3.7 WELDING GENERATOR

A welder generator creates power for welding without reliance on mains electricity. Simply fill up the fuel tank, just as you would for a regular generator, and the welder generator will power your welding equipment wherever you need it.

TYPES OF WELDING GENERATORS

The two main types of D.C. welding generators. They are:

1. Opposition Series Generator
2. Split-Pole D.C. Welding Generator.

1. Opposition Series Generator:

a. Separately Excited:

A schematic of electrical circuit of a separately excited opposition series generator is shown in figure. This generator has two field windings. One called the separate excitation field, produces a constant magnetic flux, ϕ_m, and is energized with alternating current through a ferro-resonant voltage regulator and a silicon rectifier, both mounted on the generator frame. The other called the opposition series field, is placed in series with the welding circuit. At no load, there is no current flowing through the series field winding and the emf of the generator is solely due to the magnetic flux, ϕ_m. When the welding circuit is completed and an arc is struck, the series winding produces a varying magnetic flux, ϕ_o, which opposes the main field flux, ϕ_m. With the increase in welding current, the effect of opposition series field also increases, so that the total magnetic flux is decreased, and the terminal voltage of the generator is brought down. When there is a short-circuit, the two magnetic fluxes become nearly equal in magnitude, the total magnetic flux collapses, and the terminal voltage of the generator drops to zero. Thus, the effect of the opposition series field is one of producing drooping volt-ampere characteristic. Welding current can be adjusted continuously by varying the main flux, ϕ_m, with a rheostat, R_h.

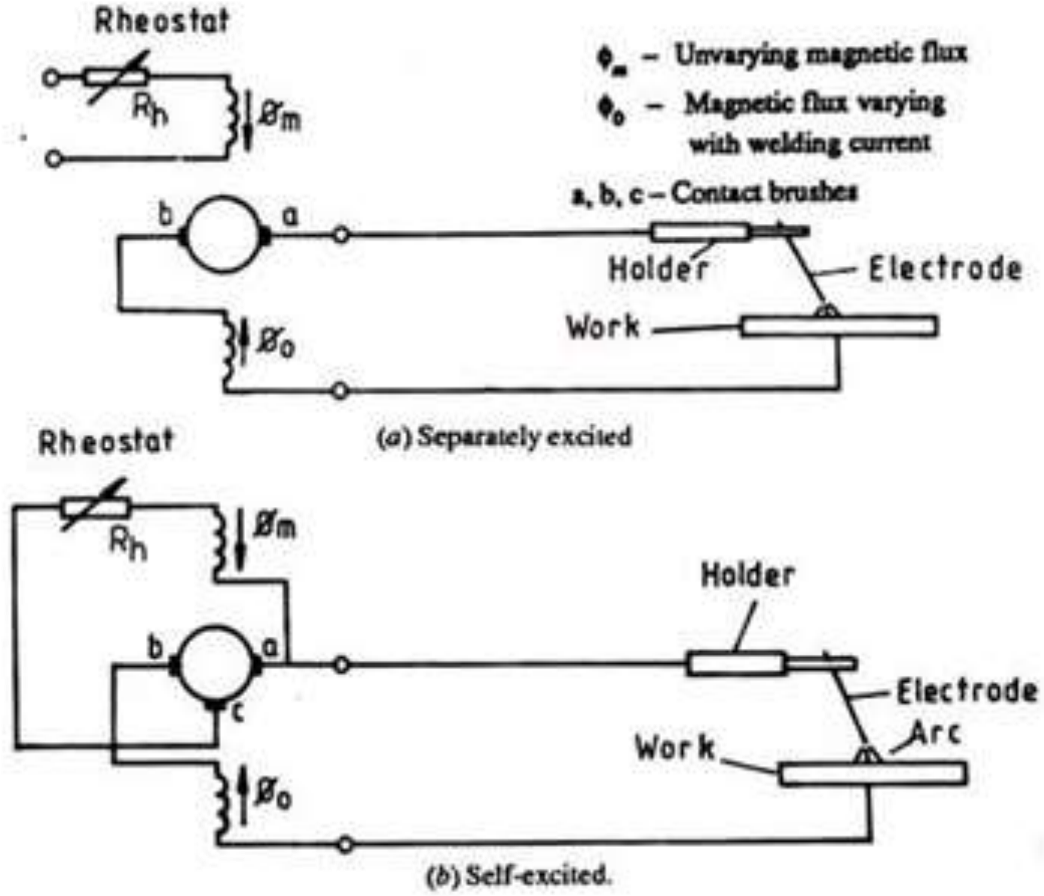

Figure 3.7.1 Opposition series generator

[Source: "https://www.yourarticlelibrary.com", Page: 1]

b. Self-Excited

A circuit diagram of a self-excited series generator is shown in figure. As seen from the diagram, the field winding is energised from one-half of the armature winding of the generator itself. This is why there is a third brush c, placed between the main brushes a and b. For that reason, it is also known as **Third Brush Generator**. Under load, the voltage between brushes a and c remains practically constant and the self-excitation field winding connected across the two brushes produces a constant magnetic field, ϕ_m . When the arc is initiated, the welding current flows in the series field winding connected so that its magnetic flux, ϕ_0, opposes the magnetic field, ϕ_m, of the exciter. The larger the current in the welding circuit, the stronger the bucking action of the series winding, and lower the generator voltage, as the e. m. f. induced in the armature winding of the generator depends on the resultant magnetic field. At the time of short circuit the values of ϕ_m and ϕ_0 are nearly equal and opposite in action hence the resultant flux is almost negligible and the terminal voltage drops to zero. Thus, the series winding helps in achieving a drooping volt-ampere characteristic of the power source. Most of the generators for manual and automatic welding like SMAW and submerged arc welding are of the opposition series type.

2. Split-Pole D.C. Welding Generator:

In a split-pole welding generator a drooping volt-ampere characteristic is obtained owing to the effect of armature reaction. This generator is also called a BIPOLAR WELDING GENERATOR and is employed mainly for manual welding. This generator has four main poles and three sets of brushes riding the commentator, as shown in Fig. 4.22. As distinct from the conventional dc generator in which north and south poles are placed alternatively, in a bipolar generator the like poles are placed side by side (S_1 S_2 and N_1N_2). Two adjacent like poles may be regarded, magnetically, as a single pole split into two parts, hence the name split-pole generator.

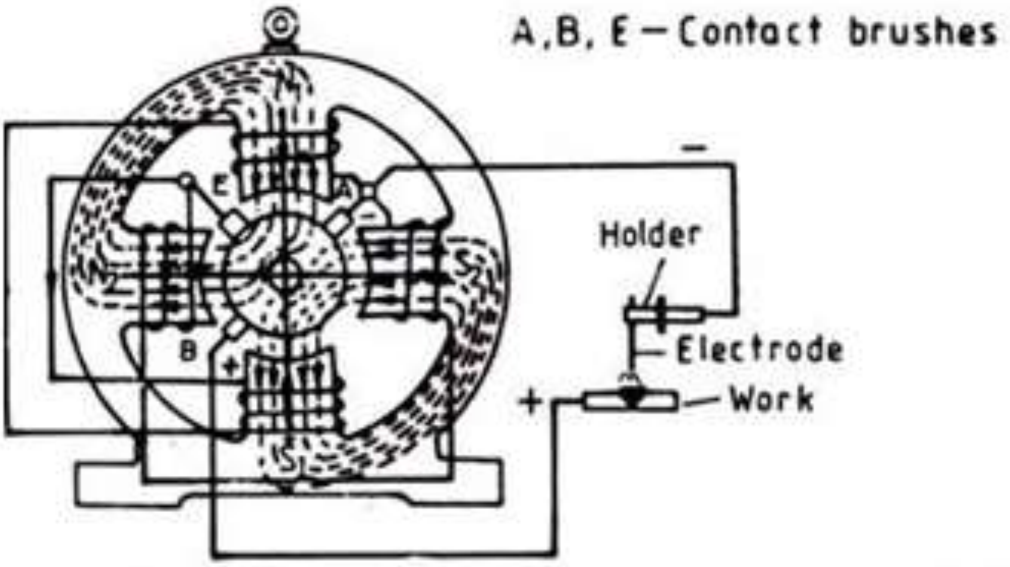

Figure 3.7.2 Split-pole DC welding generator

[Source: "https://www.yourarticlelibrary.com", Page: 4]

The magnetic flux linking the poles may be divided into two parts. One part moves from N_1 to $S_1$and the other from N_2 to S_2. The magnitude of the emf in armature depends on the densities o two fluxes denser the flux cut across by the armature conductors, the greater the emf of the armature. The welding circuit is connected to the brushes A and B, and the field coils wound upon the magnetic poles are connected to the brushes A and E. When the arc is started, the current flowing through the armature winding sets up a magnetic field around it. The magnetic flux emerges from the armature core and spans the air space between the armature and the poles. A part of the flux enters S_1 has its path through the frame, S_2, and the air gap in the armature core. The other part of the flux has its path through N_1, the frame, N_2, and crosses the air space to enter the armature core. The path of the magnetic flux in the armature is shown by the dotted lines. The larger the current in the armature winding, the stronger the magnetic flux. Referring to the diagram, it can be seen that the magnetic flux in the armature winding moves with the magnetic flux in the poles N_1 and S_1(as shown by thick arrows) and against the magnetic flux in the poles N_2 and S_2. In other words, the armature magnetic flux tends to build up magnetic flux in the poles on the one side, and to kill it on the other. The magnetic poles N_1 and are so constructed that they operate in conditions of magnetic saturation, and the addition of armature magnetic flux cannot increase it anymore, much as a saturated saline solution cannot dissolve anymore salt. The magnetic flux of the armature, which opposes the magnetic flux in the poles N_2 and S_2, reduces this flux and in fact almost kills it. The alternating action of the main magnetic flux increases as the current in the welding circuit increases. A weaker magnetic flux in the poles produces a lower generator voltage. Thus, in the split-pole welding generator the drooping volt-ampere characteristic is obtained by the bucking action of the magnetic flux of the armature winding, that is, by the armature reaction.

Output Volt-Ampere Characteristics of Welding Generators:

D.C. welding generators are usually dual control machines. A dual control machine has both current and voltage controls. These controls offer the welder the maximum flexibility for different welding requirements. Such a welding power source inherently has slope control which means the slope of the volt-ampere curve can be set to the desired shape. Generators that are compound wound with separate continuous current and voltage controls can provide the operator with a selection of volt-ampere curves at almost any amperage capability within the total range of the power source. Thus, the welder can set the open circuit voltage with voltage control and the maximum current (short circuit current) with the current control. These settings adjust the welding generator to provide a static volt- ampere characteristic that can be suited to the job requirements within the available ranges. The independent effects of current and voltage control on the volt-ampere characteristics of such a welding power source.

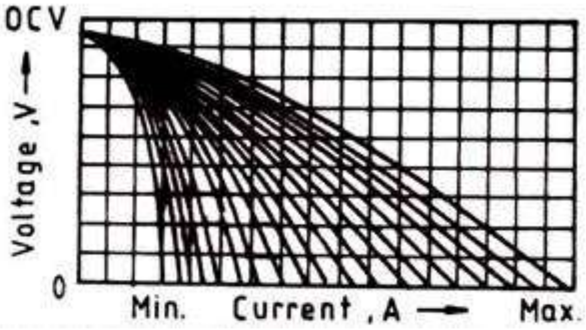

Figure 3.7.3 Effect of current control on volt-ampere characteristics

[Source: "https://www.yourarticlelibrary.com", Page: 6]

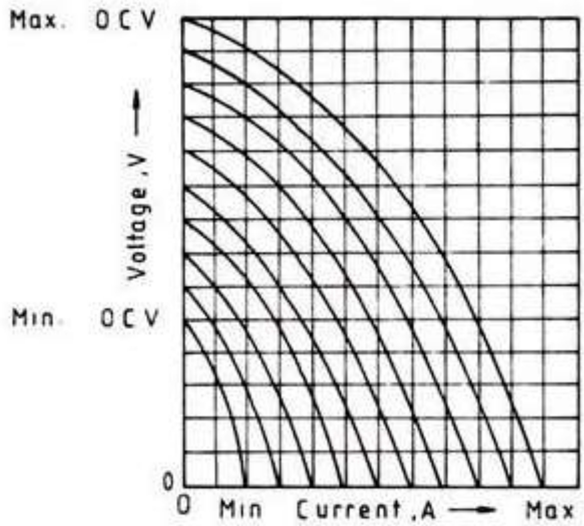

Figure 3.7.4 Effect of voltage control on volt-ampere characteristics

[Source: "https://www.yourarticlelibrary.com", Page: 6]

Multi-Operator D.C. Welding Power Sources:

A multi-operator welding generator has two field windings, one shunt and the other connected in series aiding so that the magnetic flux of the series winding coincides in sense with that of shunt winding. Because of this the generator has a flat rather than a drooping volt-ampere characteristic. From a multi-operation welding generator the current is taken to bus bars, and from there to a group of welders. As power source has a flat volt-ampere characteristic, the voltage across the busbar remains constant and independent of the load. To obtain a drooping characteristic, ballast rheostats are connected in series with the arcs at the scene of the welding operation. The rheostat also serves to control the welding current. Most of these multi-operator sets produce a constant voltage of 60 volts or so. These welding sets take up less space than single operator units serving the same number of operators. Therefore, this type of plant is economical for installations where work is concentrated in one shop. They are also cheaper than the equivalent number of single operator sets, and are more economical to service and maintain. **In tapped reactor method**, output current is regulated by taps on the reactor. This has limited number of current settings. **In the moving coil method** of current control, relative distance between primary and secondary windings is changed. When coils are more separated out current is less. **In magnetic shunt method**, position of central magnetic shunt can be adjusted. This changes the magnitude of shunt flux and therefore, output current. When central core is more inside, load current will be less and vice versa. In **continuously variable reactor method**, output current is controlled by varying the height of the reactor. Greater the core insertion, greater the reactance and less the output current. Reverse is true for less height of core insertion **saturable reactor method,** the reactance of the reactor is adjusted by changing the value of dc excitation obtained from bridge rectifiers by means of rheostat. When dc current in the central winding of reactor is more, reactor approaches magnetic saturation. This means the reactance of reactor becomes less. Vice versa happens on the A welding transformer is a step-down transformer that reduces the voltage from the source voltage to a lower voltage that is suitable for welding, usually between 15 and 45 volts. The secondary current is quite high. 200 to 600 amps would be typical, but it could be much higher. The secondary may have several taps for adjusting the secondary voltage to control the welding current. The taps are typically connected to a several high-current plug receptacles or to a high current switch. For welding with direct current (DC) a rectifier is connected to the secondary of the transformer. There may also be a filter choke (inductor) to smooth the DC current. The entire transformer and rectifier assembly may be called a transformer or welder, but "welding power supply" would be more appropriate term.

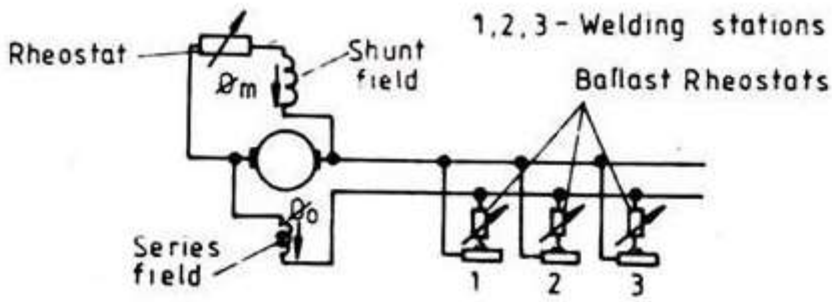

Figure 3.7.5 Multi-operator DC welding generator

[Source: "https://www.yourarticlelibrary.com", Page: 7]