SPORTPLANE BUILDER...

By Tony Bingelis

SWITCHES AND SWITCH-LIKE DEVICES

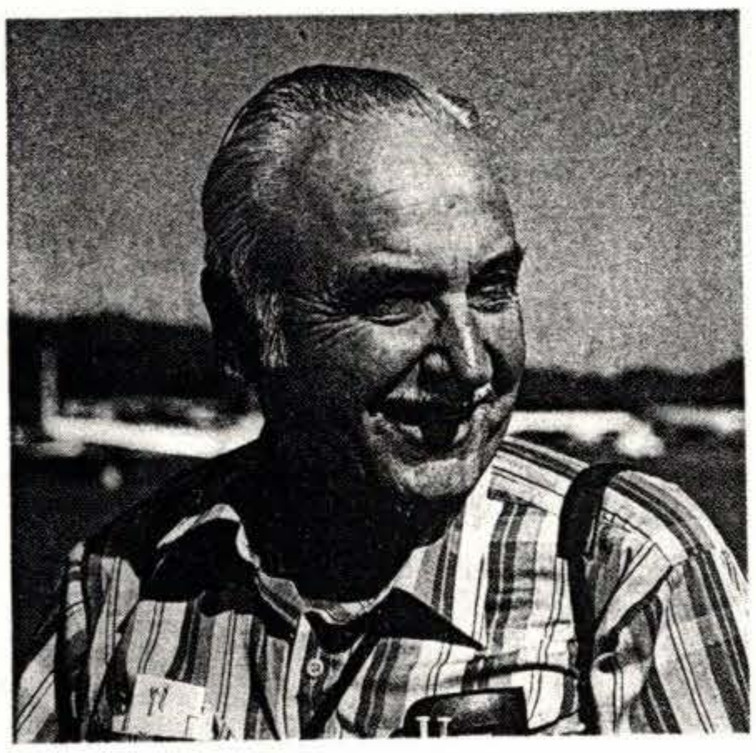
Part 2

The 6-terminal double-pole, double-throw (DPDT) switch is a most interesting and useful device. This switch can be wired to permit reversing the polarity of a direct drive motor so that it will change its direction of rotation. The ability to reverse motor direction is essential in both landing gear and flap electrical circuits.

Motor reversal is simply accomplished by cross-connecting a jumper wire between terminals 3 and 5, and another between terminals 2 and 6 as shown in Figure 1.

The main thing to remember about these 6-terminal DPDT switches is that when the toggle is flipped down, the opposite (upper end) terminals are electrically connected.

Flip the toggle lever up and the lower 4 terminals are closed. For all practical purposes, the two center terminals are "common" connections with one side usually connected to the power source (battery) and the other to ground.



Flap Switch Selection

When you select a switch for your flaps, you will undoubtedly elect to use a DPDT switch whose two extreme ON positions are momentary contact positions. That is, when the toggle lever is moved to one of the momentary contact ON positions, the spring-loaded lever will return automatically to a neutral or OFF position when it is released. This means that you will have to hold the toggle lever in either of its two momentary ON positions until the flaps are retracted or have reached the degree of deflection you want.

The flap toggle lever being spring loaded to a neutral position makes it an easy matter to deploy any degree of flaps you want without having to physically move the toggle to an OFF position to stop their movement. Likewise, "milking" the flaps UP after a take-off, or during a go-around, is much easier to do with this type of momentary contact switch.

Landing Gear Switch Requirements

The momentary contact type of switch used for the flaps is not suitable for use in your landing gear circuit as you want the gear to complete its retraction or extension cycle once the switch lever is flipped.

The DPDT switch ordinarily used for this purpose will have ON/NONE/ON positions. That, essentially, provides two positions . . . one for the gear DOWN and the other for the gear UP. A DPDT switch having ON/OFF/ON toggle lever positions could be used, of course, but the possibility would always exist that you might accidentally move the switch to the OFF position, leaving the landing gear in some intermediate stage of retraction.

Actually, a gear selector switch should always be in either the UP position or in the DOWN position. This is possible because the landing gear travel limits are established by Limit Switches which will automatically open the electrical circuit to the motor when the landing gear reaches its fully retracted or extended position.

Switch Installation Notes

You will find that some catalogs list switches as being 1-hole or 3-hole mount types. What this means is what it says. You will have to drill 3 holes in the instrument panel to install the 3-hole mount switch. Two of the holes are for the mounting screws and the third (center) hole is for the protruding button, toggle lever or rocker that activates the switch.

A 1-hole mount switch is neck-mounted through a single hole in the panel . . . a much neater installation. Furthermore, a 1-hole mount switch insures a smooth area around its installed location making it easier to affix adjacent switch identification labels or placards. The other type (3-hole mount switch) has screws protruding that can mess up your switch identification efforts.

Almost all toggle switches have screw type terminals for the attachment of the wires. I prefer to use split type (helical) lock washers under the screw heads rather than the star washers in making my terminal connections. I don't know that this is an industry standard, but it is my own as I believe the split type lock washer is the more reliable of the two types. Another thing, it might be a figment of my imagination but it seems that the teeth of the star lock washers lose some of their locking bite when re-used.

Solenoids

A solenoid is nothing more than another type of switch. It is one that you activate by causing a small electrical current to flow through a coil to induce an electrical field around a plunger (armature). The electrical field surrounding the plunger causes it to move and mechanically complete a circuit between the solenoid's two larger copper terminals. See Figures 2, 3 and 4.

The cylindrical silver-colored solenoids used in aircraft have three terminals, sometimes four. Two of the terminals are large and the other one (or two) decidedly smaller.

Although most solenoids resemble each other externally, there is a difference, primarily in the coil.

For instance, a starter solenoid is engaged for only a few seconds or minutes at a time in a starter circuit. Its coil, therefore, is designed for this "intermittent operation" only. This type of solenoid would overheat if used continuously. That's why you should never use a starter solenoid as a battery connector solenoid.

A battery solenoid, on the other hand, can withstand continuous operation for hours because its coil has a much higher resistance than that in a starter solenoid. This higher resistance keeps a battery solenoid from overheating.

Unfortunately, you cannot tell which type of solenoid it is simply by looking at its external appearance. About the only clue stamped on a solenoid may be its voltage rating (12 volts/24 volts, etc.). Sometimes below one of the large copper terminals (usually the left one), the word "BAT" may be embossed on

H 39F $8.10

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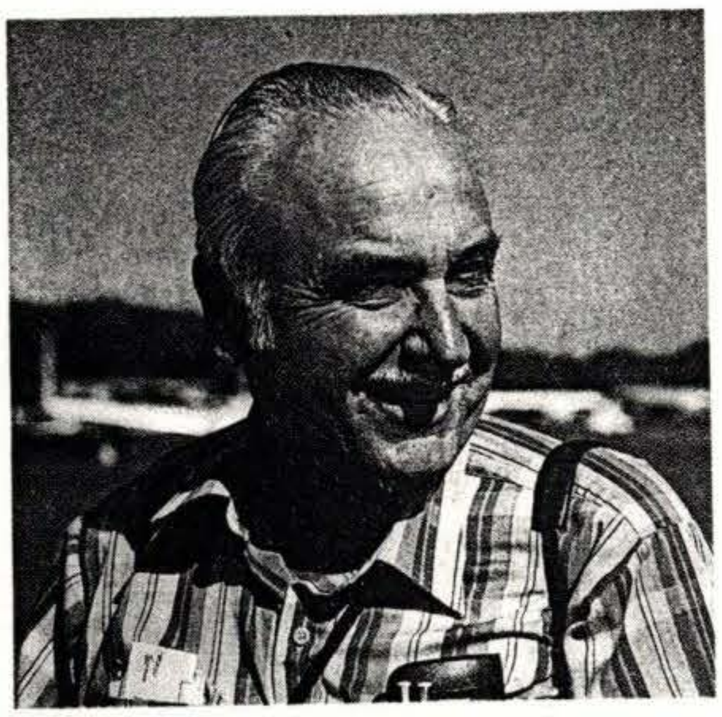

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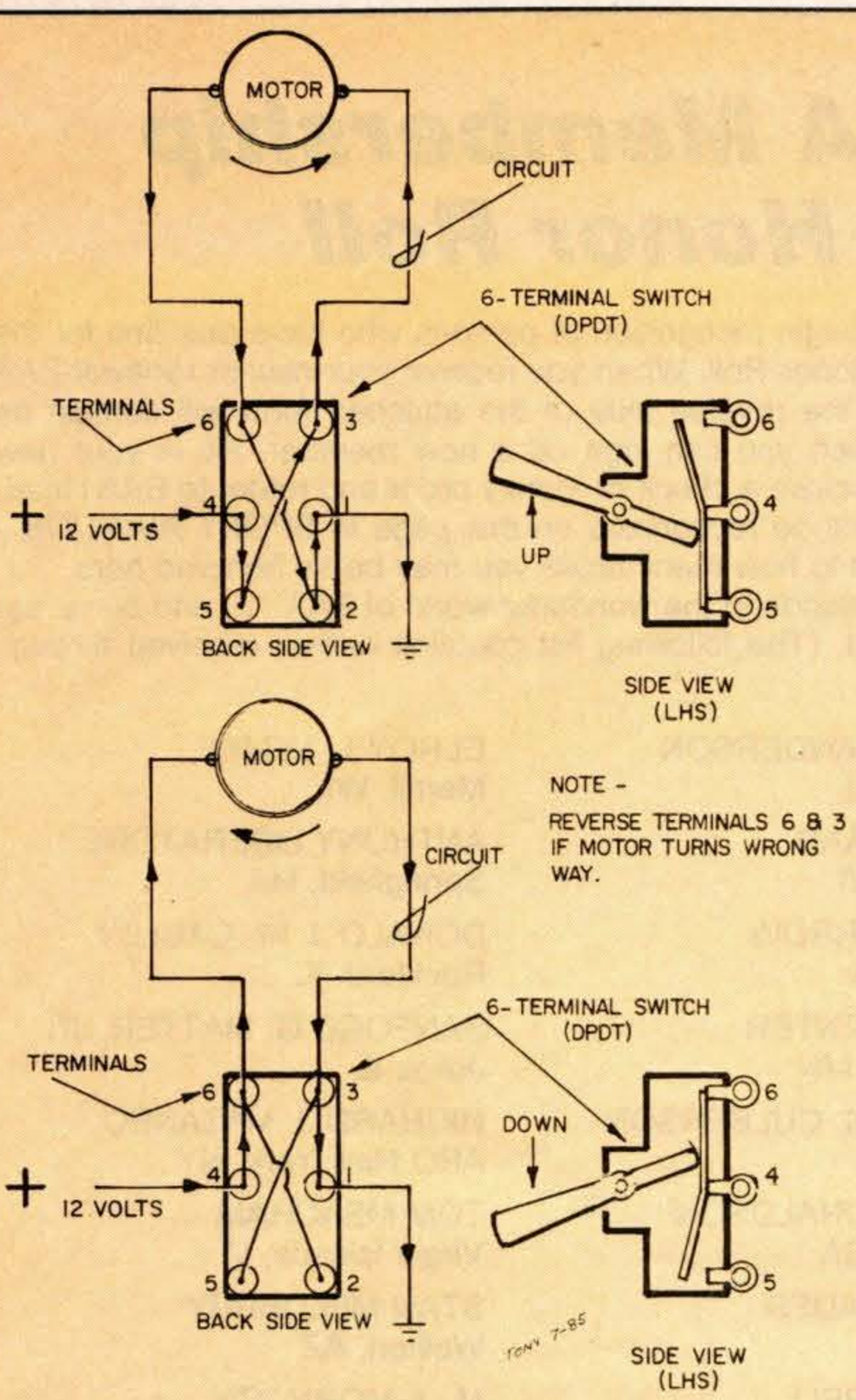
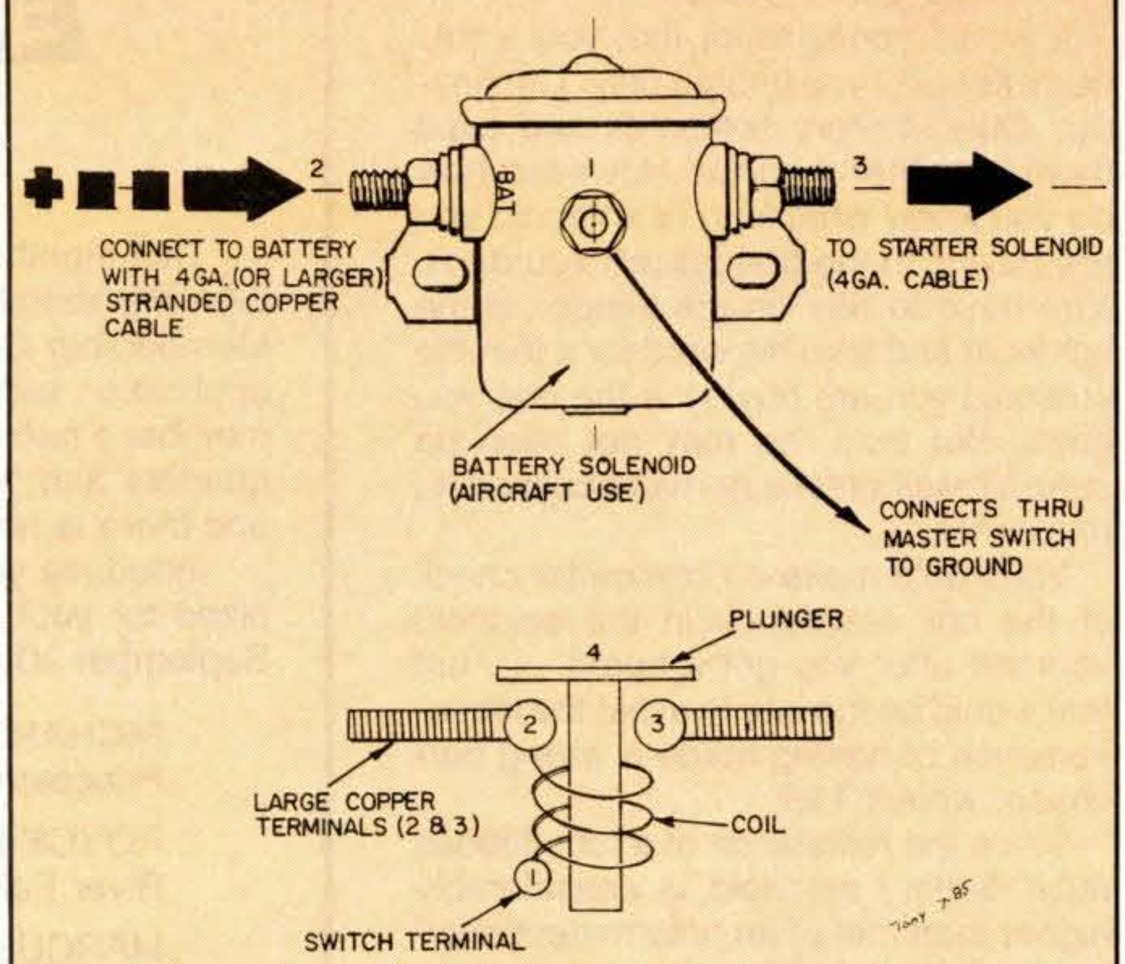


FIGURE 1.

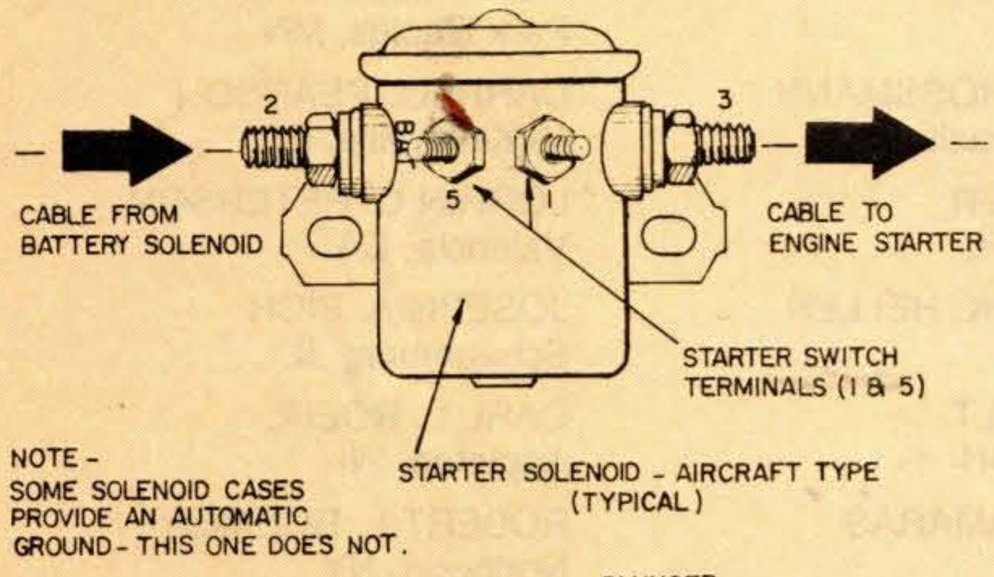
REVERSING POLARITY IN A D.C. MOTOR
(LANDING GEAR/FLAPS SYSTEMS)



BATTERY SOLENOID - INTERNAL CIRCUIT
(SCHEMATIC)

FIGURE 2.

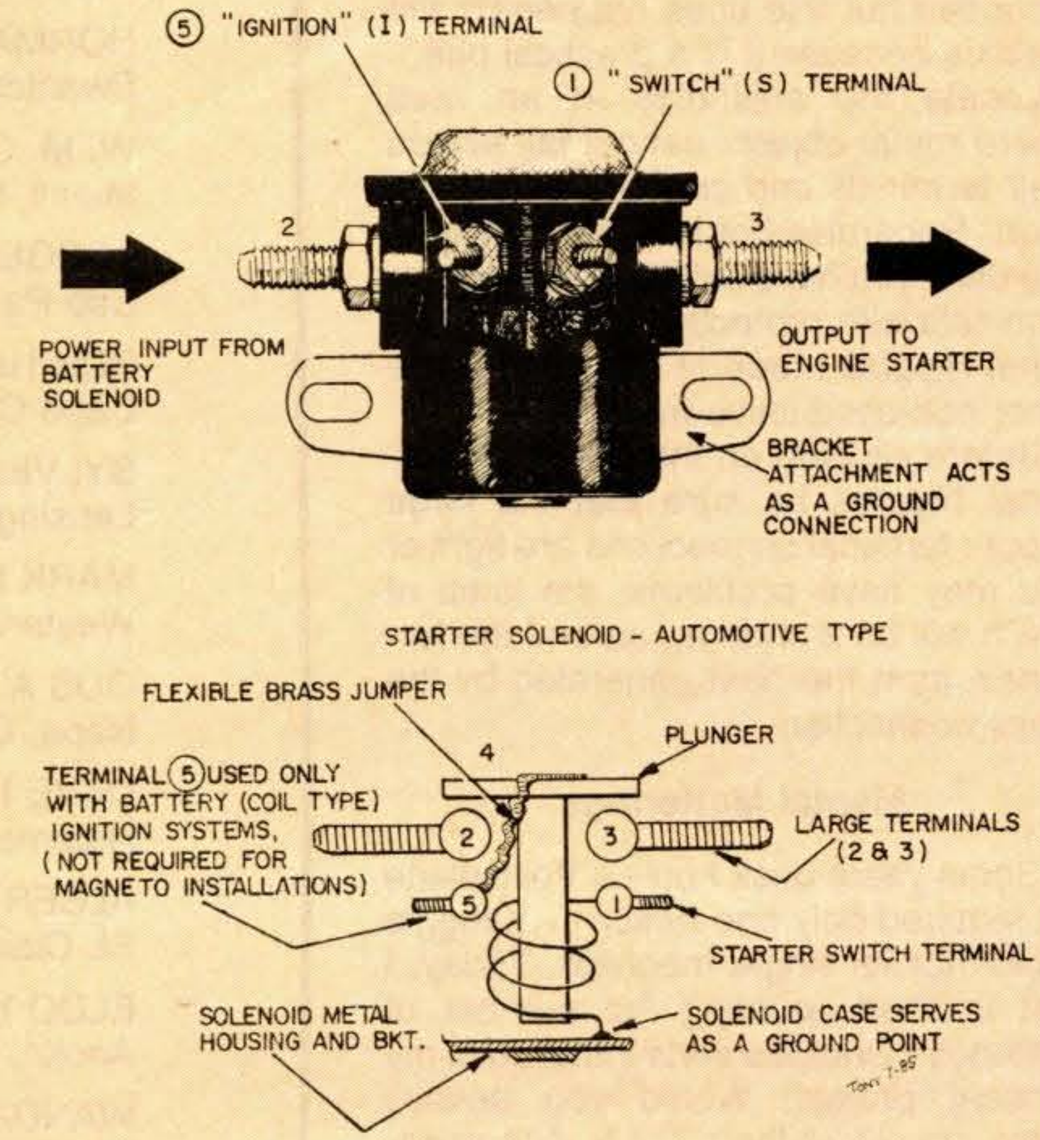
CONTINUOUS DUTY SOLENOID
(TYPICAL APPLICATION)



STARTER SOLENOID - INTERNAL CIRCUIT
(SCHEMATIC)

FIGURE 3.

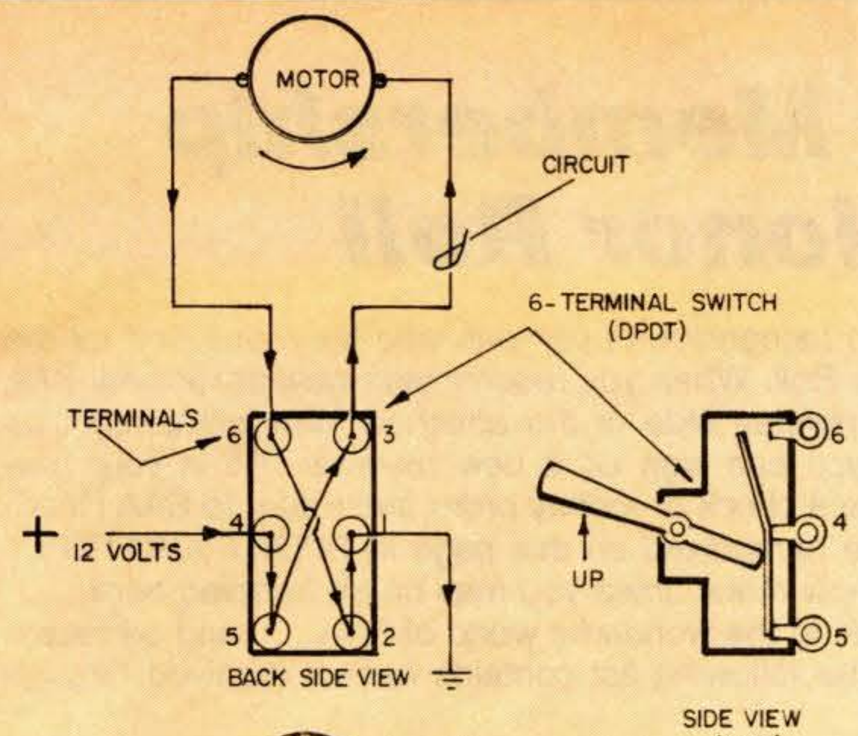
INTERMITTENT DUTY SOLENOID
(TYPICAL APPLICATION)

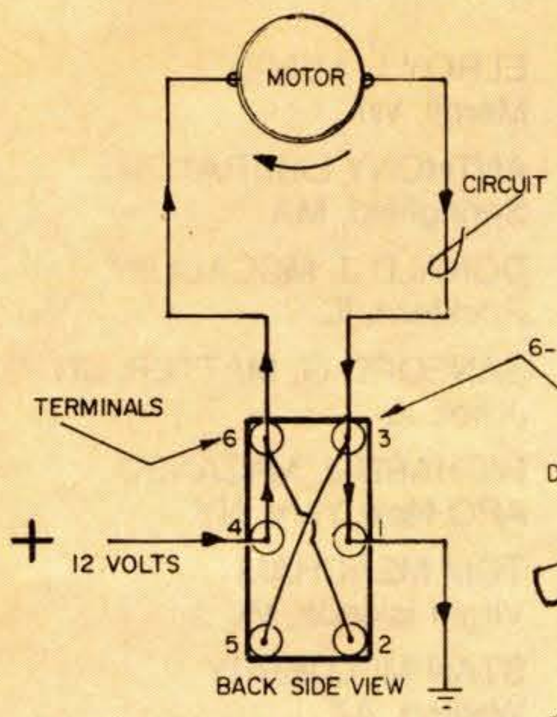


STARTER SOLENOID - AUTOMOTIVE TYPE

FIGURE 4.

INTERMITTENT DUTY SOLENOID
(AUTOMOTIVE TYPE)





NOTE -

REVERSE TERMINALS 6 & 3 IF MOTOR TURNS WRONG WAY.

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REVERSING POLARITY IN A D.C. MOTOR
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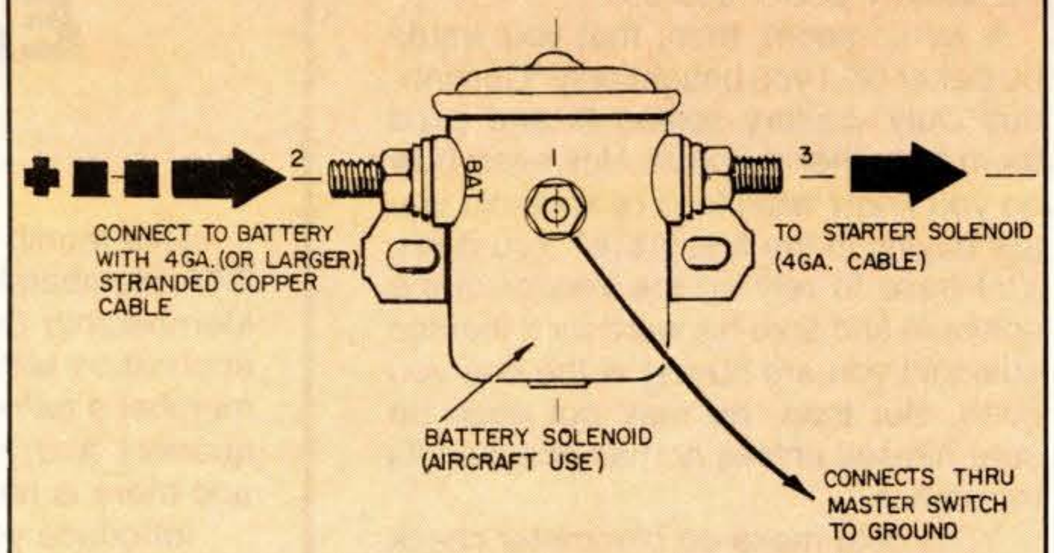

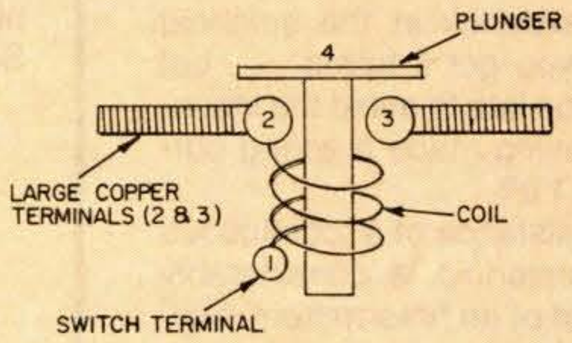

BATTERY SOLENOID - INTERNAL CIRCUIT
(SCHEMATIC)

FIGURE 2.

CONTINUOUS DUTY SOLENOID
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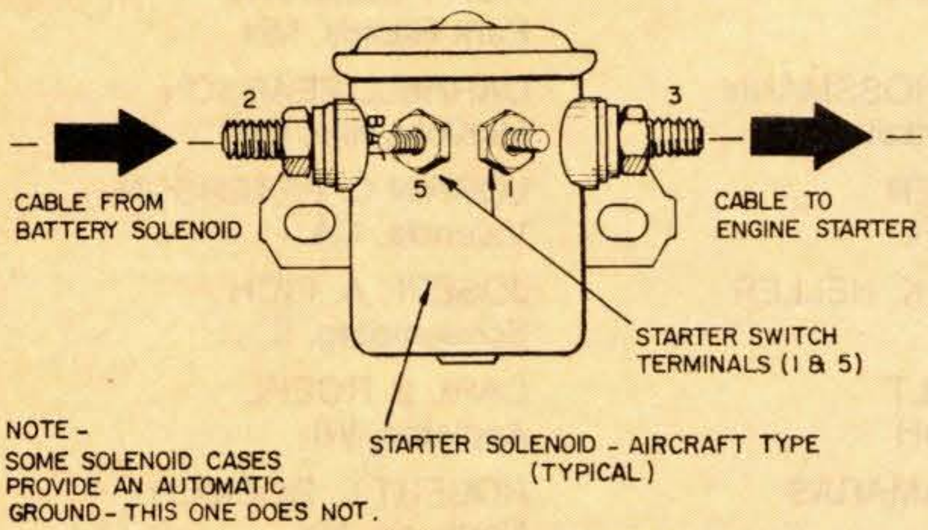
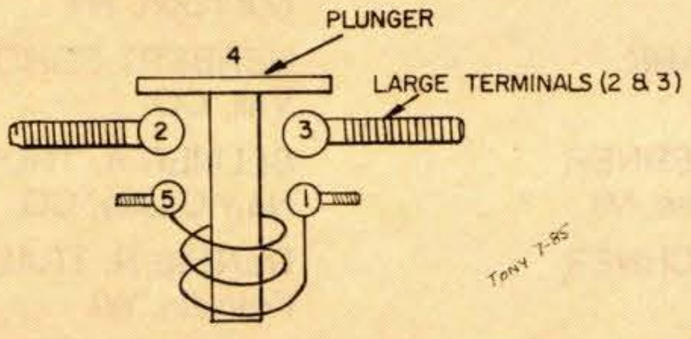


NOTE -
SOME SOLENOID CASES PROVIDE AN AUTOMATIC GROUND - THIS ONE DOES NOT.



STARTER SOLENOID - INTERNAL CIRCUIT
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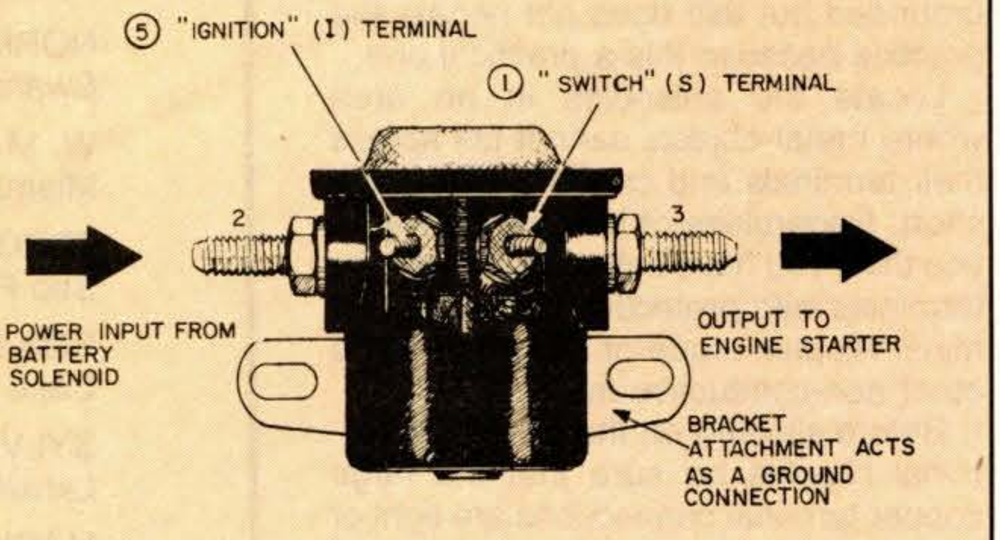

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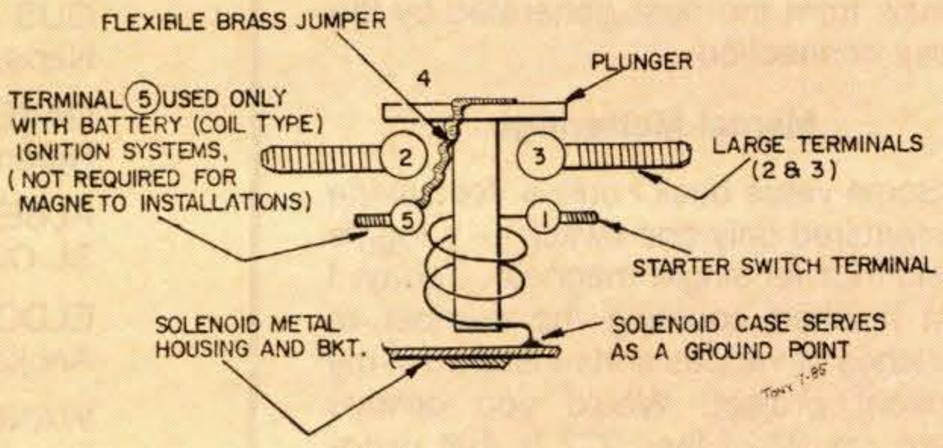

FIGURE 4.

INTERMITTENT DUTY SOLENOID
(AUTOMOTIVE TYPE)

the metal case. This identifies the large terminal which should be connected to the battery power source.

It would seem, then, that you would be better off if you bought only "Continuous Duty" battery solenoids and used them for either purpose. However, how do you know what kind of solenoid you are buying in the first place? You don't. You have to rely on the vendor of the solenoid and take his word for it that the solenoid you are buying is the one you need. But then, he may not even be

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You could make an ohmmeter check of the coil resistance in the solenoid yourself after you get it home . . . but that would be too late to avoid the inconvenience of having made a wrong purchase, wouldn't it?

Since the resistance of a "continuous duty" battery solenoid is considerably higher than that of an "intermittent duty" starter solenoid it should be easy enough to determine which is which with an ohmmeter.

According to my notes a 12 volt solenoid built for "intermittent duty" will have a coil resistance of only 4 to 6 ohms while a solenoid intended for "continuous duty" will register a much higher coil resistance, 8 to 10 ohms.

Solenoid Installation Notes

Most solenoids are installed on metal firewalls so their case is automatically grounded to the aircraft ground. Some solenoids may not need the case grounded but this does not negate the practice because it is a practical one.

Locate the solenoids in an area where metal objects cannot fall across their terminals and create an electrical short. Regardless of how safe an area you think you have selected, protect the terminals with protective Electrical Terminal Nipples made of rubber or some other non-conductive material.

Before slipping on the Electrical Terminal Nipples be sure that the large copper terminal connections are tight or you may have problems, the least of which will be a charring around the terminals from the heat generated by the loose connection.

Mental Mutterings

Some years back I built a Volksplane tht required only one switch — a toggle switch for its single magneto. Today, I just finished counting the number of switches of various sorts installed in my present project. Would you believe there are 27 of them??? Is that **progress**?

More next month.

If you wish to contact the author for additional information, please write to Tony Bingelis, 8509 Greenflint Lane, Austin, TX 78759.