

tension of spring S1, contact points C1 are separated. The field current now flows through R1 and L2. Because resistance is added to the field circuit, the field is momentarily weakened and the rise in terminal voltage is checked. Also, since the L2 winding is opposed to the L1 winding, the magnetic pull of L1 against S1 is partially neutralized, and spring S1 closes contact C1. Therefore, R1 and L2 are again shorted out of the circuit, and the field current again increases; the output voltage increases, and C1 is opened because of the action of L1. The cycle is rapid and occurs many times per second. The terminal voltage of the generator varies slightly, but rapidly, above and below an average value determined by the tension of spring S1, which may be adjusted.

The purpose of the vibrator-type current limiter is to limit the output current of the generator automatically to its maximum rated value in order to protect the generator. As shown in *Figure 12-330*, L3 is in series with the main line and load. Thus, the amount of current flowing in the line determines when C2 is opened and R2 placed in series with the generator field. By contrast, the voltage regulator is actuated by line voltage, whereas the current limiter is actuated by line current. Spring S2 holds contact C2 closed until the current through the main line and L3 exceeds a certain value, as determined by the tension of spring S2, and causes C2 to be opened. The increase in current is due to an increase in load. This action inserts R2 into the field circuit of the generator and decreases the field current and the generated voltage. When the generated voltage is decreased, the generator current is reduced. The core of L3 is partly demagnetized and the spring closes the contact points. This causes the generator voltage and current to rise until the current reaches a value sufficient to start the cycle again. A certain minimum value of load current is necessary to cause the current limiter to vibrate.

The purpose of the reverse current cutout relay is to automatically disconnect the battery from the generator when the generator voltage is less than the battery voltage. If this device were not used in the generator circuit, the battery would discharge through the generator. This would tend to make the generator operate as a motor, but because the generator is coupled to the engine, it could not rotate such a heavy load. Under this condition, the generator windings may be severely damaged by excessive current.

There are two windings, L4 and L5, on the soft iron core. The current winding, L4, consisting of a few turns of heavy wire, is in series with the line and carries the entire line current. The voltage winding, L5, consisting of a large number of turns of fine wire, is shunted across the generator terminals.

When the generator is not operating, the contacts, C3 are held open by the spring S3. As the generator voltage builds up, L5

magnetizes the iron core. When the current (as a result of the generated voltage) produces sufficient magnetism in the iron core, contact C3 is closed, as shown. The battery then receives a charging current. The coil spring, S3, is so adjusted that the voltage winding does not close the contact points until the voltage of the generator is in excess of the normal voltage of the battery. The charging current passing through L4 aids the current in L5 to hold the contacts tightly closed. Unlike C1 and C2, contact C3 does not vibrate. When the generator slows down or, for any other cause, the generator voltage decreases to a certain value below that of the battery, the current reverses through L4 and the ampere turns of L4 oppose those of L5. Thus, a momentary discharge current from the battery reduces the magnetism of the core and C3 is opened, preventing the battery from discharging into the generator and motoring it. C3 does not close again until the generator terminal voltage exceeds that of the battery by a predetermined value.

Differential Relay Switch

Aircraft electrical systems normally use some type of reverse current relay switch, which acts not only as a reverse current relay cutout but also serves as a remote control switch by which the generator can be disconnected from the electrical system at any time. One type of reverse current relay switch operates on the voltage level of the generator, but the type most commonly used on large aircraft is the differential relay switch, which is controlled by the difference in voltage between the battery bus and the generator.

The differential type relay switch connects the generator to the main bus bar in the electrical system when the generator voltage output exceeds the bus voltage by 0.35 to 0.65 volt. It disconnects the generator when a nominal reverse current flows from the bus to the generator. The differential relays on all the generators of a multiengine aircraft do not close when the electrical load is light. For example, in an aircraft having a load of 50 amperes, only two or three relays may close. If a heavy load is applied, the equalizing circuit lowers the voltage of the generators already on the bus and, at the same time, raise the voltage of the remaining generators, allowing their relays to close. If the generators have been paralleled properly, all the relays stay closed until the generator control switch is turned off or until the engine speed falls below the minimum needed to maintain generator output voltage.

The differential generator control relay shown in *Figure 12-331* is made up of two relays and a coil-operated contactor. One relay is the voltage relay and the other is the differential relay. Both relays include permanent magnets that pivot between the pole pieces of temporary magnets wound with relay coils. Voltages of one polarity set up fields about the temporary magnets with polarities that cause the permanent magnet to move in the direction necessary to close the relay contacts;