Construction

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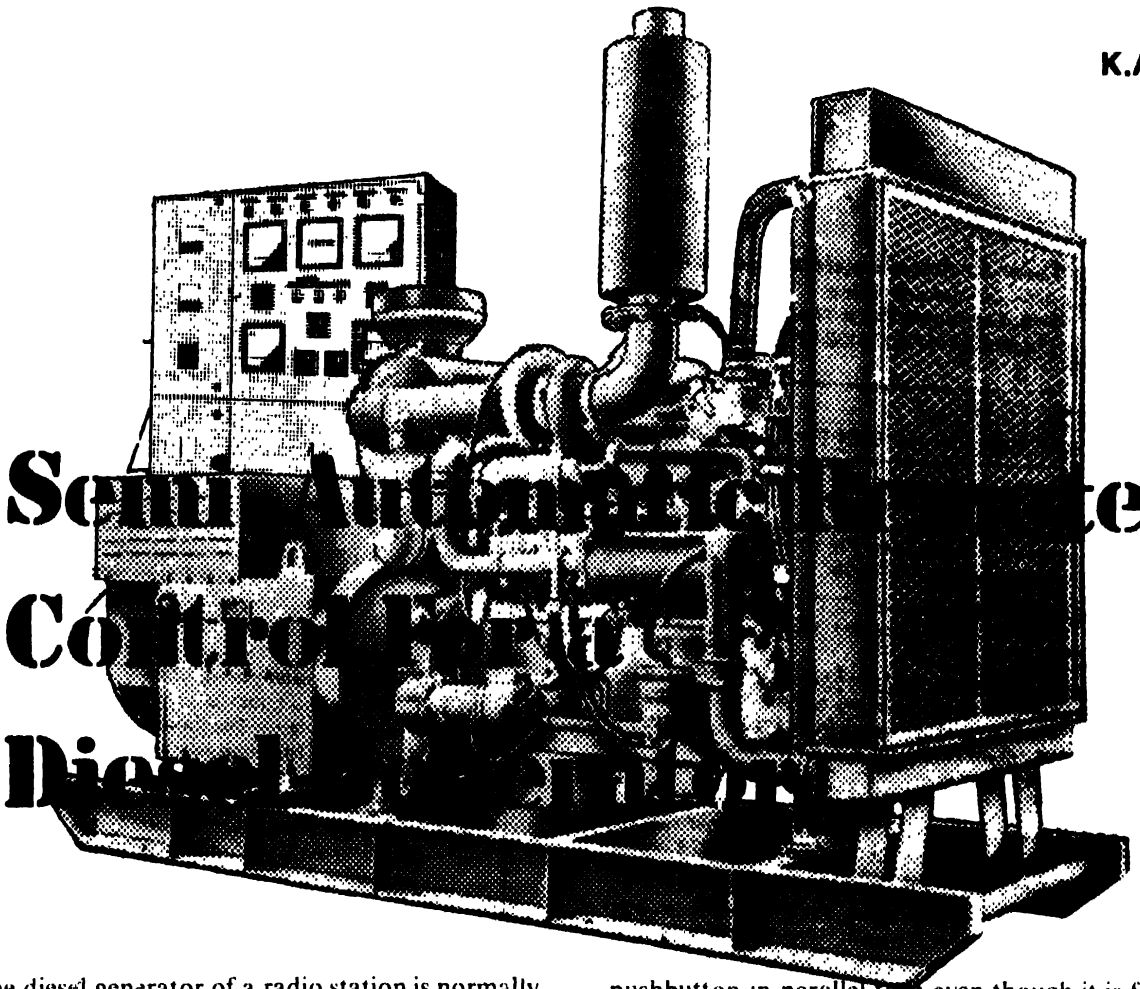

Semi Automatic Remote Control For Diesel Engine

The diesel generator of a radio station is normally installed at a place far off from the control room. In case of power supply failure, which is very frequent in some areas, it is a laborious and time consuming process to go and switch it on and then to switch it off. If the transmitter is powered by diesel generator, then the delay in switching on the generator results in prolonged service interruptions.

At most of the stations, it is observed that only remote starting facility is provided by just putting a parallel push-button. Since the stop operation is not remote, there is an inherent delay in switching off the generator due to obvious reasons, resulting in wastage of fuel.

In order to eliminate the delay in switching on and off and also to reduce the wastage of fuel and time, it is necessary to have the provision of both start and stop operation of generator from remote. In almost all the diesel generators, a starting pushbutton switch is provided. A very heavy current flows through this pushbutton in order to operate the starting solenoid. Moreover, the generator does not start with a momentary push of a button. Instead, it is necessary to keep the pushbutton pressed for at least 2-3 seconds.

Therefore, it is not desirable to provide a remote starting pushbutton in parallel to it even though it is found that at many places a parallel pushbutton is brought on the control panel. This requires a heavy-duty pushbutton, a heavy-duty battery cable and above all the battery gets discharged soon.

Stop operation in a diesel generator is not electrical. In order to stop the generator, the fuel supply cut off lever has to be pulled mechanically. The lever has to be kept pulled till the generator comes to a dead halt. If the lever is released before the generator comes to a halt, it picks up speed again and restarts.

Thus the stop operation is rather complicated. It is therefore not provided on the pretext that it is not necessary as the generator can be stopped at leisure, once the power supply restores. Obviously, this results in wastage of fuel.

Scope

An ideal system of remote control should have the following features.

1. Diesel generator should start with a momentary push of a button.
2. It should also stop with a momentary push of another button.
3. It should have an automatic cutout for the starting

solenoid. Otherwise, there is a possibility of the starting solenoid keeping the starting motor engaged with the generator for longer time and ultimately both the motor and the solenoid may get destroyed.

4. It should also have an automatic cutout for the stop solenoid. This is essential. Otherwise, the solenoid will burn if the supply is not disconnected due to some fault in the circuit.

5. Proper interlocking between the start and the stop pushbuttons should be there. This means that while the generator is off, stop pushbutton should be made inoperative. And also, when the generator is on, start pushbutton should be made inoperative.

6. There should be a remote/local switch on the generator panel in order to ensure the safety of the personnel working on the generator.

Generally, the changeover from normal supply to generator supply is made by an iron-clad switch. For remote control system, it is necessary to replace this switch by contactors of suitable ratings, and the control pushbuttons should be brought on to the panel near the start and stop pushbuttons. The main advantage of having contactors in place of switch is that, in case of power supply failure, after switching on the generator remotely, the changeover to generator supply can also be made instantly. An ideal system should also have an automatic changeover to generator supply once the generator is switched on and vice versa.

Before designing an actual circuit, the time required to start the generator after pressing the pushbuttons was noted and found to be about 2-3 seconds. The time taken to stop the generator after pulling the off lever was also noted and found to be about 8 seconds. It is to be noted here that this time varies with the capacity of the diesel generator (for 20kVA generator about 8 seconds are needed). Therefore, it was decided to provide an electronic time delay of 3 seconds for starting and 10 seconds for stopping.

Taking into consideration all the above points, a very simple transistorised circuit was designed, as shown in the diagram.

Refer the circuit diagram. Supply to the circuit is derived from the same 12V battery which is used for starting the generator.

Starting operation

Once start pushbutton S1 is momentarily pressed, capacitor C2 charges to approximately +7V, and transistor T1 is instantly driven into saturation, energising relay RL2 in its collector circuit. Capacitor C2 keeps providing base current to T1 through 10k resistor and hence T1 remains in conduction, keeping the relay energised even after the pushbutton is released.

But after three seconds, C2 does not provide sufficient base current to keep transistor T1 into saturation and hence it is pulled out of conduction and the relay in its collector circuit gets de-energised. The normally-open contact of the relay RL2 extends +12V to the dual-head lamp relay (RL4 and RL5) coils simultaneously. The start solenoid (RL8) gets supply through the normally-open contacts of RL4 and RL5a connected in series as shown. Thus the diesel generator starts.

After three seconds, relay RL2 gets de-energised and the supply to the solenoid is disconnected. Once the generator picks up speed and the output voltage becomes normal, relay RL1 also gets energised. This relay also interrupts 12V supply to the dual relays through one of its pairs of contacts. Coils of dual relays RL4 and RL5 have been energised and their contacts connected in series to extend supply to the start solenoid, in order to ensure positive tripping in case any one of the relays get stuck up. Relay RL1 with one of its pairs of contacts gives an indication of diesel generator 'on' condition by flashing an LED on the control panel.

Stop operation

For pulling the off lever, a 12V solenoid (RL9) is used. This solenoid is mounted on the generator in such a manner that it pulls the off lever completely, when it gets energised.

When the diesel generator is not running and the stop pushbutton S2 is pressed, transistor T2 does not get base drive, since the corresponding normally-open contact of relay RL1 is included in series with stop pushbutton. When the diesel generator is on, relay RL1 is energised. Now when the stop pushbutton is pressed momentarily, transistor T2 instantly conducts into saturation and relay RL3 in its collector circuit gets energised.

Capacitor C3 keeps T2 on, and hence the relay RL3 on, for about 10 seconds. With the normally-open contact of RL3, supply is extended to dual-head lamp relay RL5 to its 'b' coil. Thus with its RL5b contact, stop solenoid is energised and it pulls the off lever. Since relay RL3 remains energised for 10 seconds, and so does the dual relay coil RL5b, the solenoid keeps the off lever pulled for 10 seconds and the generator stops.

Stop solenoid protection circuit

Normally-closed contact of RL6a relay is inserted in series with the normally-open contact of RL5 relay in the stop solenoid circuit. Whenever diesel generator stop pushbutton is pressed momentarily, RL5b coil gets energised and +12V is extended to stop solenoid via N/C contact of RL6a. Supply is also simultaneously extended to stop solenoid protection circuit as shown and, therefore, capacitor C5 starts charging through 22k resistor (R11). After about 12 to 15 seconds, sufficient voltage is developed across C5 and hence transistor T3 conducts and actuates relay RL7 in its collector circuit. This 6V relay in turn energises coil of dual-head lamp relay RL6a and its contact is opened to interrupt the supply to stop solenoid.

But prior to the operation of RL6 relay, the supply to stop solenoid protection circuit is removed by contact of RL5b

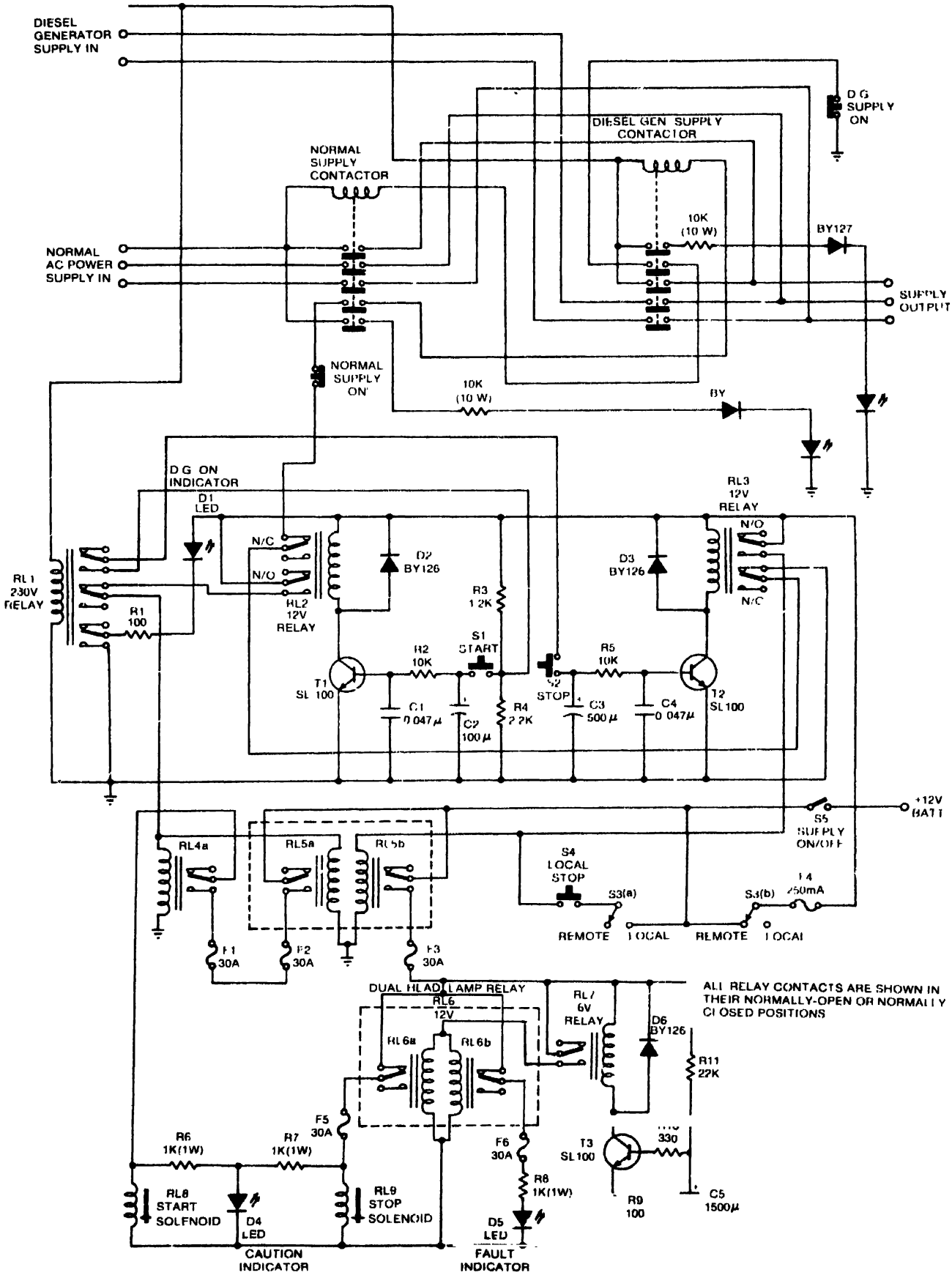

Fig. 1: Circuit diagram of the semi-automatic remote control of diesel generator.

List of components required and their approximate price

S. No.	Name of components	Qty required	Rate per piece	Total amount
1	12V solenoid (Lucas made used in cars)	1 No	350	Rs 350.00
2	12V relay with two C-O contacts	2 Nos	10	20.00
3	6V relay	1 No	15	15.00
4	O-F-N relay (230V AC)	1 No	100	100.00
5	Dual-head lamp relay (type PMP 2103 used in car)	3 Nos	80	240.00
6	Miscellaneous (switches, push-buttons, LEDs, PCB resistors and transistors)			100.00
			Total	Rs 825.00

All these items are available in the usual electronics shops in cities nowadays and their procurement should not be a problem.

after about 10 seconds. Therefore, RL6 relay operates only in case of faults such as welding of contact of RL5b or shorting of transistor T2. Relay RL6 operates under such faulty conditions and protects the stop solenoid from burning.

Whenever relay RL6 operates, red LED lights up via its RL6b contact, indicating the fault in the circuit. This LED is installed on the control console in the control room. The fault can be traced by switching off the battery supply by a rotary switch provided, as shown in the diagram. (Note: contact of RL6a relay is modified from normally open to normally closed.)

Caution indication

This indication (red LED) is also installed on the control console. Whenever the diesel generator is started or stopped, this indication comes as long as the start or stop solenoid is energised and persists as long as the solenoids remain energised. Caution indication appears for about two seconds whenever diesel generator is started and for about 10 seconds whenever diesel generator is stopped.

If this indication persists for more than the above stipulated period, it shows that the corresponding solenoid supply is through and it is about to burn. Operator should immediately swing into action under such circumstances and switch off the battery supply using the rotary switch provided on the diesel generator panel.

In short, this caution indication keeps a watch on both the solenoids and cautions the operator. But the possibility of this caution indication persisting is very remote since due care is taken to provide an automatic protection to both the solenoids while designing the circuit.

A remote/local switch is provided on the generator control panel. Before starting the work on generator, this switch has to be put in local mode so that nobody can start the generator from remote.

Stop pushbutton is also provided on the generator itself. This pushbutton is effective only when the switch is in local mode. This facility is provided to stop the generator by pressing the pushbutton instead of pulling the lever manually.

Normal/diesel generator changeover contactor system

As shown in the diagram, the coil circuit of the normal supply contactor is normally closed and hence normal supply is always through.

For changing over to the generator supply, it is necessary to first start the diesel generator and then press the DG supply on pushbutton. If the generator is not on, the changeover has no meaning and hence deliberately made ineffective, as is clear from the circuit.

In case power supply fails, diesel generator should be started by just pressing the DG start pushbutton. Changeover to diesel generator supply takes place automatically, once the generator attains full speed. This is achieved by including the normally-closed contact of relay RL2 in the diesel generator contactor coil circuit, as shown.

Also when the generator is switched off, the diesel generator supply is automatically changed over to normal supply. This is so since the normally-closed contact of relay RL3 is included in the diesel generator contactor coil circuit.

Following LED indications are provided on the control panel:

1. DG on indication (Yellow LED)
2. DG supply on indication (Yellow LED)
3. Normal supply indication (Green LED)
4. Caution indication (Red LED)
5. Fault indication (Red LED)

Salient features of the circuit

1. Starting operation: By momentary pressing the start pushbutton.
2. Stop operation: Also by momentary pressing the stop button.
3. Starting solenoid does not get supply in case start pushbutton is pressed by mistake when the DG is on.
4. Stop solenoid does not get supply in case stop button is pressed by mistake when the DG is not on.
5. In case of power supply failure, changeover to DG supply is automatic, once the DG is switched on.
6. Once the DG is stopped, changeover to normal supply is automatic.
7. Automatic DG supply changeover takes place only when DG attains normal speed and normal voltage.
8. Complete safety to start and stop solenoid, both automatic as well as manual, has been ensured.
9. Remote/local switch is provided on the DG panel, to ensure safety to the personnel working on DG.
10. Heavy start and stop current required for operation of solenoids, does not flow through the pushbuttons. Instead only 0.7mA of current at 7V flows through the pushbutton.
11. Moreover, the circuit draws a negligible current from the battery. □