Tungusten Inert Gas Welding (TIG)

Tungsten-Inert Gas Welding

In the tungsten-inert gas welding process, the arc is maintained between a nonconsumable tungsten electrode and the workpiece in a protective inert gas atmosphere. Figure 5.33 schematically shows the process. Any filter material needed is supplied externally. Normally, a dc arc is used with tungsten as the negative pole.

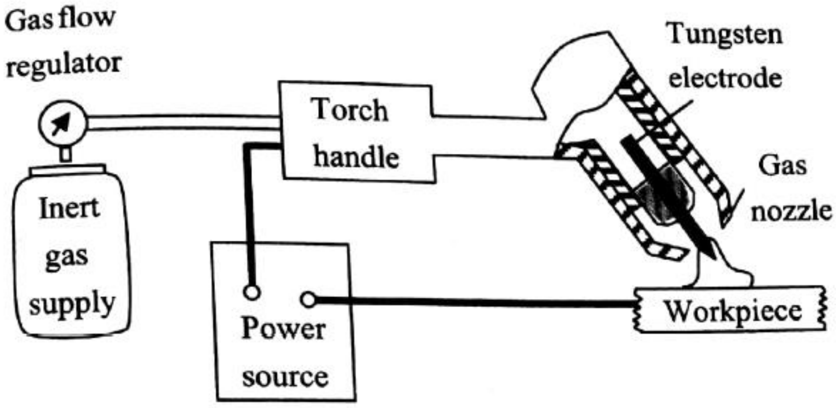


Figure 5.33: Tungsten-inert gas welding equipment

This is not possible for metals, such as Al and Mg, where the oxide layer persists if the work piece is used as the anode. This layer prevents the formation of the weld pool. The mobile cathode spot can disperse the oxide layer but excessive heat is generated at the tungsten electrode if this is used as the anode. Hence, an ac arc is used for such materials. To avoid the melting of the electrode, thorium or zirconium is added to the tungsten (to increase the melting point).

Argon is most commonly used to provide the inert atmosphere. Nitrogen is sometimes used for welding copper. This is a special type, costly welding process used only for aluminium, magnesium, and other reactive metals. To prevent the possible little contamination, an argon deoxidant is added to the filler rod.

Metal-Inert Gas Welding

Figure 5.34 schematically represents a metal-inert gas welding process. Here, the arc is maintained between a consumable electrode and the workpiece in an inert gas atmosphere. The coiled electrode wire is fed by drive rolls as it melts away at the tip. Except for aluminium, a dc source is used with the consumable electrode as the positive terminal. The difference in this respect with the tungsten-inert gas welding should be noted. For welding steel, a shielding is provided by CO_2 for lower cost. Normally, a high current density in the electrode (of the order of 10,000 amp/cm^2) is used so that a projected type of metal transfer results. The welding current is in the range 100-300 amp. The process is primarily meant for thick plates and fillet welds.

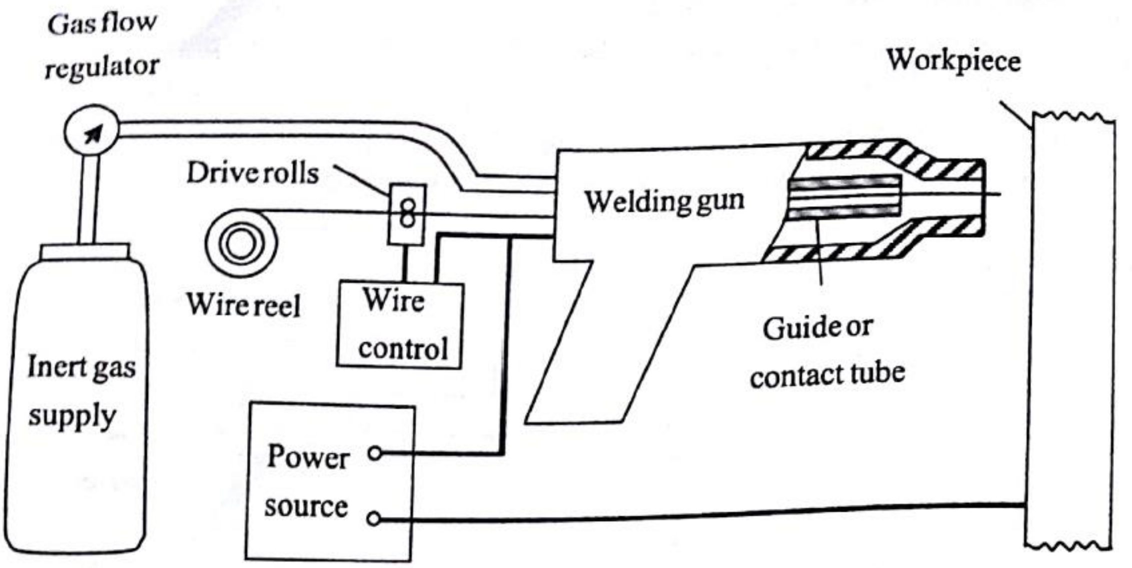


Figure 5.34: Metal-inert gas welding equipment

17.7 RESISTANCE WELDING

In resistance welding the metal parts to be joined are heated by their resistance to the flow of an electrical current. Usually this is the only source of heat, but a few of the welding operations combine resistance heating with arc heating, and possibly with combustion of metal in the arc. The process applies to practically all metals and most combinations of pure metals and those alloys, which have only a limited plastic range, are welded by heating the parts to fusion (melting). Some alloys, however, may welded without fusion; instead, the parts are heated to a plastic state at which the applied pressure causes their crystalline structures to grow together. The welding of dissimilar metals may be accomplished by melting both metals frequently only the metal with the lower melting point is melted, and an alloy bond is formed at the surface of the unmelted metal.

In resistance welding processes no fluxes are employed, the filler metal is rarely used and the joints are usually of the lap type. The amount of heat generated in the workpiece depend on the following factors:

(1) Magnitude of the current,

(2) Resistance of the current conducting path, and

Mathematically,
$$H = IVt$$
$$= I(IR)t$$
$$= I^2Rt$$

Principle of casting:

In this process, the material is first liquefied by properly heating it in a suitable furnace, then, the liquid is poured in to a previously prepared mould cavity where it is allowed to solidify. Subsequently, the product is taken out of the mould cavity, trimmed, and cleaned to shape.

Principle of Forging

Forging can be defined as the working of a metal, mostly in hot condition under direct compressive loads, like loads of impact (hammering) or pressure (pressing) or both, to obtain a useful shape and improve its mechanical properties.

Most forging operations are carried out hot, although certain metals may be cold forged. The process may be carried out on materials in either hot or cold state. When forging is done cold, processes are given special names. Therefore, the term forging usually implies hot forging carried out at temperatures which are above the recrystallization temperature of the material.

Extrusion

Extrusion is a plastic deformation process in which a block of metal (billet) is forced to flow by compression through the die opening of a smaller cross-sectional area than that of the original billet as shown in Fig. 1. Extrusion is an indirect-compression process. Indirect-compressive forces are developed by the reaction of the work piece (billet) with the container and die; these forces reach high values.

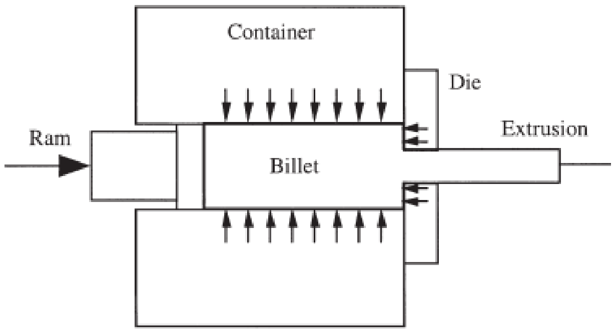


Fig. 1 Definition and principle of extrusion

The reaction of the billet with the container and die results in high compressive stresses that are effective in reducing the cracking of the billet material during primary breakdown from the billet. Extrusion is the best method for breaking down the cast structure of the billet because the billet is subjected to compressive forces only. Extrusion can be cold or hot, depending on the alloy and the method used. In hot extrusion, the billet is preheated to facilitate plastic deformation.

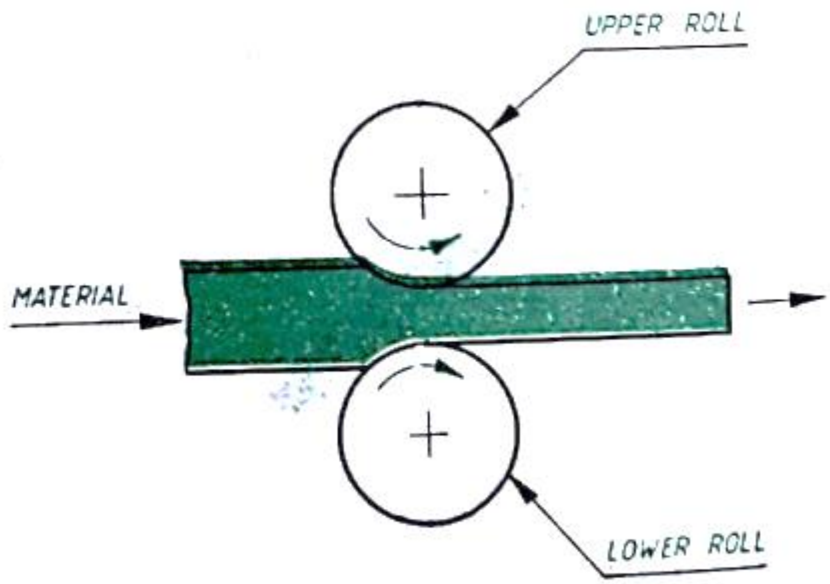
The cross-sections that can be produced vary from solid round, rectangular, to L shapes, T shapes.

Principles of Rolling:

The rolling is a process which consists of passing the metal through a gap between rollers rotating in opposite direction. This gap is smaller than the thickness of the part being worked. Therefore, the rollers compress the metal while simultaneously shifting it forward because of the friction at the roller-metal interfaces.

When the work piece completely passes through the gap between the rollers, it is considered fully worked. As a result, the thickness of the work is decreases while its length and width increases.

However, the increase in width is insignificant and is usually neglected. The Fig. 2.4 shows the simple rolling operation of a plate. The decrease in thickness is called draft, whereas the increase in length is termed as absolute elongation. The increase in width is known as absolute spread.



cutter to get the required

6.2 PRINCIPLE OF MILLING

Principle of milling is as shown is the figure 6.1 (a) and (b). In milling, the work piece which is rigidly held on table is fed slowly against a uniformly rotating cutter such that the material is removed as the work piece advances. The work piece can be fed in either direction i.e opposite of that of the rotation of the cutter or in the same direction of that of the cutter.

- If the work piece is fed in the direction opposite that of the cutter, the process is called as "up milling" or "conventional milling".
- If the work piece is fed in the direction same as that of the cutter, the process is called as "down milling" or "climb milling".

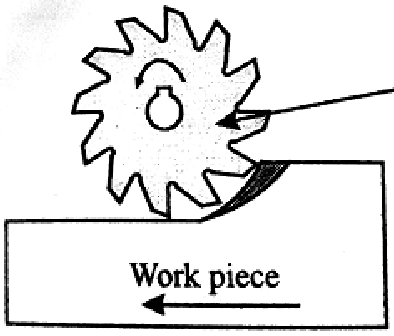


Figure 6.1 (a) Up - milling

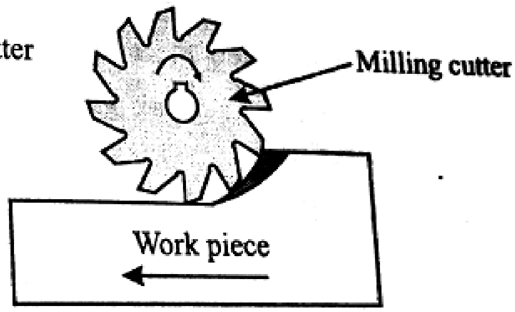


Figure. 6.1 (b) - Down milling

Solar energy:

Solar energy is the most readily available source of energy. It does not belong to anybody and is, therefore, free. It is also the most important of the non-conventional sources of energy because it is non-polluting and, therefore, helps in lessening the greenhouse effect. The sun constantly delivers 1.36 kW of energy per square meter to the earth. The energy which reaches the earth surface contains both beam radiation and diffused radiation. The radiation reaches the ground directly from the sun is called beam radiation. Diffuse radiation is that solar radiation received from the sun after its direction has been changed by reflection and scattering by the atmosphere.

The problem with solar radiation is estimation of diffused radiation & beam radiation, both radiations are not constant. It keeps on changes every minute, hour, day month and year. Therefore it is difficult to design a solar device which will suit to our requirements. To harvest solar energy we need solar collectors, these collectors are designed to absorb and store the solar energy and these devices should work more effectively in varying temperature conditions.

The collectors used to absorb solar energy are broadly classified in to two types they are,

1) Flat plate collectors

2) Concentrating collectors

1.7.2 Flat plate collector

Solar energy can directly converted into heat energy by using a flat plate collector. figure (1.2). shows a schematic representation of flat plate collector which consists of a glass plate, an absorber plate, water tubes provided with insulation. In this, a black plate (absorber plate) is used to absorb the sun light as it can absorb maximum sun light falling on it. The heat generated is transported to the point of use through the tubes provided. Insulation is done to minimize the heat losses. This type of collector is commonly used for solar water heating applications.

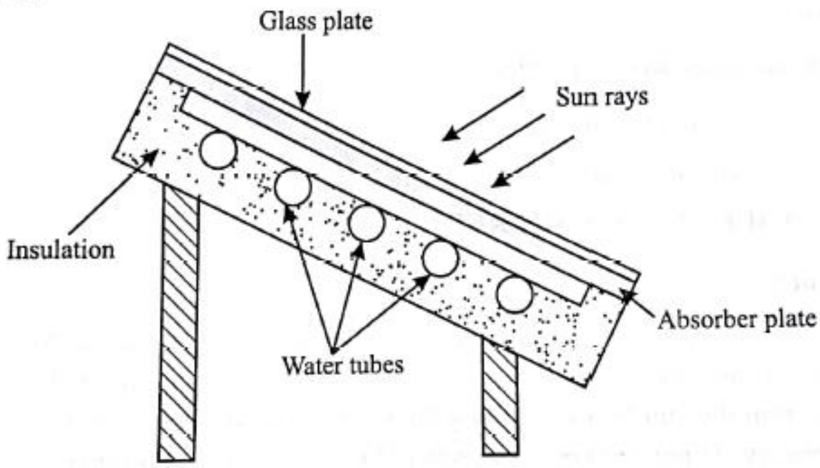


Figure 1.2: Solar flat plate collector

Merits

1. The energy from the sun is available at free of cost
2. It is non-depletable source of energy .
3. Doesn't cause pollution
4. The energy source can be directly converted into the required form.

De - Merits

1. Initial cost is high
2. Availability is not uniform.
3. The technology is not yet developed for commercial applications.

1.7.3. Wind Energy

The kinetic energy of moving air over the earth surface can be used for the generation of electrical energy. Wind energy is an indirect source of solar energy and can be utilized to produce electricity.

The schematic representation of a wind mill is shown in figure 1.3. It consists of a rotor fitted with blades. As the air current flows over the blades, the rotor rotates and produces energy (rotational). This in turn, can be converted as electrical energy by coupling to a generator. Wind energy is also used for grinding grains, pumping water etc.,

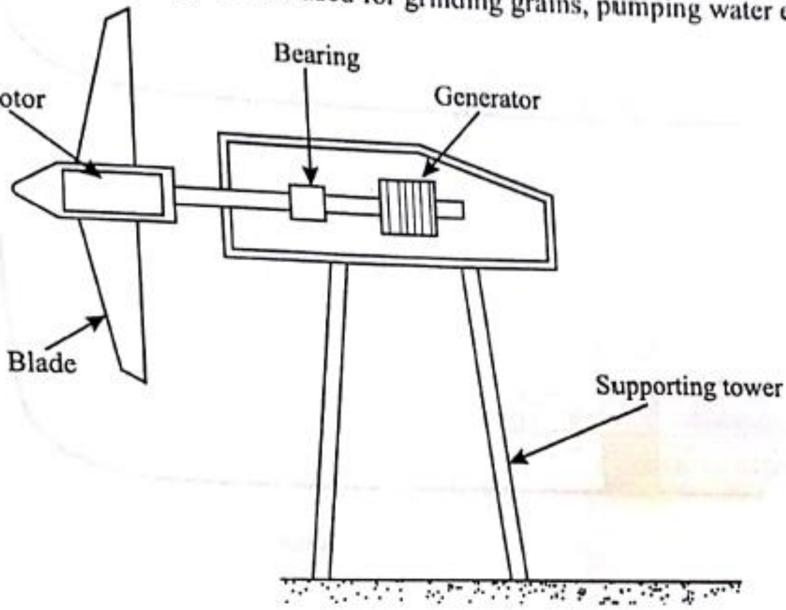


Figure 1.3: Schematic representation of a wind mill

Merits

1. Wind energy is inexhaustible / renewable source of energy
2. Wind energy is a cheap source of power
3. Doesn't cause any pollution, thus it is environmental friendly source of energy
4. Best source to generate energy in remote areas.

De-Merits

1. Only in selected places it can be harnessed
2. Fluctuating source of energy as it depends on velocity of the wind.

4.10 ROOM AIR CONDITIONER

Room air conditioner, also called *window units* is the simplest form of air conditioning designed to cool a single room. It is a single unit that fits into the window frame of a room, which is to be cooled. Figure 4.4 shows the components of a room air conditioner in its simplest form. Also refer figure 4.5.

The air conditioner unit mainly consists of a compressor, condenser, expansion valve, and a evaporator working in a vapour compression cycle. Other components include an air filter, a control panel, a double shaft motor that drives a fan at one end and a blower at the other end. The evaporator and expansion valve are located at the room side (indoor), while the compressor and condenser are located at the outdoor side. The room side and the outdoor side of the unit are separated by an insulated partition wall within the casing of the air conditioner.

Working

The blower draws the warm air from the room through the air filter and over the evaporator coils. The low pressure and low temperature liquid refrigerant (partly vapour) flowing through the evaporator coils absorb heat from the warm air and undergoes a change of state from liquid to vapour. The blower then delivers the cool air to the room where it mixes with the room air to bring down the temperature and humidity of the room.

The low temperature and low pressure vapour refrigerant from the evaporator is drawn by the suction of the compressor, which compresses it to high pressure and temperature. The high pressure, high temperature vapour refrigerant now flows through the condenser coils. The fan located at the outdoor side draws atmospheric air and blows it over the condenser coils. The heat contained in the refrigerant is dissipated to the atmosphere, and as a result, the vapour refrigerant condenses to liquid state.

The high pressure, low temperature liquid refrigerant now enters the expansion valve, where it is expanded to low pressure and temperature. The low pressure and low temperature liquid refrigerant (partly vapour) enters the evaporator coils, absorb heat from the warm air, and the cycle repeats until the desired temperature inside the room is achieved.

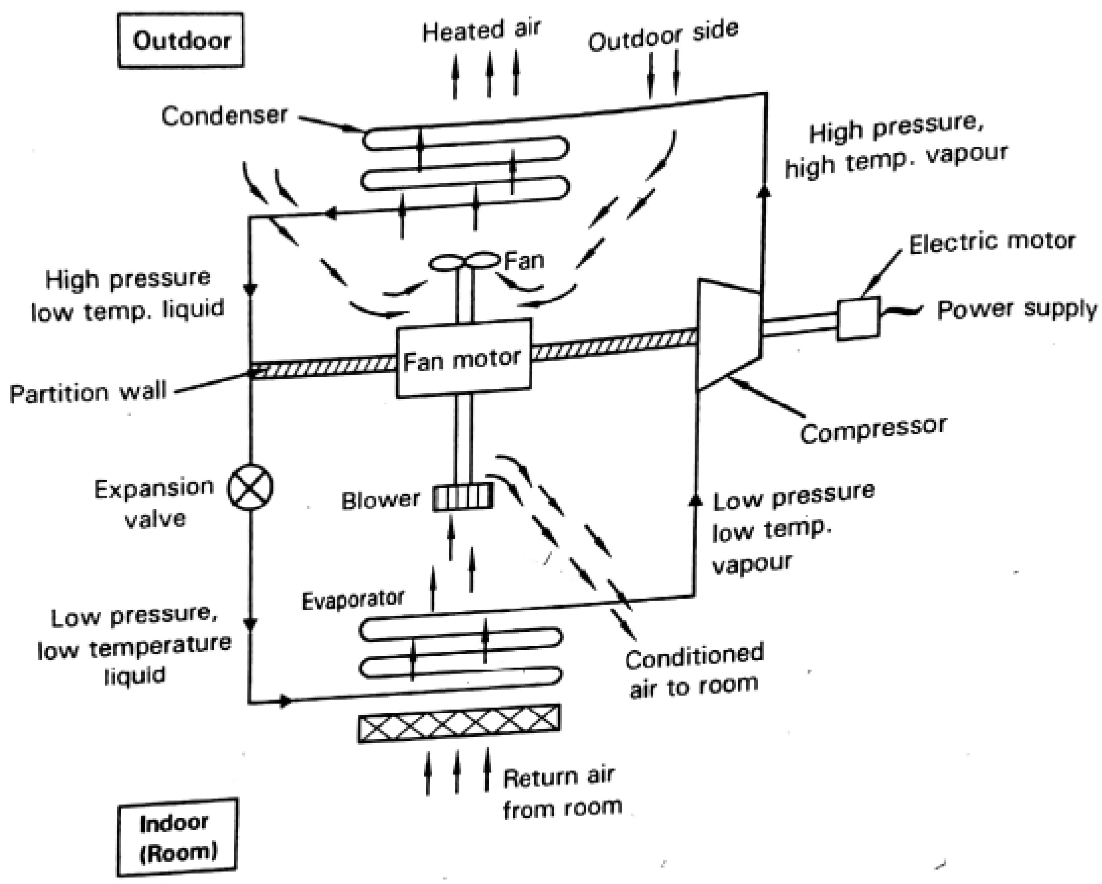


Figure 4.4 Room air conditioner