possibility for electrical shock because of higher open circuit voltage.

Welding of thin gauge sheets, cast iron and non-ferrous metals (in certain cases) will be difficult.

it can only be used where electrical mains supply is available.

Advantages of DC welding

Required heat distribution is possible between the electrode and the base metal due to the change of polarity (positive 2/3 and negative 1/3).

It can be used successfully to weld both ferrous and non-ferrous metals.

Bare wires and light coated electrodes can be easily used.

Positional welding is easy due to polarity advantage.

It can be run with the help of diesel or petrol engine where electrical mains supply is not available.

It can be used for welding thin sheet metal, cast iron and non-ferrous metals successfully due to polarity advantage.

It has less possibility for electrical shock because of less open circuit voltage.

It is easy to strike and maintain a stable arc.

Remote control of current adjustment is possible.

Disadvantages of DC welding

DC welding power source has:

- a higher initial cost
- a higher operating cost
- a higher maintenance cost
- trouble of arc blow during welding
- a lower working efficiency
- noisy operation in the case of a welding generator
- occupies more space.