Power conditioning equipment

The solar photovoltaic arrays deliver variable d.c. power depending upon the solar insulations level. Equipment is needed to convert the d.c variable out put of the array to a form which is suitable for load. The equipment required to do this is known as power conditioning equipment. Fig.1 shows a block diagram of interconnection between solar array, power conditioning and load. For small and predictable loads
(few hundred watts), a simple direct battery charging system is adequate.

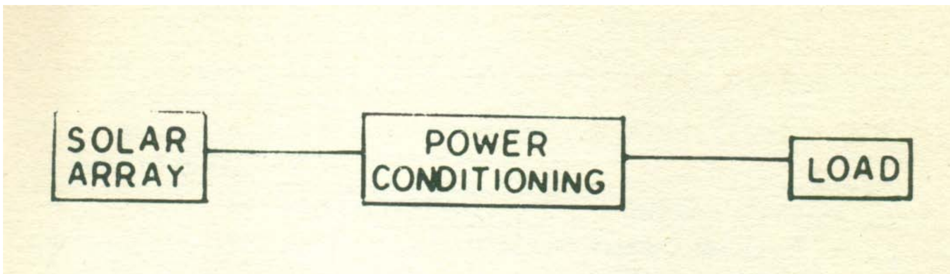

Fig.1 A PV system with power conditioner

System with storage batteries

A series blocking diode prevents the discharge of the battery through solar cells during period of low isolation and a current limier prevents over charging the battery during longer periods of high insulation This is shown in fig.2 There is some wastage of energy in the current limiter but for simplification this may be acceptable in smaller direct load systems. For individual load or a group of loads the array d.c out put need not be converted into a.c as d.c motors and pumps are or can be easily made available. However, if the present loads are not to be disturbed, a 50 or 60 HZ inverter is needed, depending upon the country of usage. A mixed ac/dc supply should be avoided as it may complicate power control conditions. Solid state inverters are highly efficiency of the order of 95%. In some systems the load is supplied either by the solar arrays or by the utility.

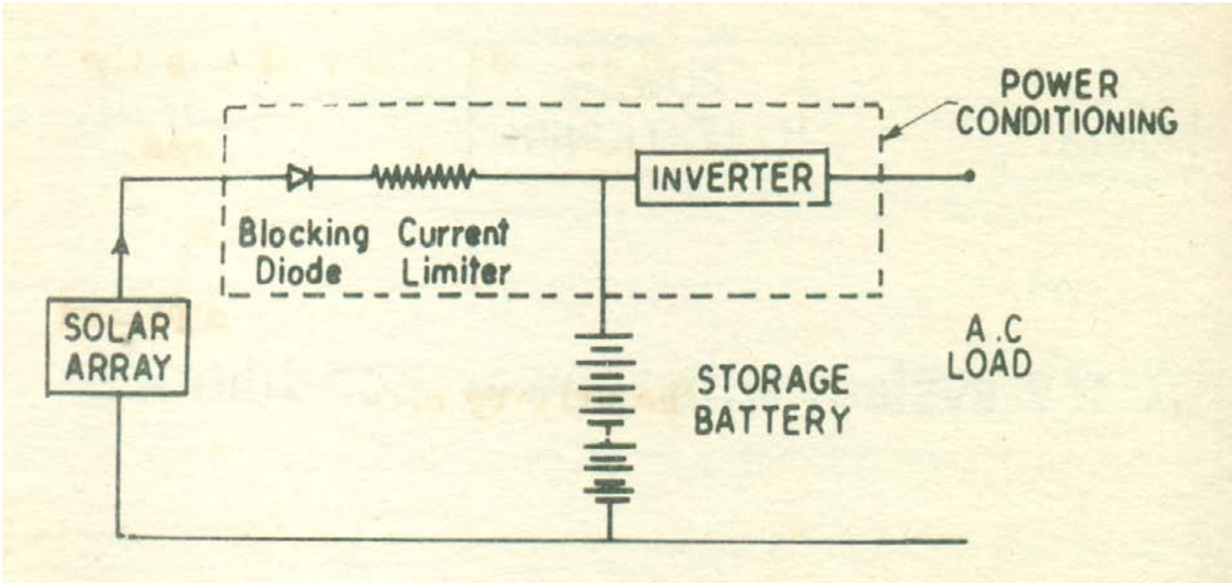

Fig.2: System with battery storage

No battery system

System with no battery system is shown in Fig.3. The solar array is connected to the a.c. load through an inverter. The load is also connected to the grid. A maximum power tracker is directly connected to the solar cell circuits. When the solar array power out put capability allows the inverter power to exceed the load demand, the excess power flows into the grid. During night periods and also during period of low insulation, power is supplied by grid to the load. The utility distribution system becomes the storage medium for the photovoltaic system. Such a system may be for individual households in conjunction with utility power availability.

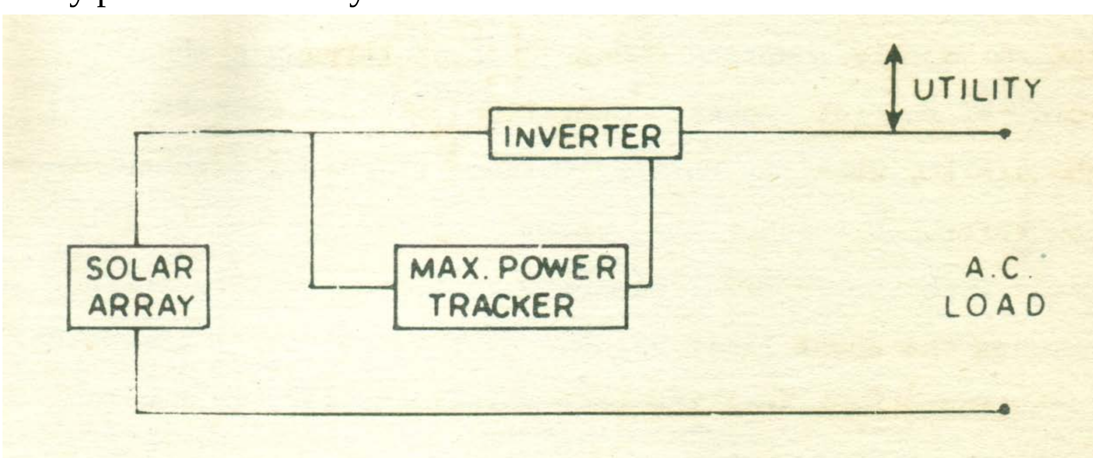

Fig. 3 : system with no battery

PV –Grid interconnection with battery storage:

This system is shown in fig.4.

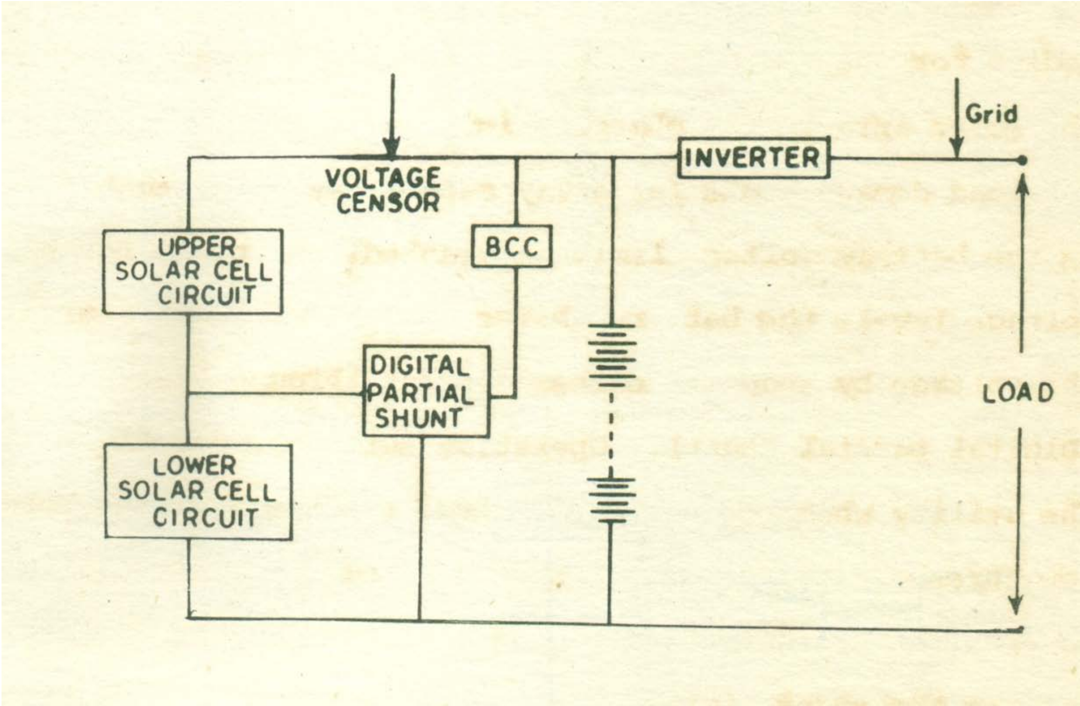

Fig.4: PV –Grid interconnection with battery storage.

In this system the battery acts as a storage medium for the solar power. The battery is connected across the solar array. The charging is at a rate determined by the load demand and solar array capability until such time as the battery voltage limit is reached. At the predetermined voltage level, the battery charge controller (BCC) limits the voltage by shunting excess current through a shunt (Digital partial Shunt). Operation switches over to the utility when the battery voltage reaches a predetermined low threshold value. The system continues on the utility power with the inverter disable until the battery voltage reaches the shunt limit value. At this point the operation is switched back into the photovoltaic/battery system by energizing the inverter operation.

PV system with diesel backup and battery storage

In a large isolated system away from utility grid, a diesel generator may be provided as a back up system as shown in fig.5. There is no maximum power tracking provided and battery overcharge is prevented by automatically switching off part of the array when the battery is fully charged and the array output exceeds the load requirement The diesel generator will start automatically when the battery state of charge drops to 20%. The system shuts down when diesel fails to start. The components of the power conditioning equipment are:

- Inverters
- Maximum power tracking controller
- Battery charge controller
- Digital partial shunt
- Transfer switch

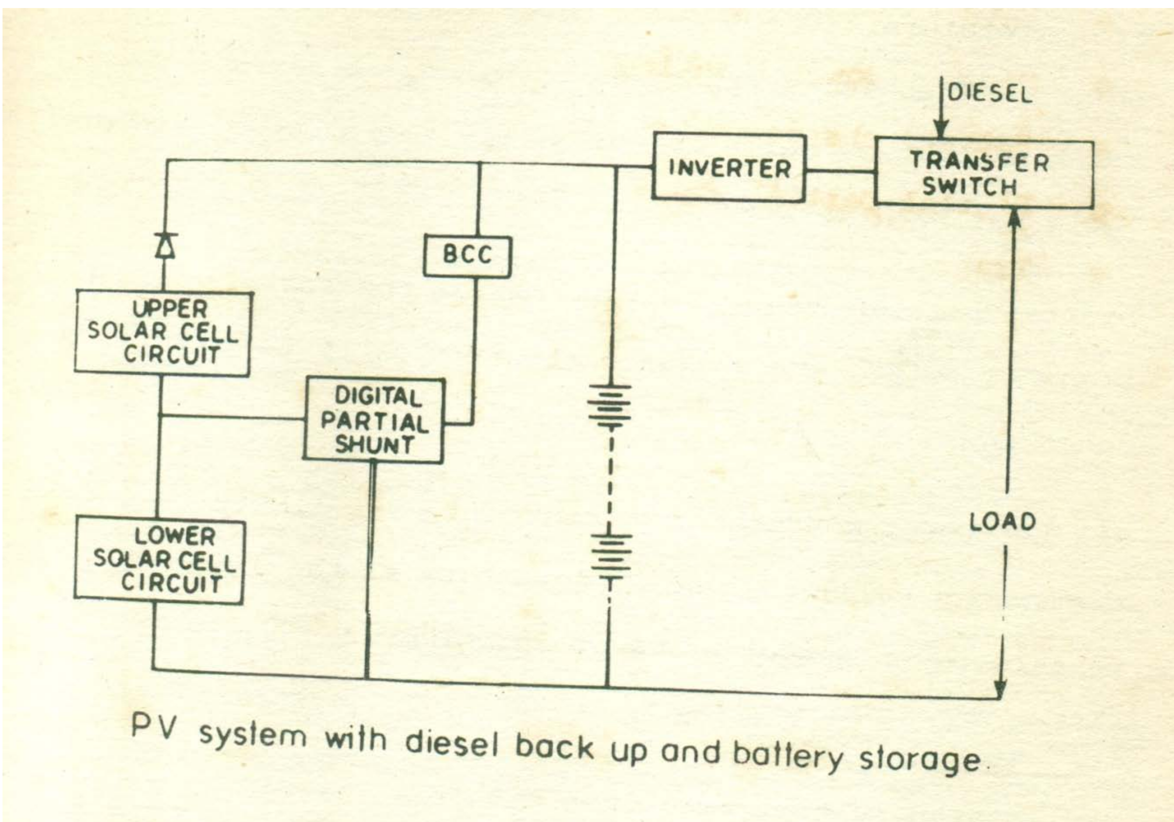

Figure.5 PV system with diesel backup and battery storage