#39E .15

SPORTPLANE BUILDER...

By Tony Bingelis

SWITCHES AND SWITCH-LIKE DEVICES

I suspect that there are more cute little Radio Shack switches to be found in homebuilts than there are Military Standard types or similar "aircraft quality" switches . . . and why not?

A switch is a very simple device. One that usually poses no problem even to the builder who selects one at random and installs it where he happens to need it.

Sometimes styling is the overriding factor and the builder finds himself picking a particular switch type for its decorative effect more than for its electrical pedigree. This method of switch selection may be O. K. for an infrequently used minor circuit but I would certainly give more attention to selecting the more important switches. Switches like the ignition switch, master switch, landing gear and flap switches, to name a few, should all be top quality switches. The best you can obtain.

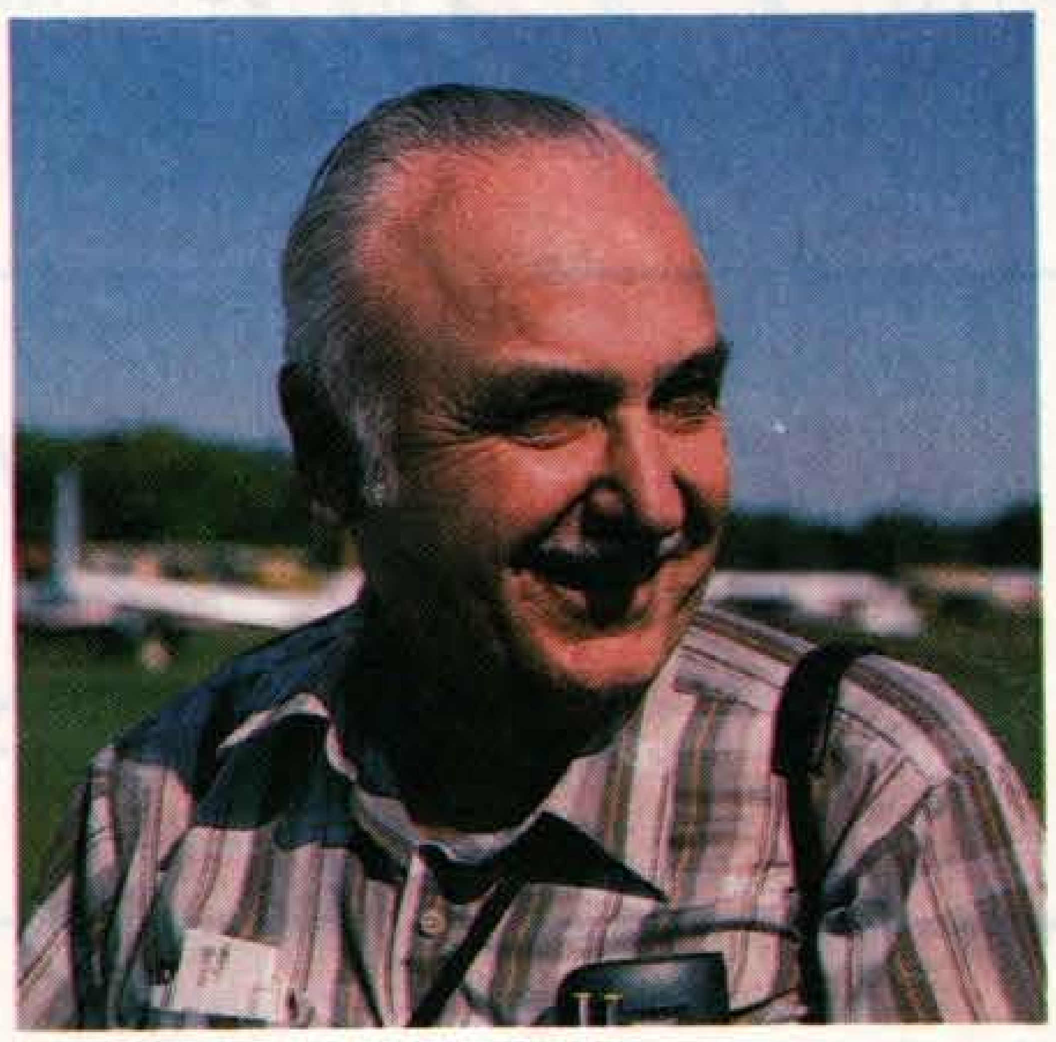
Actually, there is no need to sacrifice styling, either. With so many switch designs to select from you should never have to forego electrical reliability for styling. All you need to do is continue your search until you locate the type switch you need and want.

Although there are hundreds of switch shapes, styles and sizes to pick from, don't let that confuse you. All switches provide essentially the same function . . . that of controlling an electrical circuit. The switch provides a positive and quick means of stopping, starting or diverting the direction of current flow in an electrical circuit. All you have to do is flip, turn, push or pull the toggle, button, knob or lever.

However, even though all switches function in the same basic manner, not all of them belong in anybody's aircraft. Some are so shoddily constructed that they would probably have a short service life and perhaps introduce the risk of an electrical fire.

Switch Selection

Aircraft quality switches are ruggedly constructed and have sufficient capacity to repeatedly break and remake a circuit thousands of times over without failing. They can also carry the rated connected load current continuously without overheating. Perhaps the most important element of a good quality switch is the snap action mechanism which produces a rapid opening and closing of the contacts regardless of how slowly you flip the operating toggle or rocker. A snap action just about eliminates contact arcing . . . a common fault with poorly designed cheapie switches.



Since the electrical capacity of a switch is so important, most builders try to determine its nominal rating before getting into its other qualities. Although some aircraft switches have their continuous current rating (nominal rating) embossed or stamped on the switch housing, many do not. That may make it a bit more difficult for you to ascertain that the switch's norminal rating is high enough for your purpose before you buy it.

Naturally, there is no harm in using a switch that has a considerably higher ampere rating than you need. The converse, however, could result in a hot smoking switch. Incidentally, don't be mislead by the size of a switch. A big switch does not necessarily indicate that it can handle high amperages.

When selecting a switch, you should realize that some circuits are subjected to an abnormally higher current draw than they require in continuous operation. An incandescent lamp, like a landing light for example, subjects its circuit to a very high initial current draw when the switch is closed. This is often called a "High In-rush Circuit" and may require a switch capacity 5 times greater than that needed for continuous operation.

A direct current electric motor also imposes a much higher current draw during its starting phase than it needs when it is running continuously. Although an electric motor may only draw two or three amps running free, its start-up demand may exceed 10 amps.

Relays and solenoids likewise induce higher current loads on a switch because of their inductive circuits. When the control switch is opened, the magnetic energy stored in the relay or solenoid coils is released and can produce an arc, to the detriment of the switch. A switch used in a relay or solenoid circuit should have twice the capacity of its nominal current need.

Switch Designations

At the risk of providing more information about switches than you need (or care) to know, I think the following can be useful when making your switch purchases.

Switch types are identified by the number of poles, throws and positions they provide. A bit of clarification follows:

Pole — The pole in a switch may not even resemble a pole. It is the movable metal contactor. The number of poles is the same as the number of external terminals on the switch through which current can enter or leave.

Throw — The throw indicates the number of circuits each pole can complete through the switch.

Position — The number of positions a switch has is the number of stops at which the toggle or switch activator can come to rest while opening or closing a circuit.

When browsing through a catalog listing of switches, you will find that the above defined terms are used in a sort of shorthand language to describe the various switches. These are:

Single-pole, single-throw (spst) switches — they can handle only one circuit.

Single-pole, double-throw (spdt) switches — two circuits can be completed but not simultaneously.

Double-pole, single-throw (dpst) switches — handle two circuits simultaneously.

Double-pole, double-throw (dpdt) switches — handle two circuits with each throw.

Perhaps figures 2 through 5 will help you visualize these combinations better.

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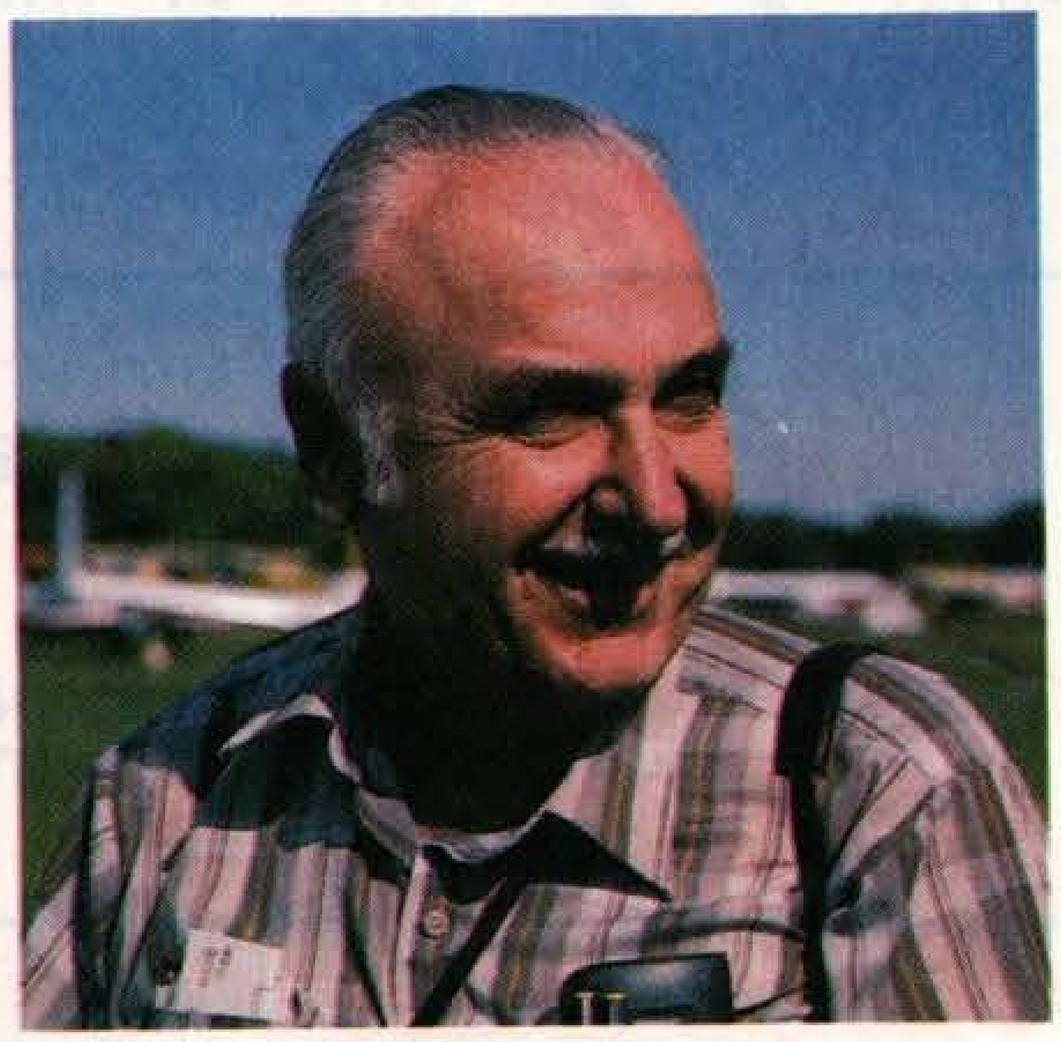

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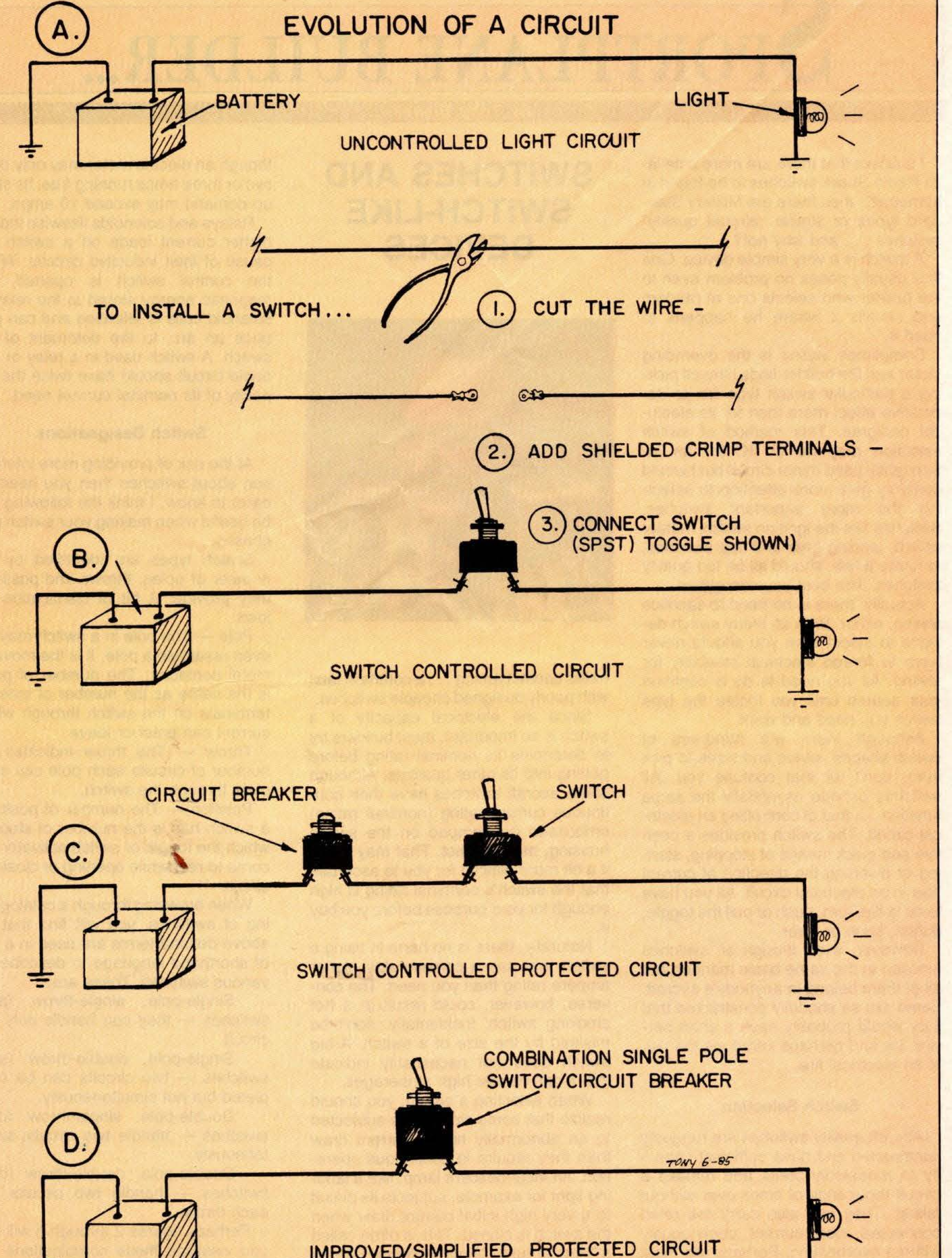

A.
EVOLUTION OF A CIRCUIT
BATTERY
LIGHT
UNCONTROLLED LIGHT CIRCUIT
TO INSTALL A SWITCH...
1. CUT THE WIRE -
2. ADD SHIELDED CRIMP TERMINALS -
3. CONNECT SWITCH
(SPST) TOGGLE SHOWN)
B.
SWITCH CONTROLLED CIRCUIT
CIRCUIT BREAKER
SWITCH
C.
SWITCH CONTROLLED PROTECTED CIRCUIT
COMBINATION SINGLE POLE
SWITCH/CIRCUIT BREAKER
D.
TONY 6-85
IMPROVED/SIMPLIFIED PROTECTED CIRCUIT

FIGURE I.

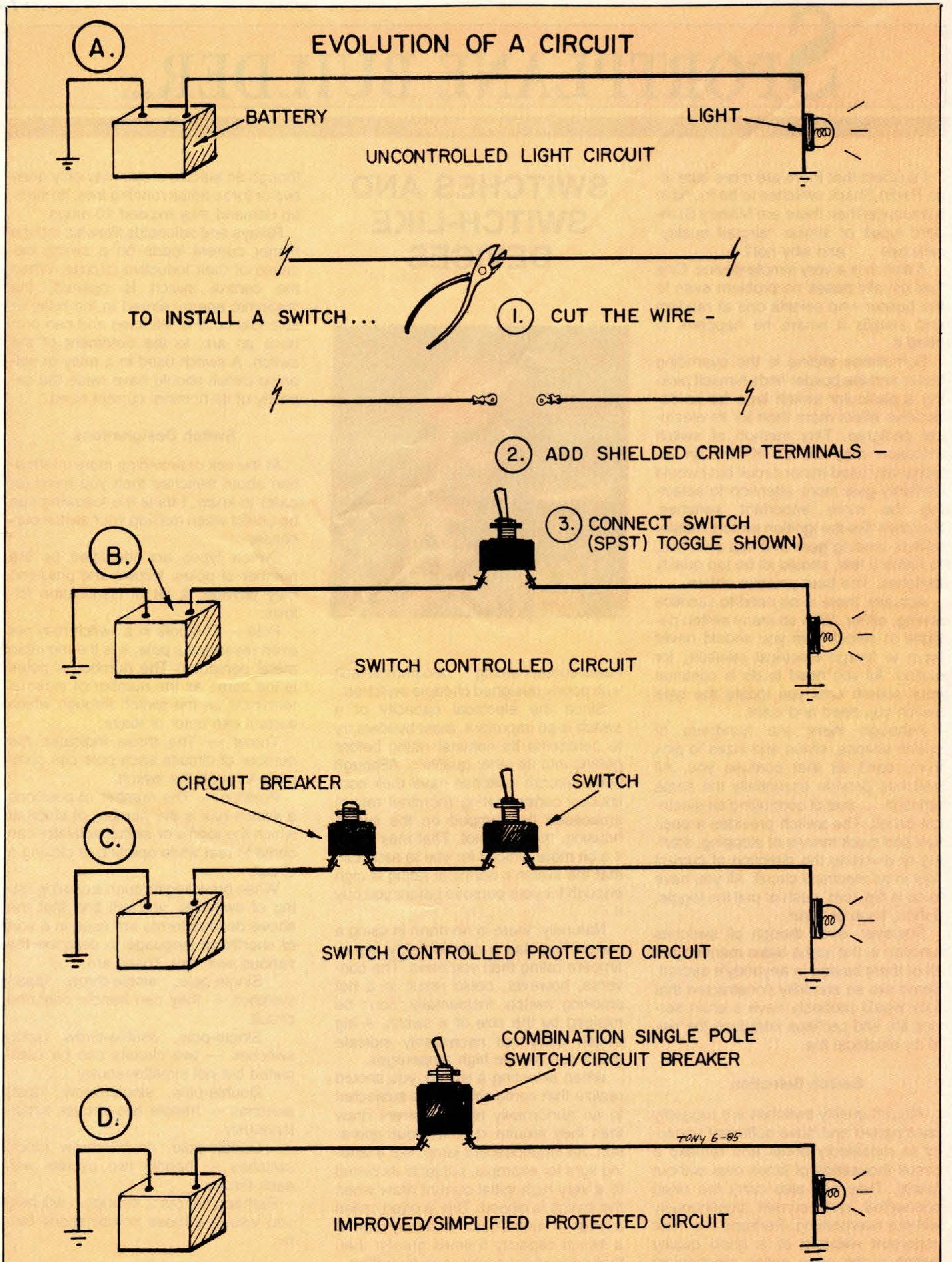
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FIGURE I.

highly stylized designs. A toggle activator is easy to isolate among a batch of switches and is easy to operate with a flick of a finger or thumb.

The large old military type toggle switches are not very classy appearing as they are neck mounted through a single hole in the panel. A thin nut secures the switch to the panel. With part of the neck showing, and the rather large hole through which the toggle protrudes, a sort of unfinished appearance results. Still, most builders think they make a pretty macho installation.

I dare say that over 90% of the toggle switches installed in sport aircraft are the simple single-pole, single-throw (spst) switches. These switches ordinarily have two positions, either ON or OFF (see Figure 2).

Toggle switches may be obtained that are spring loaded to provide a momentary type of contact if required. For the most part, more two and three position switches are used than any of the momentary contact type.

Rocker Switches

A rocker switch seems to have all the advantages of the toggle switch and has decorative class to boot. It is a very popular type of switch with homebuilders and it lends itself to sophisticated cockpit decor.

You can use a rocker switch interchangeably with a toggle switch having the same nominal rating.

Push-Button Switches

A push-button switch is a rare item in sport aircraft. With the exception of an occasional starter button or a push-to-talk mike switch, the spring loaded momentary contact push-button switch is seldom used in experimental aircraft. One thing you can say for the push-button switch, it does have a heavy current capacity seldom equalled by most other switches.

Fuses

Most of us don't regard the lowly fuse as a sort of switch but it really is. A fuse will automatically open the circuit when the rated current flow is exceeded. The excess heat this generates causes the fuse element to melt (blow) and the circuit is opened. The main drawback to this device is that the fuse once blown must be removed and replaced with a new one to reactivate the circuit.

Incidentally, you could open and close the circuit by removing and reinstalling the fuse to control the circuit . . . a crude switching means at best. Obviously, fuses make better circuit protectors than they do switches.

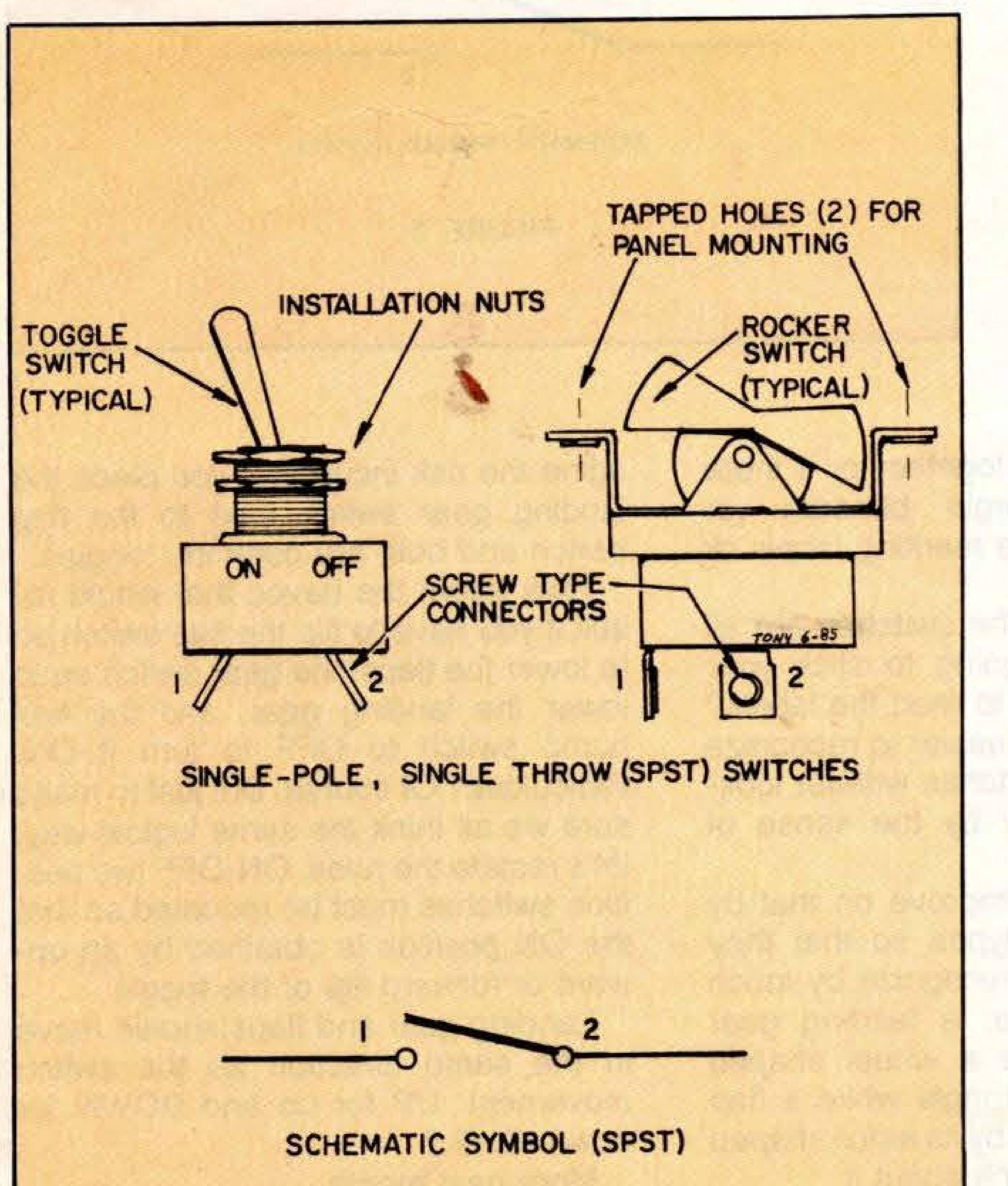
Switch Applications

Use the simple two position (spst) switches, either toggle or rocker types, for your light circuits and for switching accessories on and off.

A double-pole, single-throw switch (dpst) is commonly used as a master switch so that both the battery circuit and the alternator (generator) circuits can be controlled simultaneously. Most builders prefer to use the standard (RED) rocker switch embossed with the word "Master". If you look far enough you may find a split type master switch embossed "BAT" on one half and "ALT" on the other. This switch can be operated individually or, most usually, jointly.

As you know, when the master switch is flipped ON, it connects the battery contactor coil to ground and the alternator field circuit to the battery actuating the entire power system. In this set-up, any light or accessory connected to the main power source (bus bar) can be operated simply by closing that individual switch. However, when the master switch is turned OFF, the main circuit is opened and all individual lights and accessories will cease to function regardless of their individual switch positions.

This is an extremely vital provision in the event of an emergency landing or



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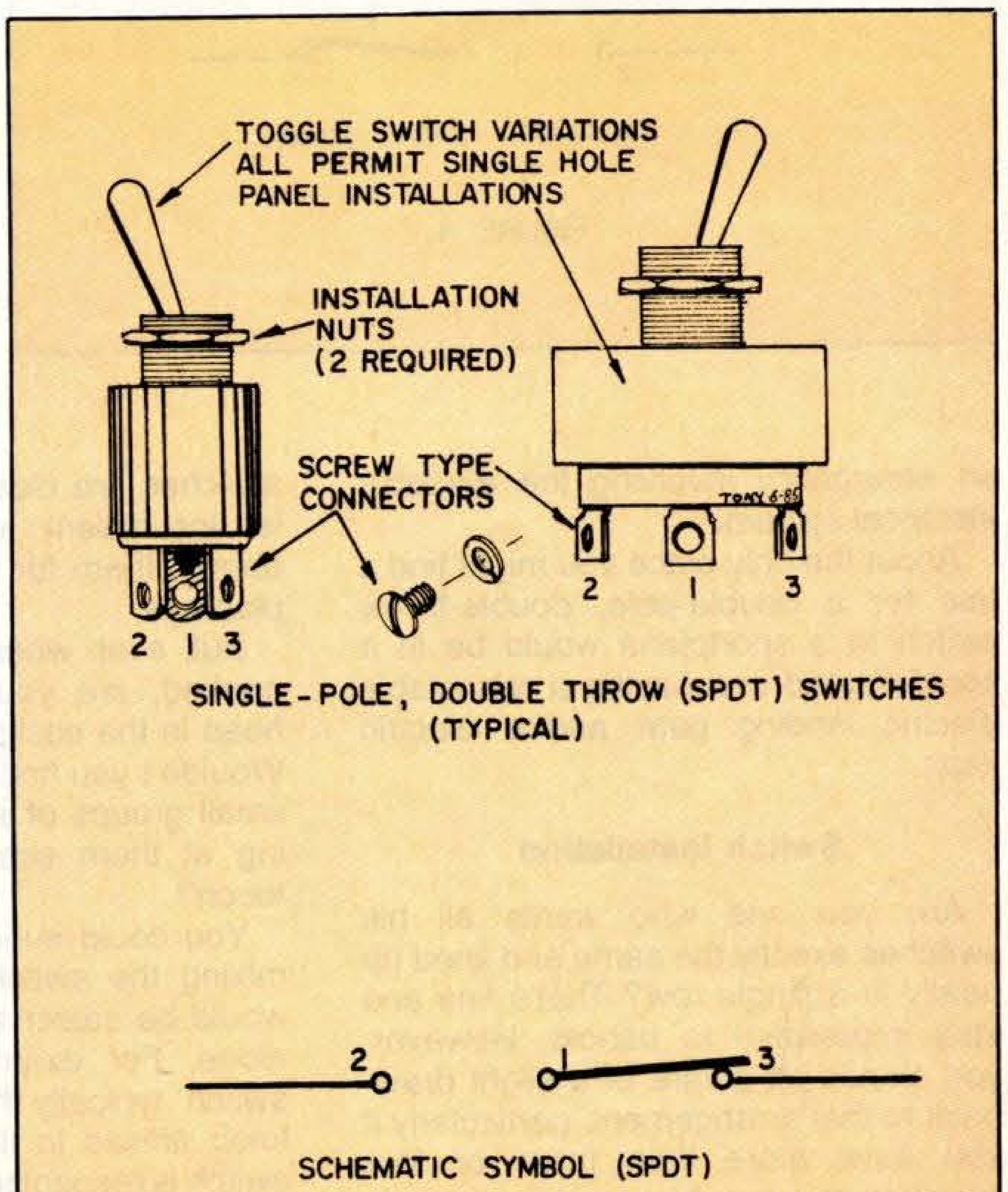

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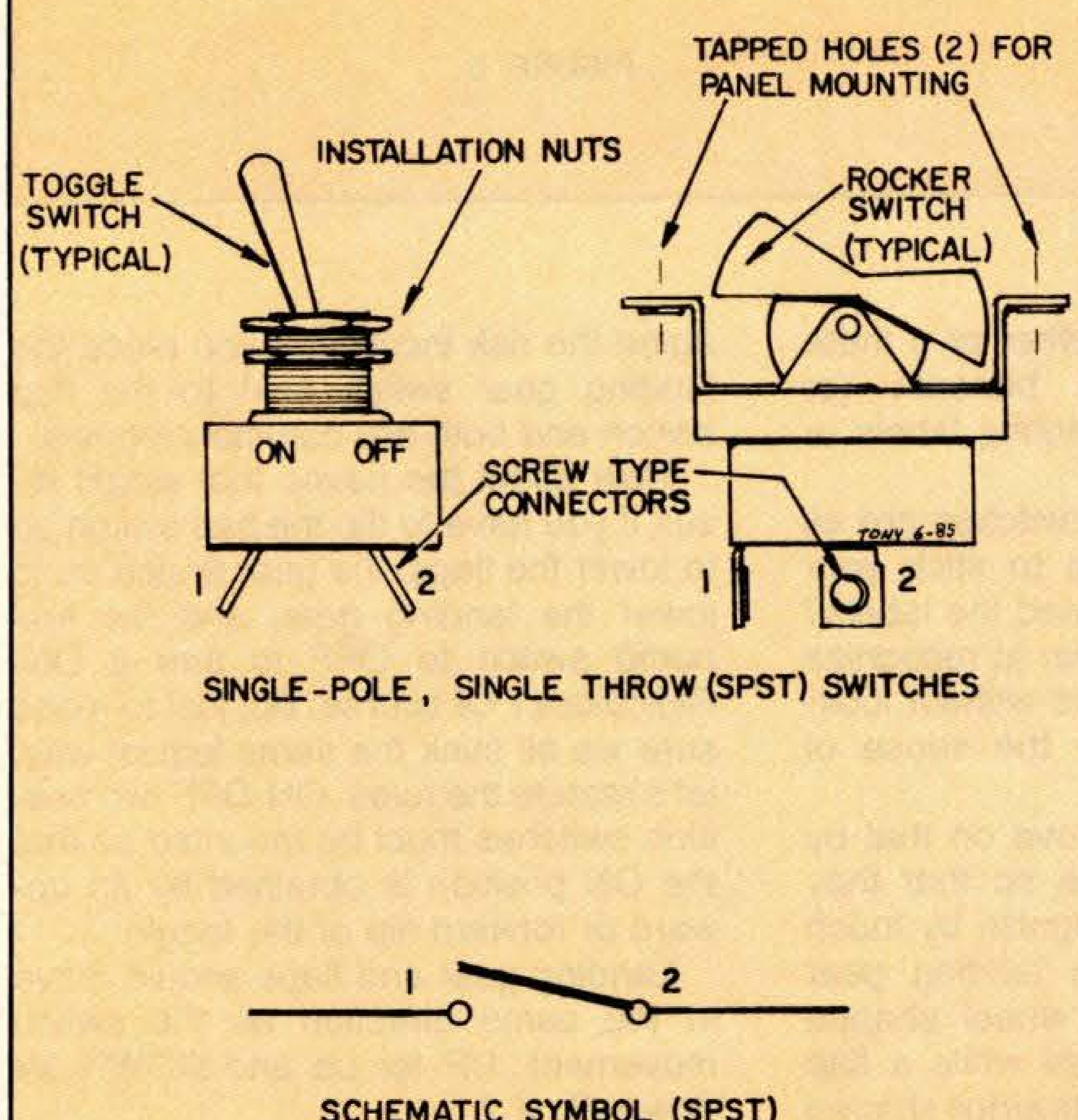

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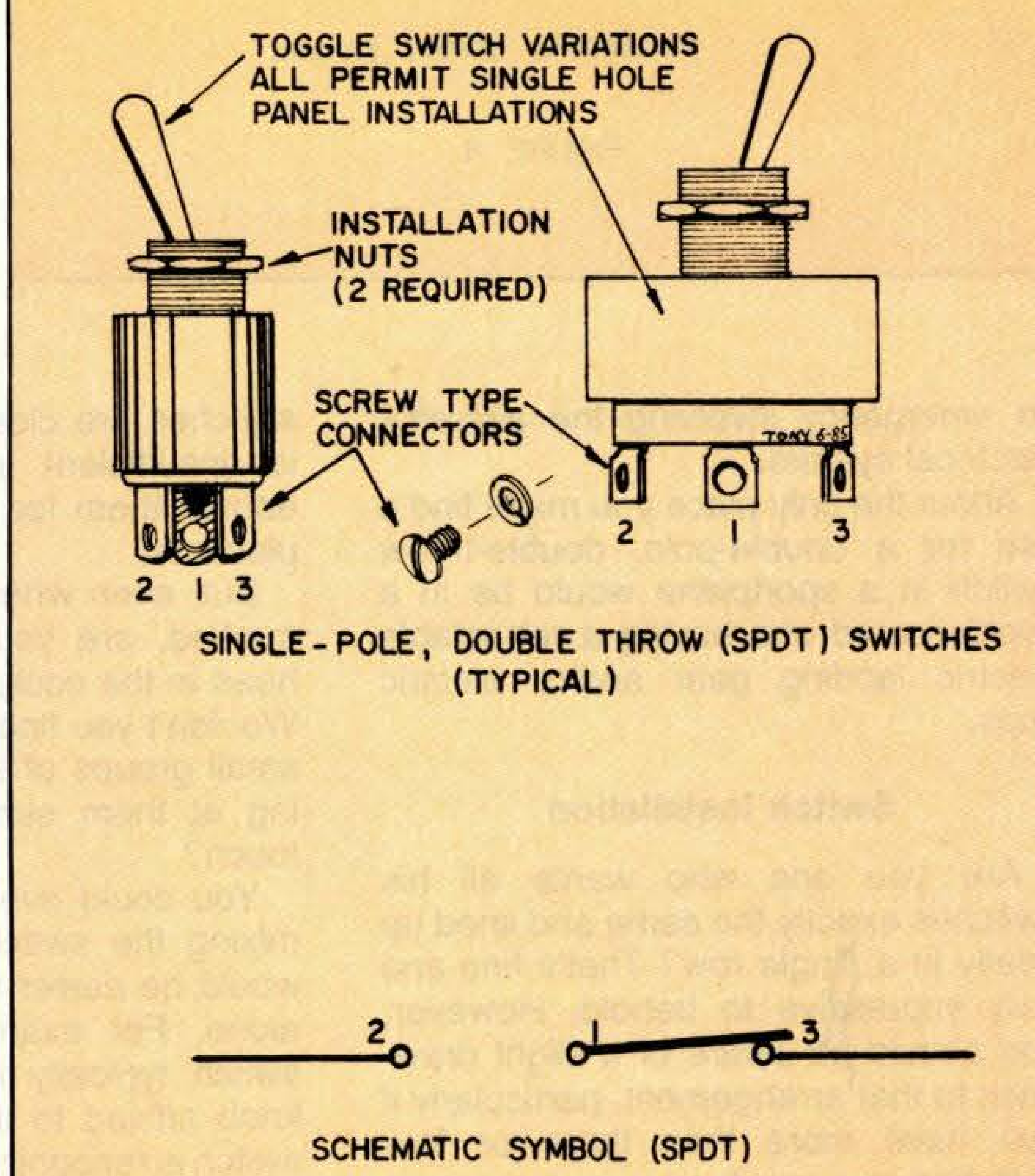

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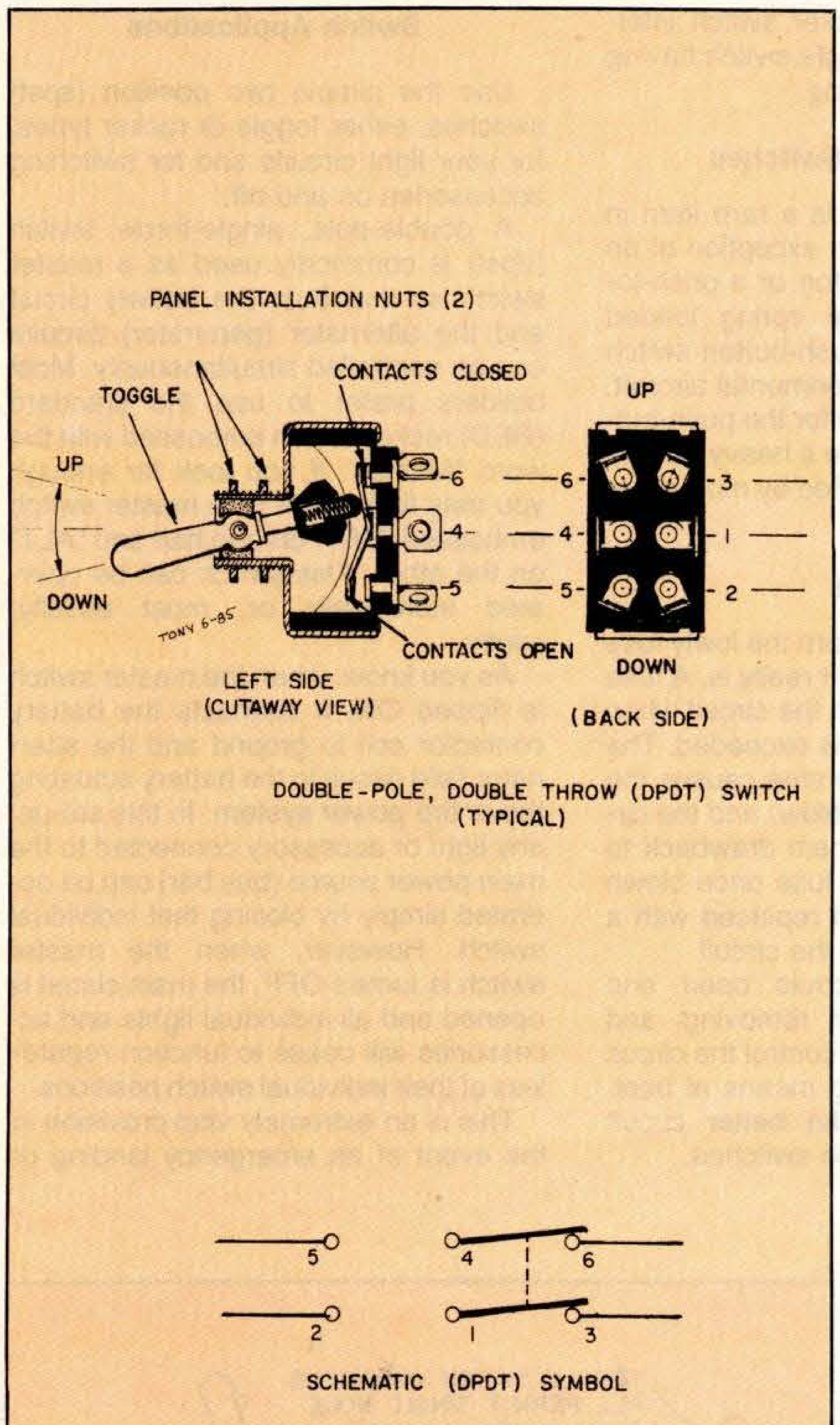

FIGURE 4.

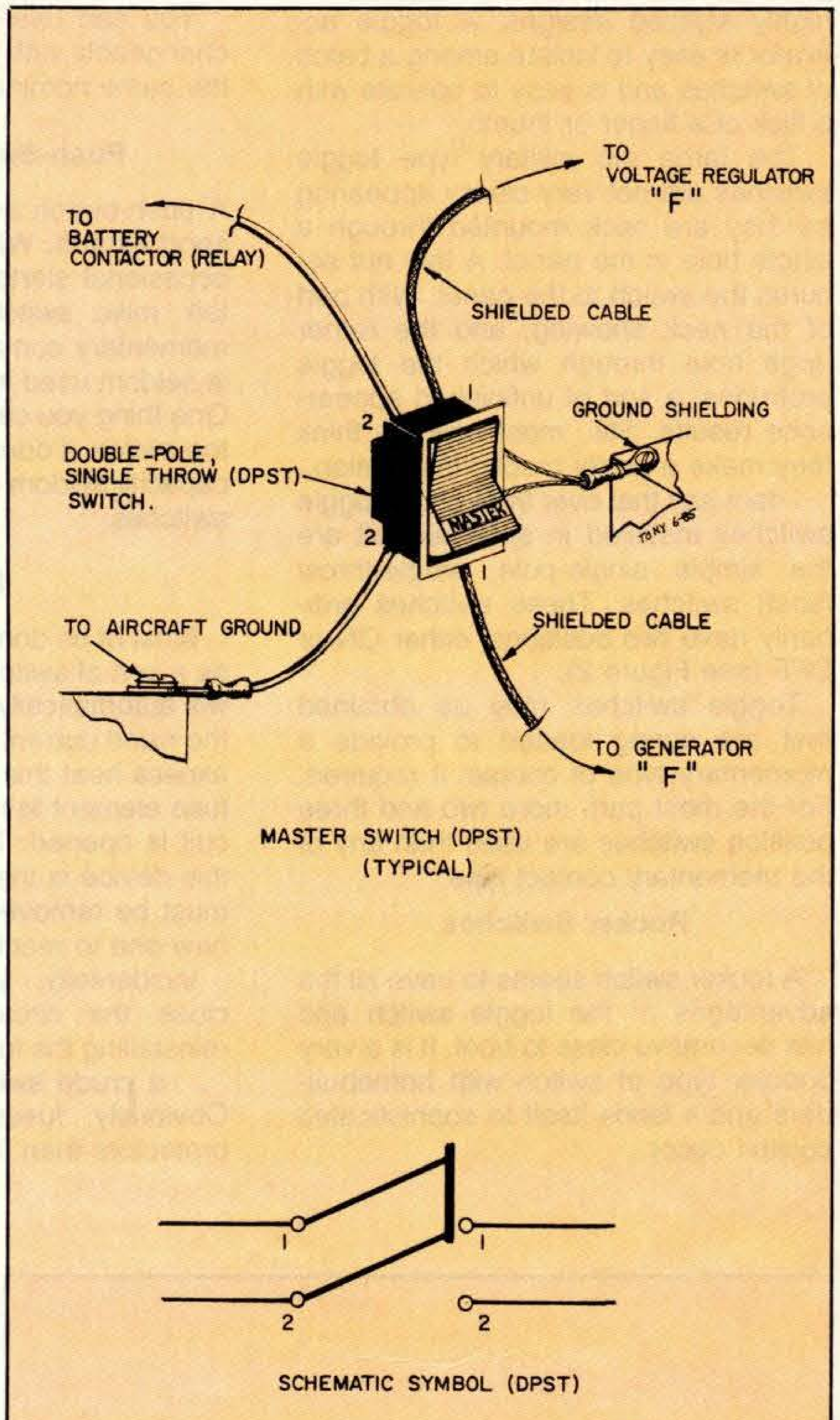

FIGURE 5.

an emergency involving the aircraft's electrical system.

About the only place you might find a use for a double-pole, double-throw switch in a sportplane would be in a sophisticated one having a retractable electric landing gear and/or electric flaps.

Switch Installation

Are you one who wants all his switches exactly the same and lined up neatly in a single row? That's fine and very impressive to behold. However, you should be aware of a slight drawback to that arrangement, particularly if you have more than three or four switches in a row.

How will you remember which switch is which? You're right. You don't have to remember which is which if each is marked. Indeed, all switches should be labeled or marked. However, labeling can be difficult, especially if the switches are close together or if there is insufficient margin beneath (or above) them for the marking labels or placards.

But, even when the switches are all marked, are you going to stick your head in the cockpit to read the labels? Wouldn't you find it easier to recognize small groups of switches without looking at them simply by the sense of touch?

You could even improve on that by mixing the switch types so that they would be easier to recognize by touch alone. For example, a landing gear switch typically has a wheel shaped knob affixed to its toggle while a flap switch is recognized by its airfoil shaped toggle activator. Think about it.

Direction of Operation

Switches have gotten many a pilot into serious trouble because of their location and direction of operation. Imagine the risk incurred if you place the landing gear switch next to the flap switch and both are common toggles.

How about the havoc that would result if you have to flip the flap switch up to lower the flaps, the gear switch up to lower the landing gear, and the fuel pump switch to OFF to turn it ON. Ridiculous? Of course. But just to make sure we all think the same logical way, let's restate the rules. ON-OFF two position switches must be mounted so that the ON position is obtained by an upward or forward flip of the toggle.

Landing gear and flaps should move in the same direction as the switch movement. UP for up and DOWN for down. O. K.?

More next month.

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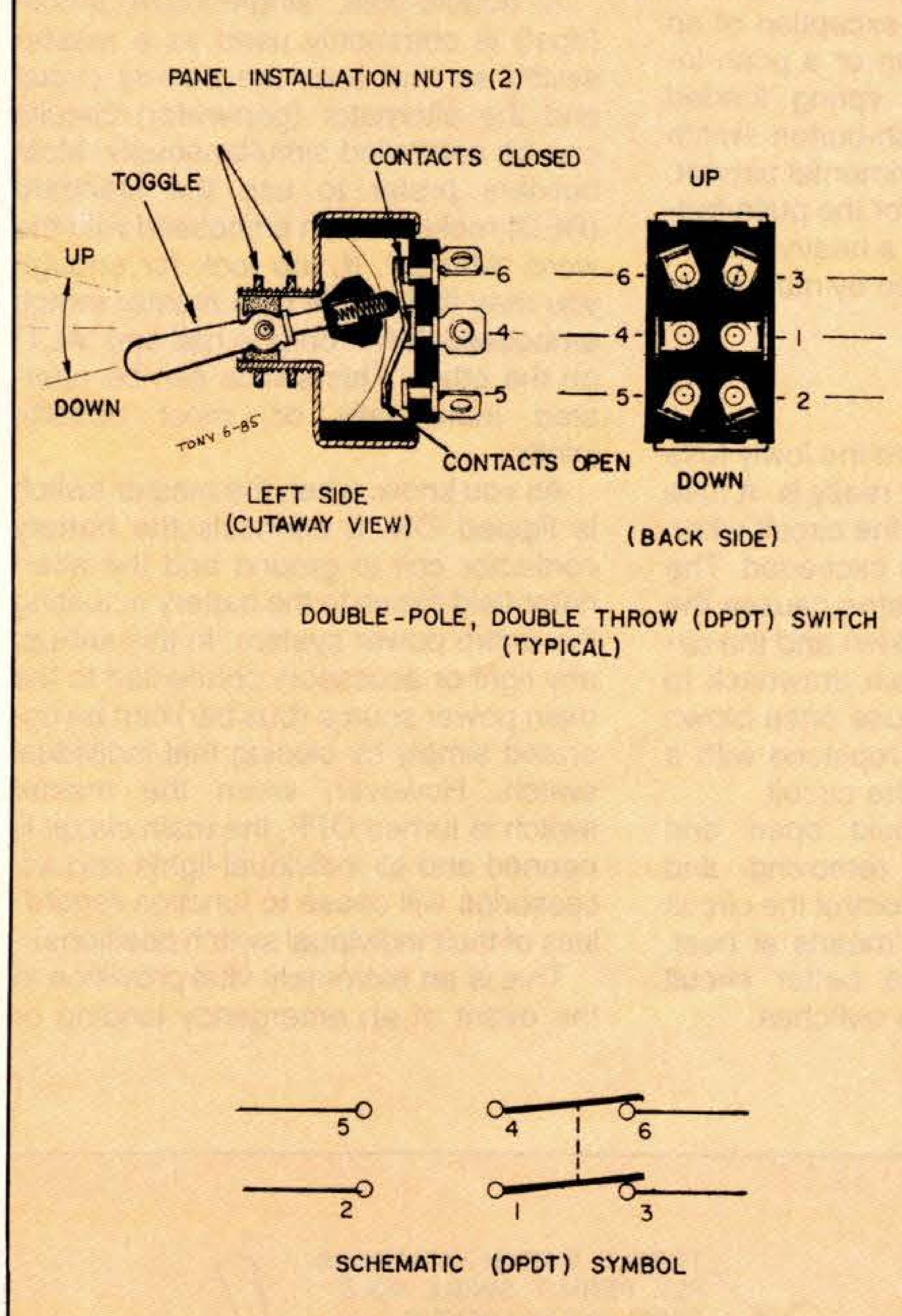

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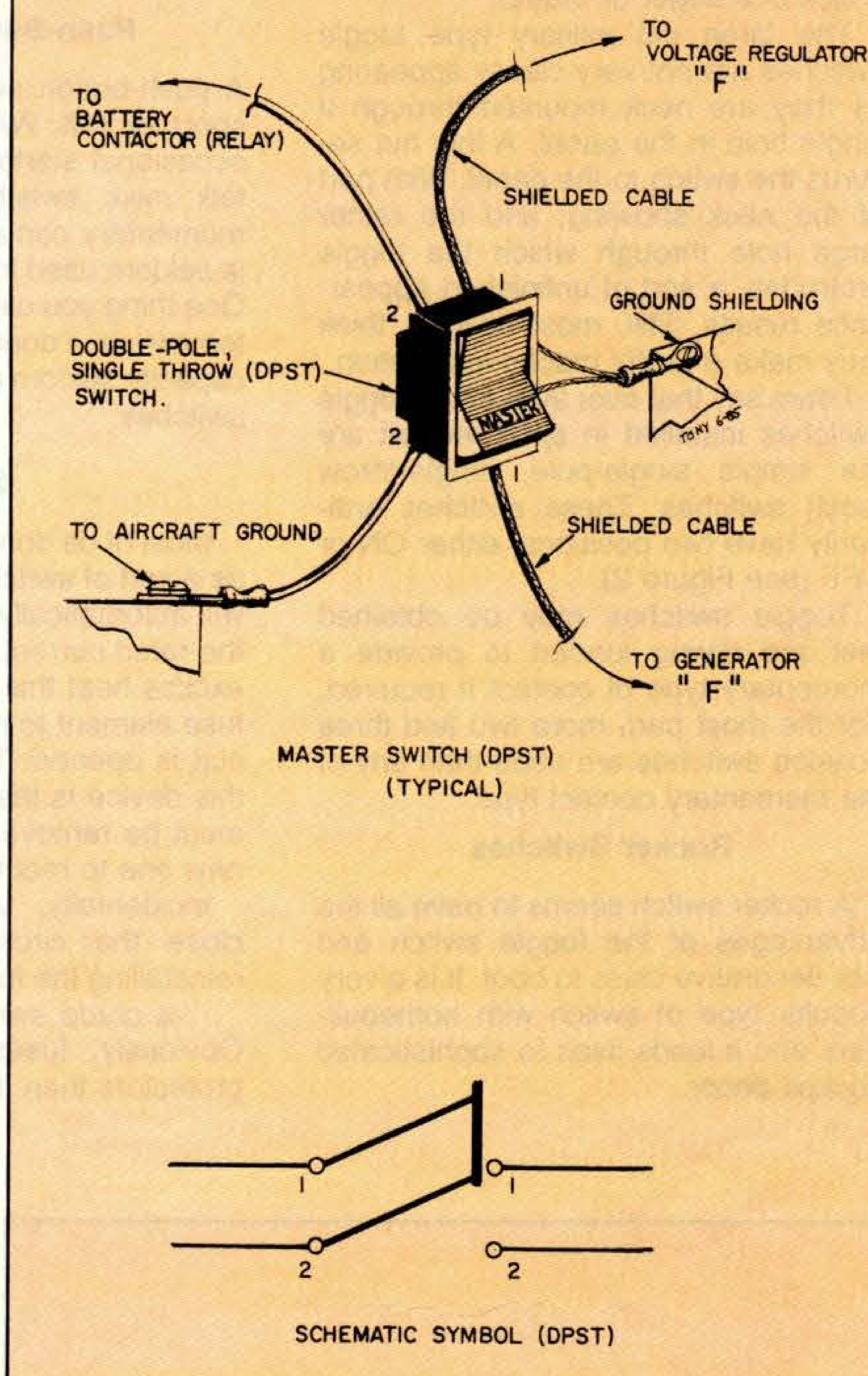

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